Uttar Pradesh Rajarshi Tandon
Open University

MBA-3.31
MASTERS OF BUSINESS ASMINISTRATION

MATERIALS MANAGEMENT

MBA-3.31

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ISBN-978-93-83328-64-2

Printed By – M/s K.C.Printing & Allied Works, Panchwati, Mathura -281003.

BLOCK I :INTRODUCTION AND CONCEPT

In **Block 1** you will learn about material planning, how it is implemented in Organizations. You will also see how evolution of different planning came into existence and their impact on organizations. Besides this you will also learn about Just in time technique, material control and break even analysis in detail.

In **Unit1** will give you a thorough knowledge about Material Planning: Material Requirement Planning andManufacturing Resource Planning. It will also cover few other types of planning just to give an overview how different types of planning evolved in organizations over time.

In **Unit 2**students will be able to get information about Just In Time, JIT Production Planning, Strategic Material Planning,

In **Unit 3**students will get complete understanding aboutMaterial Control: Acceptance, Sampling, Inspection, Make Or Buy Decision, Simple Cost Analysis, Economic Analysis,

In **Unit 4** students will learn about Break Even Analysis, Break Even Point Theory, Whether To Add Or Drop a Product Line, Store Management And Warehousing, Process and Requirements Explosion.

UNIT 1 : MATERIAL PLANNING

Unit Structure

1.0Objectives

After completing this unit students will be able to:

- Know about Material Planning
- Learn Techniques of Material Planning
- Have a thorough knowledge of Material Requirement Planning (MRP I)
- Understand the concept of Manufacturing Resource Planning (MRP II)
- Have a brief knowledge of Distribution Requirements Planning (DRP)
- Know about Production Planning
- Understand about Advanced Planning and Scheduling Software (APS)
- Learn about Enterprise Resource Planning ERP

1.1 Introduction

Materials' planning has been defined as the scientific way of determining the requirements of raw materials, components and other items needed for production within the economic investment policies. It is rather a sub system in the overall planning activity.

The factors affecting materials planning can be classified into micro and macro factors. Factor such as price trends, business cycles, government policy, credit policy etc. form part of macro factors; while factors such as corporate objectives, plant capacity utilization, working capital, lead times, inventory levels, delegation of power, seasonality, communication system etc. are micro in nature.

1.2Techniques of Materials Planning:

The techniques of materials planning are:

(a) Bill of Materials Explosion and

(b) Past Consumption Analysis.

(a) Bills of materials explosion:

The planning for materials management is aimed at determining the demand for the end-products. This is possible only through farsightedness or forecasting. Therefore, forecasting forms "the basis for materials planning. There are various techniques for forecasting. These techniques are equally applicable to demand forecasting.These techniquesare:

(i) Moving averages method.

(ii) Exponential smoothing and Time series.

After demand forecast, the exercise of materials planning starts. Requirements for various materials are ascertained from the demand forecast. For this purpose, the bill of materials is used through explosion charts. Here the use of computers is very effective for "exploding" bill of materials with demand forecasts. The bill of materials is prepared and issued by the planning or engineering department in a standard form.

An explosion chart is just a series of bills of materials grouped together in a matrix form so that combining the requirements for different components can be done. Materials planning are usually made for a short period on a quarterly basis and at the beginning of every quarter; it is quite natural to find that some materials are in short supply and some in excess. This can be ascribed to wrong forecasting.

To rectify such errors in the estimation of materials, quarterly planning is resorted to. In engineering industries, even quarterly planning seems to be too long and realistic ordering is placed with the suppliers.

(b) Past Consumption Analysis:

For continuously needed materials and the materials where no bill of materials is possible, this technique of analysis is adopted- The past consumption data is analyse and a projection for the future on the basis of past experience and future need is made. To prepare such a projection, "average" or "mean" consumption and the "standard deviation" are taken as bases and as guidelines for each item.

These are all statistical tools and are very effective to absorb the stock of fluctuation in consumption of direct and indirect materials where no straight-forward norms of consumption can be formulated. In the process industries, this technique is particularly suitable.

Test Your Progress

1. What do you understand by material planning?

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2. What are the techniques involved in material planning? Explain in brief.

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3. What is past consumption analysis?

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4. What are the methods involved in Bills of material explosion technique?

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1.3 Material Requirement Planning (MRP- I)

A Material Requirements Planning (MRP) system is a planning and decision-making tool used in the production process which analyses current inventory levels vs. production capacity and the need to manufacture goods, based on forecasts. MRP schedules production as per bills of materials while minimizing inventory. The technique is computerized and looks at requirements within a fixed period.

1.3.1 Features of Material Requirement Planning:

Main features of Material Requirement Planning are:

- **A master production schedule:**A statement of the planning includes orders, forecasts and capacity.
- **Bill of materials (BOM):**All the materials and components required to make the final product.
- **Inventory status file:**Stock records that allow gross requirement to be adjusted to net requirement.

1.3.2 Need for Material Requirement Planning

Companies need to manage the types and quantities of materials they purchase strategically; plan which products to manufacture and in what quantities; and ensure that they are able to meet current and future customer demand—all at the lowest possible cost. MRP helps companies maintain low inventory levels. This is why there is a need for Material Requirement Planning.

1.3.3Importance of Material Requirement Planning

MRP, which is done primarily through specialized software, helps ensure that the right inventory is available for the production process exactly when it is needed and at the lowest possible cost. As such, MRP improves the efficiency, flexibility and profitability of manufacturing operations. It can make factory workers more productive, improve product quality and minimize material and labor costs. MRP also helps manufacturers respond more quickly to increased demand for their products and avoid production delays and inventory stock outs that can result in lost customers, which in turn contributes to revenue growth and stability.

MRP is widely used by manufacturers and has undeniably been one of the key enablers in the growth and wide availability of affordable consumer goods and, consequently, has raised the standard of living in most countries. Without a way to automate the complex calculations and data management of MRP processes, it is unlikely that individual manufacturers could have scaled up operations as rapidly as they have in the half century since MRP software arrived.

1.3.4 Elements ofMaterial Requirement Planning

Within manufacturing, developing a plan for your resources is absolutely vital for your operation. Without proper resource planning for your manufacturing operation, you will have a

much more challenging time managing various areas within your supply chain such as inventory, production, and output.

This is why utilization of materials requirements planning (MRP) can efficiently manage materials within production, making it much easier for project managers to order and organize materials waiting to be assembled. Through MRP, the need for materials planning is eliminated and the system is able to successfully carry out an efficient strategy. MRP has become a vital component in allowing manufacturers to keep up with consistently growing demand.

There are Three Elements of Materials Requirements Planning (MRP)

Material requirements planning (MRP) systems utilize time sensitive, priority-planning techniques to calculate labor schedules and material requirements for product runs in manufacturing facilities. MRP systems rely mainly on innovative IT to maintain updated information about manufacturing needs, consumer demands, inventory levels, and more. Before implementing materials requirements planning (MRP), it is important to understand the three elements of the system. The three elements of materials requirements planning include the following:

- **MRP Information Sources -** MRP systems use four key pieces of information to determine what exactly needs to be ordered. These four information sources include production schedules, material specs, production cycle times, and supplier lead times. Production schedules help with describing in detail when each product should be manufactured. This information is then used to adjust production machines and process flows.
- **Case Studies -** Majority of businesses will conduct research, gather business intelligence and feedback from companies with similar MRP systems in their industry. The best results are always achieved when executives and top management set the necessary conditions and provide the right resources to guide organization actions.
- **Problems that are Unavoidable -** Management must recognize when there are technical and operation issues that must be addressed through training, support, and information sharing. The production schedule and materials specs will determine what materials should be ordered, so they be should mastered before moving onto further parts down the road.

1.3.5 Steps and Processes of Material Requirements Planning

MRP works because it is a well-organized framework of processes and calculations. An MRP system can completely transform a company's operational procedures. Many people within an organization contribute to the MRP process, including sales, production, purchasing, receiving, stockroom, and shipping personnel.

MRP consists of three basic steps:

Identifying the Quantity Requirements: Determine what quantity is on hand, in an open purchase order, planned for manufacturing, already committed to existing orders, and forecasted. These requirements are specific to each company and each company location and change with the date.

1. **Running the MRP Calculations:** Create suggestions for materials that you consider critical, expedited, and delayed.
2. **Complete the Orders:** Delineate the materials for the manufacturing orders, purchase orders, and other reporting requirements.

1.3.5.1MRP Inputs

The calculations that MRP performs are based on the data inputs.

As shown in the figure above, these data inputs include:

1. **Customer Orders:** This refers to the specific information you receive from customers and includes one-offs and regular ordering patterns.
2. **Forecast Demand:** This is a prediction from the marketplace about how much probable demand there will be for a product or service. It is based on historic accounting and current trend analysis.

3. **Master Production Schedule (MPS):** Both forecast demand and customer orders feed into the master production schedule. The MPS is a plan that a company develops for production, staffing, or inventory. It is the production future plan that includes the quantities you need to produce the products in a specified time period. It also includes inventory costs, production costs, inventory information, supply, lot size, lead time, and development capacity.
4. **Bill of Materials (BOM):** Also called a product structure file, this includes the details and quantities of the raw materials, assemblies, and components that make up each end product.
5. **Inventory Records:** These are the raw materials and the completed products that you either have on hand or have already ordered.

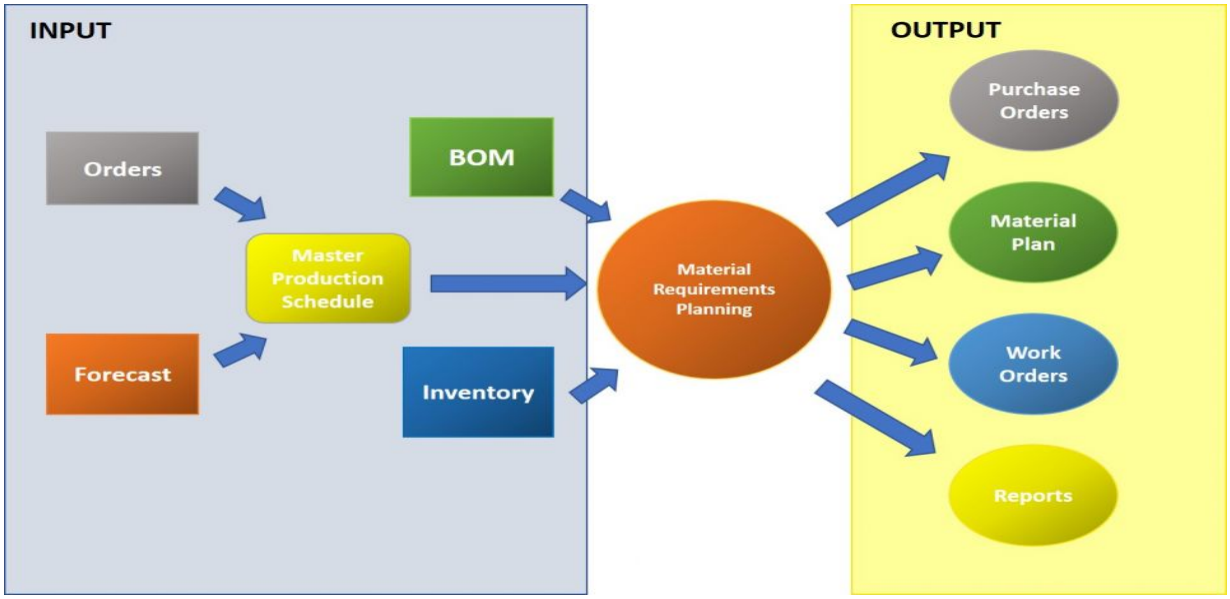

Fig. 1.1 MRP Inputs and Outputs

1.3.5.2MRP Outputs

After MRP receives the input, it generates the output. There are four main outputs. These include:

1. **Purchase Orders (PO):** This is the recommended purchasing schedule that includes the order you give to suppliers to send the materials. The PO includes a schedule with quantities and start and finish dates to meet the MPS.
2. **Material Plan:** This details the raw materials, assembly items, and component needs to make the end products with quantities and dates. We recommend that you use attribute settings to set the time fences and to firm orders.
3. **Work Orders:** This details the work that goes into producing the end product, including which departments are responsible for what part, what materials are necessary, and what the start and end dates are.
4. **Reports:** MRP generates primary and secondary reports. The primary reports include all three of the above — those that deal with production and inventory planning and control. Secondary reports are those that detail things, such as performance control, exception data (e.g., errors or late orders), deviations, and predictors of future inventories and contracts.

The MRP technique can be vague at times because we call it a calculation process without necessarily indicating how to compute the data outputs. MRP is about putting mathematical controls into place using formulas that yield optimal results. MRP is an optimal control problem that calculates the initial conditions, the dynamics, the constraints, and the objective. The

variables are the local inventory, the order size, the local demand, the fixed order costs, the variable order costs, and the local inventory holding costs. MRP comprises many methods and calculations. To find the order quantities, you can use any number of methods. Three of the most popular are:

1. **Dynamic Lot-Sizing:** In inventory theory, this model assumes that the demand for product fluctuates over time. This complex algorithm generalizes the economic order quantity model. It requires dynamic programming to perform, so mathematicians also developed the following models.
2. **Silver-Meal Heuristic:** This is an inventory control algorithm, also called least period cost, that minimizes the total relevant cost per unit of time. In other words, you use it to calculate the production quantities needed to meet the operational requirements at the lowest cost possible.
3. **Least-Unit-Cost (LUC) Heuristic:** Although quite similar to Silver-Meal, LUC chooses the period in the future based on average cost per unit rather than on average cost per period.

1.3.6 Material Requirements Planning Software

Although MRP is often an integrated, automated system, it can also be handwritten or consist of different applications or modules in disparate software systems. MRP software focuses on the period during which you create a product, identify and purchase raw materials, determine resources, and plan the steps for production. This subset of modern ERP systems is usually available as a module and looks for efficiencies in each step.

However, the cost of MRP software is a big concern for small businesses.But it's clear that the investment is a huge money saver in the long run. Furthermore, your business may fiscally require a software system due to the risk of human error, slowed production times, and excessive manual labor costs. Still, companies need to consider what type of software is most appropriate for them category-wise, size-wise, and expectations-wise. For a small business, purchasing a comprehensive ERP suite may not only be wasteful, but also time-inefficient, defeating the system's purpose.

Although the marketplace has a wide variety of providers, each claiming to offer the best system available, experts recommend that you carefully consider your needs and options before purchasing software. And while it's always good to consult your network for a consensus on what others are using, remember that what works for your colleagues may not work for you. Before looking at any features or products, consider your business goals, as well as your current requirements.

Some of the features you should consider when choosing MRP software include the following:

- Flexible requirements
- Advanced filtering
- Comprehensive drill-down capability
- Exception management
- Agile order management
- Aggregate requirements
- Workflow support
- Designated time frames
- Multiple quantity display
- Forecast consumption
- Supply-chain visibility
- Integration into multiple environments
- Software support
- Free trials

1.3.7 Advantages ofMaterial Requirement Planning

A Material Requirements Planning (MRP) system is a planning and decision-making tool used in the production process which analyses current inventory levels vs production capacity and the need to manufacture goods, based on forecasts. MRP schedules production as per bills of materials while minimizing inventory. The technique is computerized and looks at requirements within a fixed period.

Following are its advantages :

1. The MRP system is widely credited for playing a crucial part in decreasing factory inventory.
2. It also assists in manufacturing industrial products that are more complex.
3. MRP focus is on what materials are required and when they need to be sourced. It is also helpful in product customization.
4. MRP has historically been seen as giving additional advantage because it is known to schedule and track every order whether for production or purchase.
5. It leads in reduced customer lead times to improve customer satisfaction;
6. It leads in effective inventory management and optimization -- by acquiring or manufacturing the optimal amount and type of inventory, companies can minimize the risk of stock-outs, and their negative impact on customer satisfaction, sales and revenue, without spending more than necessary on inventory;
7. It aids in improved manufacturing efficiency by using accurate production planning and scheduling to optimize the use of labor and equipment;

8. It leads to improved labor productivity; and
9. It has more competitive product pricing.

1.3.8 Disadvantages of MRP

MRP has some drawbacks, including:

1. **Increased inventory costs:** While MRP is designed to ensure adequate inventory levels at the required times, companies can be tempted to hold more inventory than is necessary, thereby driving up inventory costs. An MRP system anticipates shortages sooner, which can lead to overestimating inventory lot sizes and lead times, especially in the early days of deployment before users gain the experience to know the actual amounts needed.
2. **Lack of flexibility:** MRP is also somewhat rigid and simplistic in how it accounts for lead times or details that affect the master production schedule, such as the efficiency of factory workers or issues that can delay delivery of materials.
3. **Data integrity requirements:** MRP is highly dependent on having accurate information about key inputs, especially demand, inventory and production. If one or two inputs are inaccurate, errors can be magnified at later stages. Data integrity and data management are thus essential to effective use of MRP systems.

To address these shortcomings of MRP, many manufacturers use advanced planning and scheduling (APS) software, which uses sophisticated math and logic to provide more accurate and realistic estimates of lead times. Unlike most MRP systems, APS software accounts for production capacity, which can have a significant impact on availability of materials.

1.3.9 Practices to make Material Requirements Planning Systems work

Although using an MRP system is vastly superior to cobbling together a system of spreadsheets and hand calculations, problems do arise. The biggest issue is data integrity. Data that is either not up to date or has errors gives output that is inaccurate and can end up costing your business serious money. You should carefully screen inventory and BOM data. Errors often occur during cycle-count adjustments, input and shipping, and reporting of scrap, damage, waste, and production. Barcode scanning and pull systems can minimize these types of errors.

Moreover, MRP systems can be rife with error when companies with facilities in different countries do not set up by individual location. For example, the MRP system could indicate that there is plenty of raw materials available for production when, in fact, that raw material is on the

other side of the world. Staffpower is also not always accounted for in MRP. In these cases, the MRP creates a capacity issue.

In addition, lead times can throw off MRP. The required lead time can change based on the product. MRP assumes that the lead time is always the same for each product, regardless of changes in supply, required quantities, or the possible simultaneous production of other products.

Solving your data-integrity issues may take some concentrated effort. Best practices for ensuring that your data is high-quality before you start your MRP process include:

1. Using barcode scanning or a pull system to replace stock and enter products into inventory
2. Making sure that shipping prints the container labels
3. Requiring advance shipping notifications (ASN) from your suppliers that feed into a label system. In order to detect shortages and over-shipments, match labels with internal company numbers as product arrives.
4. Recording scrap daily
5. Troubleshooting and fixing causes of cycle counts that incorrectly change your inventory
6. Confirming the bill of material at the production site.

1.4 Manufacturing Resource Planning (MRP - II)

Manufacturing resource planning is a system that is used to effectively plan the use of a manufacturer's resources. It enables manufacturers to develop a precise production schedule for the future that minimizes costs and maximizes the use of the resources available at their disposal.

Sales forecasting is important because only if the manufacturer knows the expected demand for a product will they source raw materials and schedule deliveries and quantities. It also gives assumptions for the number of machine units and labor required during a given production cycle and to fulfill a sales forecast.

Manufacturing resource planning arrives at the optimal order quantity and frequency for raw materials by adding the average use for a planned replenishment lead time with the safety stock that is required to protect the severer demand.

Thus, **"When to Order" = Average Use Time + Safety Stock**

1.4.1 Evolution of MRP- II

Manufacturing Resource Planning (MRP II) is an integrated information system used by businesses. Manufacturing Resource Planning (MRP II) evolved from early Materials Requirement Planning (MRP) systems by including the integration of additional data, such as employee and financial needs.

The system is designed to centralize, integrate, and process information for effective decision making in scheduling, design engineering, inventory management, and cost control in manufacturing.

1.4.2 Modules of MRP-II

MRP II, or **Manufacturing Resource Planning,** is comparatively a broader term. It manages resources (man, material and machine) and addresses operational planning.
These are the basic modules/functionalities in MRP II-

Fig.1.2 History of ERP

- Master Production Schedule (MPS)
- Bill of Materials (BOM)
- Item master data
- Inventory control
- Purchasing management
- Shop floor control
- MRP
- Capacity planning and demand management
- Sales and forecasting
- Input/out control and more

MRP II enables better relationships and visibility across suppliers and boosts the overall company's bottom-line through advanced planning, scheduling, and forecasting capabilities.

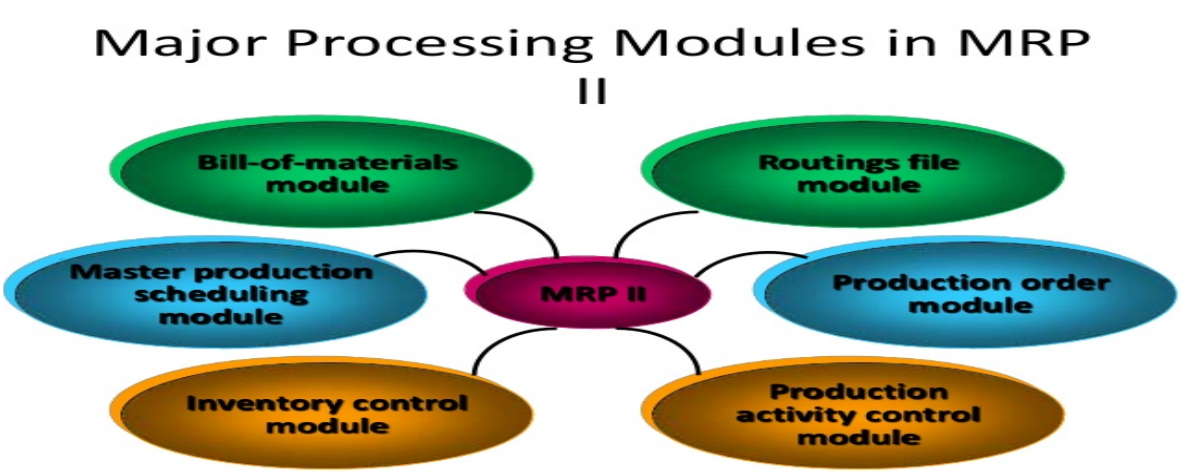

Fig. 1.3 Modules of MRP-II

Test Your Progress

1. What do you understand by Material Requirement Planning? What are its features?

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2. What do you understand by need and importance of MRP- I?

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3. Explain the inputs and outputs of MRP-I.

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4. What is manufacturing resource planning?

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5. What are the basic modules of MRP-II?

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1.5 Differences between MRP I and MRP II

For all intents and purposes, MRP II has effectively replaced MRP I software. Most MRP II systems deliver all of the functionality of an MRP system. But in addition to offering master production scheduling, bill of materials (BOM), and inventory tracking, MRP II provides functionality within logistics, marketing, and general finance.

For example, MRP II is able to account for variables that MRP is not—including machine and personnel capacity—providing a more realistic and holistic representation of a company's operating capabilities. Many MRP II solutions also offer simulation features that allow operators to enter variables and see the downstream effect. Because of its ability to provide feedback on a given operation, MRP II is sometimes referred to as a closed-loop system.

MRP I included the following three major functionalities:

1. master production scheduling
2. bill of materials
3. inventory tracking

MRP II includes those three, plus the following:

1. machine capacity scheduling
2. demand forecasting
3. quality assurance
4. general accounting

MRP II can be referred to as 'manufacturing-centric'. The underlying purpose is simply to schedule the raw materials and components and then control those areas of productions, which can help you fulfill customer orders. Therefore, it has a limited capacity to control production, based on demand forecasts. This is by far the main distinguishing factor when it comes to MRP I. MRP II, on the other hand, deals with several other aspects of production too. It would take into account the following:

- Financial estimates
- Demand forecasts
- Business planning
- Detailed capacity planning
- Payrolls
- Personnel requirements and more

So, there is no doubt that MRP II is a much more integrative and productive form of MRP. Ideally, in most companies today MRP has been replaced by MRP II, given that it has much better productivity to offer.

MRP II systems are still in wide use by manufacturing companies today and can either be found as stand-alone solutions or as part of an enterprise resource planning (ERP) system. Enterprise Resources Planning (ERP) software systems are regarded as the successors of MRP II software.

ERP suites include applications well outside the scope of manufacturing. These can include everything from human resources and customer relationship management to enterprise asset management.Due to certain limitations in MRP – II later ERP became popular. So it will be good to get its glimpse ahead in this chapter.

1.6 Distribution requirements planning (DRP)

Before ERP became popular there were other planning systems too. These systems assisted the manufacturing units till ERP took over. Let us understand DRP in a nutshell.

Distribution requirements planning (DRP), also known as distribution replenishment planning, is a continuation of MRP logic that came about in 1981. DRP takes MRP one step further and calculates how to move the materials out of the facility. The product delivery is more efficient because DRP calculates the quantity of each type of goods that requires delivery, as well as where to meet the demand. DRP is a time-based approach to guarantee that inventory that's likely to be low has a replenishment plan. DRP is similar to MRP but can work by either a push or pull system. ERP took over this functionality when it came about in the 1990s. Now, DRP can still be a stand-alone system or act as a module within an ERP system.

1.7 Production planning

Production planning is the process ensuring that there are sufficient raw materials in a manufacturing business to create the products on schedule. More advanced than MRP, it extends the latter's functionality. Developed to address some of the deficiencies of MRP, production planning expands upon MRP in the following ways:

- While MRP does not assume any limitations on production, production planning takes into account any production constraints.
- Production planning prioritizes and first completes the jobs that are the most lucrative.
- Production planning considers ordered-part lead time.
- Production planning uses more complex algorithms.

1.8 Enterprise resource planning (ERP)

Enterprise resource planning (ERP) is an extension of MRP systems that came about in the 1990s. MRP is a planning and control system for the resources in a company and was essentially the harbinger of ERP systems to come. ERP is a solution for the enterprise as a whole, with more functionality built in, extending the concepts of MRP and MRP II. All the functions in an enterprise are tightly integrated, including internal and external information. For example, an

ERP system would possess advanced functionality in the areas of financial, customer relationship, and sales order management.

Today, the difference between MRP and ERP is that MRP can be a stand-alone application or just a piece of an ERP, whereas ERP can support the whole company. ERP is a single solution that addresses all business needs, not just the scheduling of resources. ERP has moved away from its manufacturing roots and gone on to support many different types of businesses. It decreases any information redundancies and add on elements, like user-level security. The line between MRP and ERP has blurred, as the more recent ERP systems rely on similar database structures and linkages. To clarify, MRP only concentrates on:

- Quotes
- Job costing
- Sales
- Orders
- Controlling stock
- Purchasing
- Manufacturing
- Invoicing

Using an ERP system gives your company some strategic opportunities. Companies report that the biggest benefits of their ERP system are increased efficiency, integrated information, more customized reports, higher-quality customer service, and more secure data. A well-used ERP system can enable your teams to be forward-looking and support your strategic vision for growth. A good ERP strategy improves your key business processes.

ERP systems do come with challenges. However, once you've allocated substantial financial resources to a system, you must address the organizational culture, so your staff utilizes the system adequately. With an integrated system, the return on investment depends on the breaking down of company silos to achieve seamless processes.

Test Your Progress

1. What are the differences between MRP-I and MRP-II?

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2. Explain in brief : i. Production planning, and ii. Distribution requirements planning

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3. What is ERP?

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1.9 Differences between MRP and ERP

Let us take a look at the key differences between these methods;

Meaning

MRP systems focus specifically on planning and controlling how goods are assembled using multiple raw materials or components by controlling inventory, componentry and the manufacturing process whereas, ERP systems plan for resources across the entire organization,including: financial management, order management, customer relationship management, people, procurement, warehousing and fulfillment.

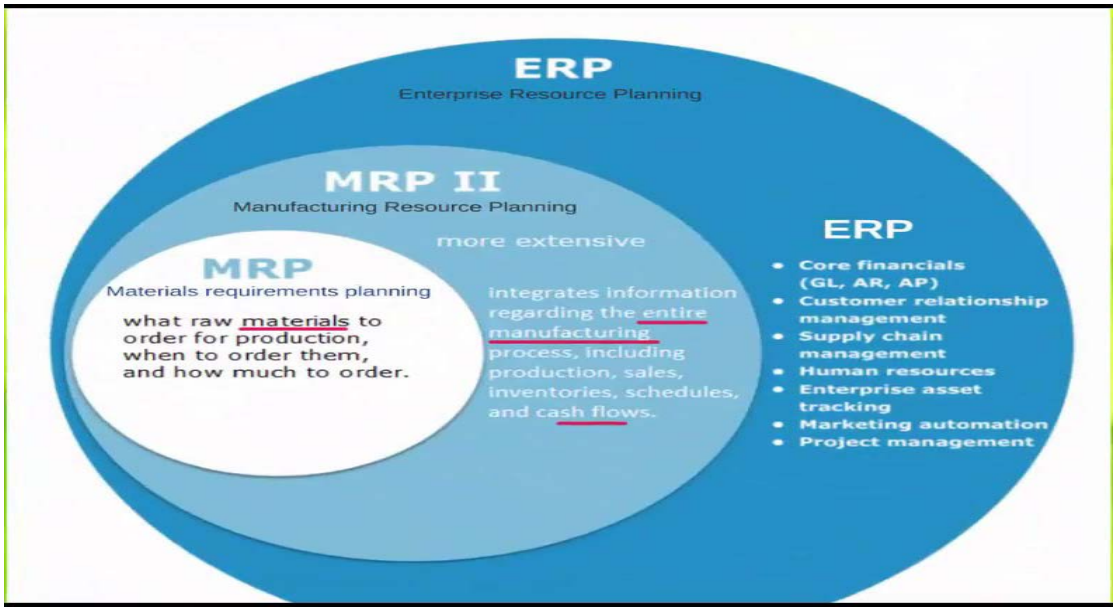

Fig. 1.4 MRP-I, MRP-II and ERP

Exhaustiveness

First of all, it is important to know that MRP works as standalone software, while ERP is actually integrated. ERP has the ability to connect to other software modules and systems seamlessly, and it is a modular network. MRP can be connected to some systems, but the process is way more complex and not so common.

The Development Segments

While MRP focuses solely on the manufacturing end of the business, the scope for ERP is much greater. The ERP modules have been designed to offer complete business control.

Business Size

ERP, owing to the extensive use and widespread modules, is most suited for large scale businesses, but MRP can be used for all categories of businesses. As long as the firm doesn't need to integrate the MRP module with several other processes, they can use it regardless of their scale of working.

The Cost Factor

The budget is often the delimiting factor, and it is important to note that ERP tends to be much more expensive compared to MRP. However, we must be quick to add that often ERP ends up justifying the cost, owing to the wide multitude of functions that it offers.

So, it is upon you to make the utility cost trade-off and decide accordingly.

1.10 Advanced Planning and Scheduling Software (APS)

There is yet another emerging method that can be used with the existing software in manufacturing concerns. And its name is Advanced Planning and Scheduling Software (APS).

Advanced Planning and Scheduling Software (APS) can easily aid with materials requirements planning (MRP). APS and MRP are able to be integrated together and can aid production facilities in various areas such as waste elimination, productivity increase, and cost reduction. APS software is a must for manufacturing facilities that are seeking to take their production facility to the next level in terms of optimal efficiency. Quickly turn your manufacturing operation into a gold mine through implementation of APS and MRP.

Advanced Planning and Scheduling (APS) software has become a must for modern-day manufacturing operations due to customer demand for increased product mix and fast delivery combined with downward cost pressures. APS can be quickly integrated with a ERP/MRP software to fill gaps where these system lack planning and scheduling flexibility and accuracy. Advanced Planning and Scheduling (APS) helps planners save time while providing greater agility in updating ever-changing priorities, production schedule, and inventory plan.

- Create optimized schedules balancing production efficiency and delivery performance
- Maximize output on bottleneck resources to increase revenue
- Synchronize supply with demand to reduce inventories
- Provide company-wide visibility to capacity
- Enable scenario data-driven decision making

Implementation of Advanced Planning and Scheduling (APS) software will take your manufacturing operations to the next level of production efficiency, taking advantage of the operational data you already have in your ERP.

1.10.1 Planning with Smartsheet

Empower your people to go above and beyond with a flexible platform designed to match the needs of your team — and adapt as those needs change.

The Smartsheet platform makes it easy to plan, capture, manage, and report on work from anywhere, helping your team be more effective and get more done. Report on key metrics and get real-time visibility into work as it happens with roll-up reports, dashboards, and automated workflows built to keep your team connected and informed.

When teams have clarity into the work getting done, there's no telling how much more they can accomplish in the same amount of time.

Test Your Progress

1. What is APS?

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2. How planning is done with smart sheet?

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1.11 Summary

Material Planningis a scientific way of determining the requirements starting with raw materials, consumables, spare parts and all other materials that are required to meet the given production plan for a certain period.

Material Requirements Planning (or MRP I) is a method that is used for the purpose of calculating the components and the materials, which in turn will be needed for the sake of making a product.

Manufacturing Resource Planning or MRP II isn't solely about the computational needs, but is a management concept that can take many forms. MRP II works within a hierarchy that divides planning into the long range, medium range, and short term.

Enterprise Resource Planning can be understood in context with MRP, which is a planning and control system for the resources in a company and was essentially the harbinger of ERP systems to come. ERP is a solution for the enterprise as a whole, with more functionality built in, extending the concepts of MRP and MRP II.

1.12Test Your Progress

1. What is material planning?
2. What are the techniques of material planning?
3. Define Material Requirement Planning.
4. What are the main features of Material Requirement Planning?
5. How does Material Requirement Planning work? What are its steps?
6. What are the advantages of Material Requirement Planning?
7. State the disadvantages of Material Requirement Planning.
8. What is the need and importance of Material Requirement Planning?
9. What is the difference between MRP I and MRP II?
10. State the following in brief:

a. DRP
b. Production Planning
c. APS

11.State the differences between MRP and ERP.

1.13Suggested Readings

1. https://www.yourarticlelibrary.com
2. https://searcherp.techtarget.com
3. https://www.cips.org
4. https://corporatefinanceinstitute.com
5. https://www.investopedia.com
6. https://www.smartsheet.com
7. https://www.netsuite.com
8. https://www.mrpeasy.com
9. https://www.optiproerp.com
10. https://www.materialsmanagement.info

UNIT 2 : JUST IN TIME

Unit Structure

2.0 Objectives

After completing this unit students will be able to:

- Get an overview of Inventory management.
- Get a deep knowledge of Just In Time (JIT) technique.
- Get a thorough knowledge of JIT Production Planning.
- Understand the concept of Strategic Material Planning.

2.1 Introduction

It was not so long ago when organizations were overstocking their warehouses with resources just in case a customer demand appears.

However, having a lot of inventories automatically means higher costs for maintaining these extra resources. Logically, more inventories require more space and an additional workforce.
In the middle of the 20th century, struggling to reduce its high inventory costs, Toyota built the foundation of Lean manufacturing.

2.2 Inventory Management

Inventory management is a systematic approach to sourcing, storing, and selling **inventory**—both raw materials (components) and finished goods (products). In business terms, **inventory management** means the right stock, at the right levels, in the right place, at the right time, and at the right cost as well as price.

The goal of **inventory management** systems is to know where your inventory is at any given time and how much of it you have in order to manage inventory levels.

Inventory management software helps you track materials in the supply chain. Inventory overseers may have to account for product movements handled by warehouse workers, delivery drivers, manufacturing employees and suppliers. Warehouse managers must also determine the inventory staff should pick and when merchandise is ready for distribution.

Your ERP provides additional layers of tracking. Mobile inventory solutions like mobile barcoding, also called mobile data collection, add heightened levels of control and oversight.

2.2.1 Types of Inventory

Inventory has different classifications at different points in the supply chain. It is the managers job to account for each product and what stage it is currently in.

There are four types, or stages, that are commonly referred to when talking about inventory:

1. Raw Materials
2. Unfinished Products
3. In-Transit Inventory, and
4. Cycle Inventory.

1. Raw Materials

Company warehouses don't just house finished products. Some manufacturers use distribution centers to store raw materials for their production lines. Inventory control software must distinguish between items on shelves meant for customers and materials allocated for business use. Barcoding enables accurate stock levels and movements by automating data collection for inventory.

2. Unfinished Products

Once raw materials move to manufacturing, they may return to the warehouse before they are ready to sell. Workers may confuse unfinished products stored on warehouse shelves for merchandise ready for delivery. Employees need to use automated data collection devices to update the status of each piece of inventory.

Mobile devices create simple processes for classification alterations. Employees can use barcode scanners, smartphones, tablets or voice picking technology to communicate the inventory's progress in the business cycle. Outfitting different departments with uniform tools prevents communication errors. As materials move between the warehouse and manufacturing, mobile data collection procedures limit mistakes.

3. In-Transit Inventory, and

Not all inventories sit in a warehouse. Accounting Coach described in-transit inventory as products the company owns but doesn't have in its possession because the items are in a transportation vehicle. Managers account for this inventory with a data collection system. Inbound Logistics reported in-transit inventory may account for 5% to 20% of a company's revenue.

4. Cycle Inventory.

Inventory that moves quickly through the supply chain is called cycle stock. These are products that arrive from a supplier or manufacturing process and are almost immediately pushed out to customers. Warehouse workers need flexible and quick procedures to keep up with the speed of cycle movements.

2.2.2 Features of Inventory Management

1. Picking and packing: Directs picking and packing employees to the correct warehouse locations.

2. Shipping: Manages bills of lading, invoices, packing sheets and other related documents.

3. Managing locations: Directs placement of items in the warehouse for the best use of space and resources.

4. Receiving orders: Manages incoming orders to direct fulfillment operations.

5. Tracking inventory levels: Keeps a running total of inventory status on each item or SKU.

6. Cycle counting: Supports cycle counting inventory strategies to maintain up-to-date totals.

7. Barcode tracking: Manages barcode scanning inputs and integrates with shipping, accounting and other systems.

8. Reporting tools: Generates data for actionable intelligence to drive tactical and strategic decision-making.

2.3Techniques of Inventory Management

Inventory management is a highly customizable part of doing business. The optimal system is different for each company.
Regardless of the system you use, the following techniques will help you improve your inventory management—and cash flow.

1. ABC Analysis:

ABC analysis stands for Always Better Control Analysis. It is an inventory management technique where inventory items are classified into three categories namely: A, B, and C. The items in A category of inventory are closely controlled as it consists of high-priced inventory which may be less in number but are very expensive. The items in B category are relatively lesser expensive inventory as compared to A category and the number of items in B category is moderate so control level is also moderate. The C category consists of a high number of inventory items which require lesser investments so the control level is minimum.

2. Drop Shipping:

Dropshipping is almost an ideal scenario from an inventory management perspective. Instead of having to carry inventory and ship products yourself—whether internally or through third-party logistics—the manufacturer or wholesaler takes care of it for you. Basically, you completely remove inventory management from your business. Even if you just want to use dropshipping to test new inventory before investing in a big order, it can be a great addition to your business.

3. Just In Time (JIT) Method:

In Just in Time method of inventory control, the company keeps only as much inventory as it needs during the production process. With no excess inventory in hand, the company saves the cost of storage and insurance. The company orders further inventory when the old stock of inventory is close to replenishment. This is a little risky method of inventory management because a little delay in ordering new inventory can lead to stock out situation. Thus this method requires proper planning so that new orders can be timely placed.

4. Material Requirements Planning (MRP) Method:

Material Requirements Planning is an inventory control method in which the manufacturers order the inventory after considering the sales forecast. MRP system integrates data from various areas of the business where inventory exists. Based on the data and demand in the market, the manager would carefully place the order for new inventory with the material suppliers.

5. Economic Order Quantity (EOQ) Model:

Economic Order Quantity technique focuses on taking a decision regarding how much quantity of inventory should the company order at any point of time and when should they place the order. In this model, the store manager will reorder the inventory when it reaches the minimum level. EOQ model helps to save the ordering cost and carrying costs incurred while placing the order. With the EOQ model, the organization is able to place the right quantity of inventory.

6. Minimum Safety Stocks"

The minimum safety stock is the level of inventory which an organization maintains to avoid the stock-out situation. It is the level when we place the new order before the existing inventory is over. Like for example, if the total inventory in an organization is 18,000 units, they place a new order when the inventory reaches 15,000 units. Therefore, the 3,000 units of inventory shall form part of the minimum safety stock level.

7. VED Analysis

VED stands for Vital Essential and Desirable. Organizations mainly use this technique for controlling spare parts of inventory. Like, a higher level of inventory is required for vital parts that are very costly and essential for production. Others are essential spare parts, whose absence may slow down the production process, hence it is necessary to maintain such inventory. Similarly, an organization can maintain a low level of inventory for desirable parts, which are not often required for production.

8. Fast, Slow & Non-Moving (FSN) Method

This method of inventory control is very useful for controlling obsolescence. All the items of inventory are not used in the same order; some are required frequently, while some are not required at all. So this method classifies inventory into three categories, fast-moving inventory, slow-moving inventory, and non-moving inventory. The order for new inventory is placed based on the utilization of inventory.

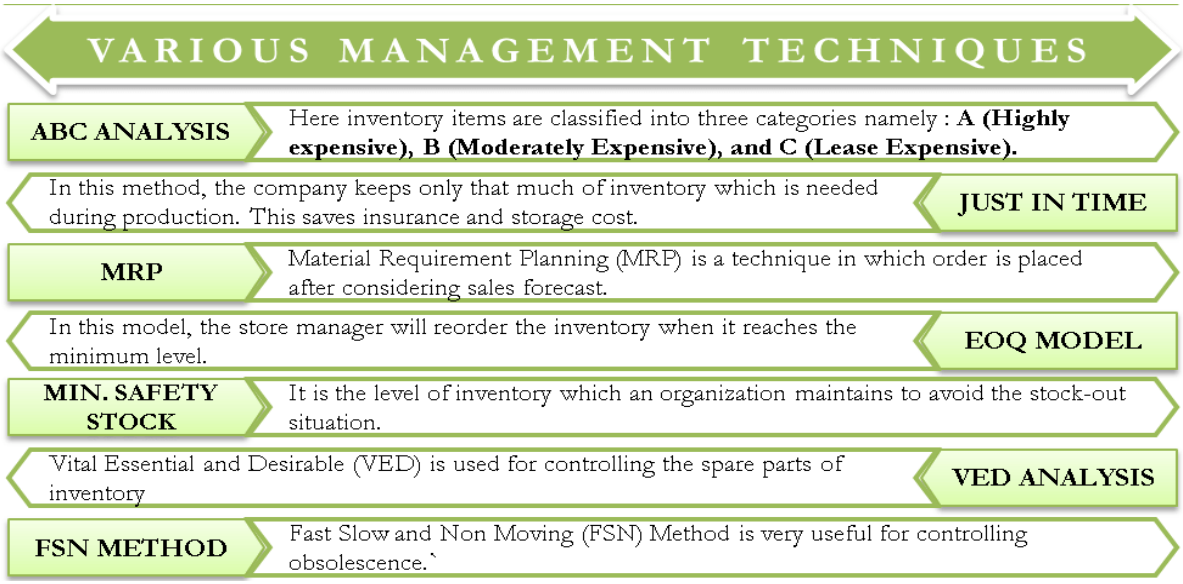

Fig. 2.1: Management Techniques

2.4 Just In Time (JIT)

Just-in-time also known as JIT is an inventory management method whereby labour, material and goods (to be used in manufacturing) are re-filled or scheduled to arrive exactly when needed in the manufacturing process.

JIT is a manufacturing management process. It was first developed and applied in the Toyota manufacturing plants in order to meet consumer demands with minimum delays. Taiichi Ohno of Japan is referred as the father of Just In Time. Toyota met the increasing challenges for survival through a management approach that was entirely focused on people, systems and plants. Toyota realized the Just In Time approach would only be successful if every person within the Toyota was committed and involved in it if plant and processes were properly arranged for maximum efficiency and output, and if the quality of the goods produced and production programs were scheduled to meet demands exactly.

2.4.1 Importance of Just in Time (JIT)

The main focus of JIT is to identify and correct the obstacles in the production process. It shows the hidden problems of inventory. Just In Time method prevents a company from using excessive inventory and smoothens production operations if a specific task takes longer than expected or a defective part is discovered in the system. This is also one of the main reason why the companies (which are opted for JIT) invest in preventive maintenance; when a part/equipment breaks down, the entire production process stops.
The prime objective of JIT is to increase the inventory turnover and reduce the holding and all connected cost. This concept was made applicable again by the Japanese firms, placing an order for the material, the same day for the production of the product.

2.4.2 Elements of Just in Time (JIT)

Fig. 2.2 Elements of Just in Time

Following are the elements involved in JIT :

Continuous improvement:

1. Attacking fundamental problems and anything that does not add value to the product.
2. Devising systems to identify production and allied problems.
3. Simplicity: Simple systems are simple & easy to understand, easily manageable and the chances of going wrong are very low.
4. A product: oriented layout for less time spent on materials and parts movement.
5. Quality control at source to ensure every worker is solely responsible for the quality of their own produced output.

Eliminating waste: These are types of such waste:

1. Waste from product defects.
2. Waste of time.
3. Transportation waste.
4. Inventory waste.
5. Waste from overproduction.
6. Processing waste.

Waste minimization is one of the primary objectives of Just In Time system. This needs effective inventory management throughout the whole supply chain. Initially, a manufacturing entity will seek to reduce inventory and enhance operations within its own organization. In an attempt to reduce waste attributed to ineffective inventory management, SIX principles in relation to JIT have been stated by Schniededans and they are:

1. Reduce buffer inventory.
2. Try for zero inventories.
3. Search for reliable suppliers.
4. Reduce lot size and increase the frequency of orders.
5. Reduce purchasing cost.
6. Improve material handling.

2.4.3 Advantages of JIT

Following are the advantages of JIT:

1. Just-in-time approach keeps stock holding costs to a minimum level. The released capacity results in better utilization of space and bears a favourable impact on the insurance premiums and rent that would otherwise be needed to be made.

2. The just-in-time approach helps to eliminate waste. Chances of expired or out of date products; do not arise at all.

3. As under this management method, only essential stocks which are required for to manufacturing are obtained, thus less working capital is required. Under this approach, a minimum re-ordering level is set, and only when that level is reached, order for fresh stocks are made and thus this becomes a boon to inventory management too.

4. Due to the abovementioned low level of stocks held, the ROI (Return On Investment? of the organizations be high in general.

5. As this approach works on a demand-pull basis, all goods produced would be sold, and thus it includes changes in demand with unanticipated ease. This makes JIT appealing today, where the market demand is fickle and somewhat volatile.

6. JIT emphasizes the ‘right-first-time’ concept, so that rework costs and the cost of inspection is minimized.

7. By following JIT greater efficiency and High-quality products can be derived.

8. Better relationships are fostered along the production chain under a JIT system.

9. Higher customer satisfaction due to continuous communication with the customer.

10. Just In Time adoption result in the elimination of overproduction.

2.4.4 Disadvantages of JIT

Following are the disadvantages of JIT:

1. JIT approach states ZERO tolerance for mistakes, making re-work difficult in practice, as inventory is kept to a minimum level.

2. A successful application of JIT requires a high reliance on suppliers, whose performance is outside the purview of the manufacturer.

3. Due to no buffers in JIT, production line idling and downtime can occur which would have an unfavourable effect on the production process and also on the finances.

4. Chances are quite high of not meeting an unexpected increase in orders as there will be no excess inventory of finished goods.

5. Transaction costs would be comparatively high depending upon the frequency of transactions.

6. JIT may have certain negative effects on the environment due to the frequent deliveries as the same would result in higher use and cost of transportation, which in turn would consume more fossil fuels.

2.4.5 Practical Examples of JIT in Industry

JIT inventory management is used today by businesses in industries ranging from retail to fast food to tech. Toyota is one of the most famous examples of Just in Time manufacturing simply because it was one of the first to implement this strategy effectively. Here are some other examples of JIT in action:

Kellogg's:

Given that **Kellogg's** produces mostly perishable goods, it shouldn't come as a surprise that they use the Just in Time inventory management method as an efficient stock management system. Kellogg's makes sure that just enough products are made to fulfill orders and limited stock is kept on hand.

Apple:

This consumer electronics giant keeps as little inventory on hand as possible. By lowering the amount of stock on hand, Apple carries a lower risk of overstocking and chalking up dead stock in its warehouses. As explained by Tim Cook, CEO of Apple, "Inventory is fundamentally evil. You kind of want to manage it like you're in the dairy business. If it gets past its freshness date, you have a problem."

Test Your Progress

1. What is inventory management?

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2. What are the types of inventory?

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3. List the features of inventory management.

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4. What do you understand by Just In Time management (JIT)? Explain with practical examples.

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5. What are the elements of Just in Time?

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2.5 JIT Production Planning

Production management is primarily concerned with formulation and design of various production policies.Production planning involves the means by which a manufacturing plan is determined, information issued for its execution, data collected and recorded, which will enable the plant to be controlled through all its stages. A few definitions are given here in order to have

clear understanding of the term 'Production Planning'. Elwood S. Buffa has nicely explained the meaning of production management. According to him, "In a broader sense, production management is concerned with coordination of materials, men, methods, machines and money in manufacturing goods. In a narrow sense it means planning, scheduling and controlling the flow of materials through a plant".

In simple words, it can be concluded that production management is concerned with decision making relating to processes for producing goods and services in accordance with the pre-determined specifications and standards by incurring minimum costs.

As already pointed out that production management is concerned with planning and initiating various production policies. Production policies and procedures are concerned with production planning and control. Production planning and control comprises of:

(a) Production planning.

(b) Production control.

It would be appropriate to explain these two terms separately in order to have clear understanding of the term 'Production planning and control'.

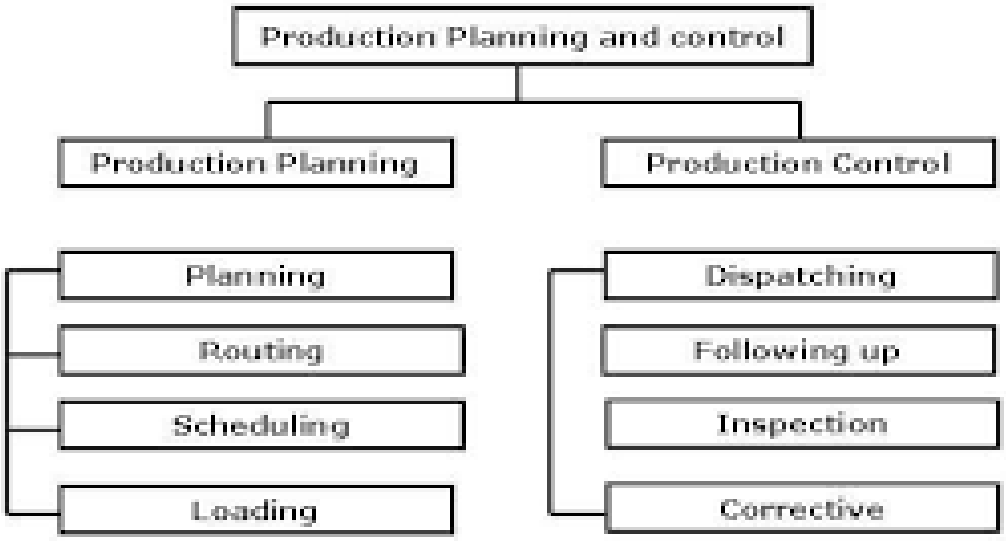

Fig.2.3 : Production Planning and Control

2.5.1 Objectives of Production Planning

The objective of production planning and control is to plan and manage the **materials** and capacities based on the customer needs. Thus production planning enables the company to fulfill customer demand and achieve other goals efficiently and with high quality.

Following are the objectives of Production Planning :

1. To achieve coordination among various departments relating to production.
2. To make adequate arrangement of men, money, materials, machines tools, implements and equipment relating to production.
3. To decide about the production targets to be achieved by keeping in view the sales forecast.
4. To keep production operation continuous.
5. To achieve desired share of the market.
6. To fix right type of man for right type of job.
7. To achieve the desired level of profit.
8. To make all arrangements to remove possible obstacles in the way of smooth production.
9. To achieve economy in production cost and time.
10. To initiate production on modern lines.
11. To operate the plant at planned level of efficiency.
12. To develop alternative plans in order to meet any emergency or contingency.

2.5.2 Importance of Production Planning

The system of production planning and control serves as the nervous system of a plant. It is a coordinating agency to coordinate the activities of engineering, purchasing, production, selling and stock control departments. An efficient system of production planning and control helps in providing better and more economic goods to customers at a lower investment. It is essential in all plants irrespective of their nature and size.

2.5.3 Advantages of Production Planning

Following are the advantages of Production Planning

1. Better Service to Customers:

Production planning and control, through proper scheduling and expediting of work, help in providing better services to customers in terms of a better quality of goods at reasonable prices as per promised delivery dates. Delivery in time and proper quality, both help in winning the confidence of customers, improving relations with customers and promoting profitable repeat orders.

2. Fewer Rush Orders:

In an organization, where there is an effective system of production planning and control, production operations move smoothly as per original planning and matching with the promised delivery dates. Consequently, there will be fewer rush orders in the plant and less overtime than, in the same industry, without adequate production planning and control.

3. Better Control of Inventory:

A sound system of production planning and control helps in maintaining inventory at proper levels and, thereby, minimizing investment in inventory. It requires a lower inventory of work-in-progress and less finished stock to give efficient service to customers. It also helps in exercising better control over raw-material inventory, which contributes to more effective purchasing.

4. More Effective Use of Equipment:

An efficient system of production planning and control makes for the most effective use of equipment. It provides information to the management regularly about the present position of all orders in process, equipment and personnel requirements for the next few weeks. The workers can be communicated well in advance if any retrenchment, lay-offs, transfer, etc. are likely to come about. Also, unnecessary purchases of equipment and materials can be avoided. Thus, it is possible to ensure proper utilization of equipment and other resources.

5. Reduced Idle Time:

Production planning and control help in reducing idle time i.e. loss of time by workers waiting for materials and other facilities; because it ensures that materials and other facilities are available to the workers in time as per the production schedule. Consequently, fewer man-hours are lost, which has a positive impact on the cost of production.

6. Improved Plant Morale:

An effective system of production planning and control co-ordinates the activities of all the departments involved in the production activity. It ensures even flow of work and avoids rushorders. It avoids "speeding up" of workers and maintains healthy working conditions in the plant. Thus, there is improved plant morale as a by-product.

7. Good Public Image:

A proper system of production planning and control helps keep systematized operations in an organization. Such an organization is in a position to meet its orders in time to the satisfaction of its customers. Customers satisfaction leads to increased sales, increased profits, industrial harmony and, ultimately, the good public image of the enterprise.

8. Lower Capital Requirements:

Under a sound system of production planning and control, everything relating to production is planned well in advance of operations. Where, when and what is required in the form of input is known before the actual production process starts. Inputs are made available as per schedule which ensures even flow of production without any bottlenecks. Facilities are used more effectively and inventory levels are kept as per schedule neither more nor less. Thus, production planning and control help, in minimizing capital investment in equipment and inventories.

2.5.4 Disadvantages of Production Planning

Undoubtedly, the system of production planning and control is a must for efficient production management; but in, practice, sometimes, it fails to achieve the expected results because of the following limitations.

1. Lack of Sound Basis:

Production planning and control are based on certain assumptions or forecasts about the availability of inputs like materials, power, equipment, etc. and customers orders. In case these assumptions and forecasts do not go right, the system of production planning and control will become ineffective.

2. Rigidity in Plant's Working:

Production planning and control may be responsible for creating rigidity in the working of the plant. Once the production planning has been completed, any subsequent change may be resisted by the employees.

3. Time-consuming Process:

Production planning is a time-consuming process. Therefore, under emergencies, it may not be possible to go through the process of production planning.

4. Costly Device or machine:

Production planning and control is not only a time-consuming process but is a costly process also. Its effective implementation requires services of specialists for performing functions of routing, scheduling, loading, dispatching and expediting. Small firms cannot afford to employ specialists for the efficient performance of these functions.

5. External Limitations:

The effectiveness of production planning and control is sometimes limited because of external factors which are beyond the control of production manager, Sudden break-out of war, government control, natural calamities, change in fashion, change in technology, etc. are factors which harm the implementation of production planning and control.

2.6 Strategic Material Planning

Strategic material planning involves the process used to determine the resources manufacturers need to meet the demand for their products or services. The level of capacity directly relates to the amount of output in the form of goods and services manufacturers can produce to satisfy customer demand.

It can guide manufacturers on how much raw materials, equipment, labor, and investment in facilities need to be acquired over a period of time to meet the future demand over products. When there is a lack of capacity planning, customers' needs are not served promptly and these customers may be lost to competition.

A good planning strategy helps adequately plan manufacturing resources. Excess capacity means the manufacturer's money is being spent inefficiently, and this could have been invested elsewhere for a profit instead. On the other hand, low capacity implies the inability of the manufacturer to produce as per what the customer wants at a particular period of time.

2.6.1 Types of Strategic Material Planning

Following are the types of Strategic Material planning:

1.Lead Strategy

The Lead Strategy involves an upfront investment in more capacity that is needed and is one of the most aggressive approaches used. Manufacturers plan to increase their capacity in advance even before the actual demand increases. This takes care of anticipated demand increases. Many manufacturers use this strategy to gain market share against competitors. This is also used when competitors are prone to inventory shortages especially when demand skyrockets. The Lead Strategy has its own risk also, as if the actual demand does not match the predicted demand, manufacturers are left with excess inventory to be stored.

2. Lag Strategy

The Lag Strategy is much more conservative than the Lead Strategy as it waits until the current capacity is stretched to its limits before adding more capacity. In this strategy, manufacturers respond to an actual increase in demand and boost capacity after the current operation runs in full steam. Here, manufacturers avoid the problem of storing excess inventory but might end up losing customers to competition.

3. Match Strategy

The Match Strategy usually adopts a mid way between the Lead and Lag strategies. Instead of boosting demand ahead of time or increasing demand after the existing capacity is exhausted, this strategy uses smaller incremental changes to the manufacturers' capacity. This is done based on the fluctuating conditions in the marketplace. Despite being more complex in nature, this is a safer bet for most manufacturers as it is much more risk-averse than the other Capacity Planning Strategies.

4. Dynamic Strategy

This strategy is a much more safer forecast driven strategy. It involves adding capacity large or small, before it is required, based on actual demand and sales forecast figures. Since this is data-driven, it proves to be much more accurate for manufacturers to plan their capacity targets and avoids wastage or shortage of capacity. However, this type of strategy does depend on good capacity planning tools which can drive accurate forecasts.

2.6.2 Process of Strategic Material planning

A good process plan can help manufacturers optimally configure the system to ensure SLAs are met while only investing the necessary resources needed to get the work completed. This helps manufacturers optimize the production process and make them prepared for the future.

1. Understanding the Service Level Requirements

- The first step is to break down the manufacturing job or production order into various categories.
- This can help create a structured flow to quantify the exact user expectations. It includes establishing workloads, determining the unit of work, and setting service levels.
- Manufacturers can then decide how each work task will be organized based on labor availability, or the complexity of work involved.
- Finally a "service level agreement" lays out the acceptable parameters between the manufacturer and the consumer.

2. Estimating and Analyzing the Current Capacity

The next step is for manufacturers to take a deeper estimate of the existing production schedule to evaluate the final capacity. Manufacturers usually analyze separate workloads and follow these steps:

- Compare the measurements of specific workloads mentioned in the SLA with the overall job objectives.
- Evaluate the actual usage of multiple resources across the system
- Check the resource utilization for each workload and then decide which of these consume more manpower.
- Finally calculate the most time consuming aspects of each workload to arrive at the response time taken for each job.

3. Planning for Future Requirements and Demand

- Once the current capacity is analyzed, manufacturers can then plan for future demand.
- By accurately forecasting the processing requirements, a system or process overload on the manufacturing set up can be avoided.
- Manufacturers would need a clear estimate of the actual incoming work that is expected in the coming few months.
- Finally, they can configure the most optimal system needed to satisfy these requirements over the forecasted period of time.

2.6.3 Checklist for making Strategic Material planning

Here is a checklist of variables to consider while doing strategic material planningyou're your concern:

1. Capacity

The most basic element which is the number of units available of a specific resource for a particular length in time. Manufacturers need to also account for any gaps/ holidays/ breaks / maintenance downtime if any, while calculating the capacity.

2. Setup/Run Hours

The next variable is to define how much time a specific operation on a job will take to eventually move through a resource. This is made up of a combination of setup time, which is a static number and the run time which depends on the number of items on the job. Finally, the total hours are compared to the total capacity of the resources needed for planning.

3. Utilization

This variable is a measurement of the capacity usage and measures the total usage of the resource. It is important for capacity planning, as it is a measure of the actual capacity compared to the estimated capacity.

4. Efficiency

Efficiency is defined as the measure of the actual setup/run time versus the estimated setup/run time for a work job. Efficiency can help track how much capacity is needed actually and the difference from the original plan. When this is multiplied across several job loads, efficiency can be a critical measure to define final performance.

5. Queue time/move hours

It is important to understand that just because an operation is scheduled to complete at a certain time using one resource, this doesn't imply that the subsequent resource can immediately start running it. It usually takes a material handler to move a specific job from one resource to the next. This can also impact the machine's utilization, since it may sit idle while waiting for the next job to be available.

6. Offset hours

From a capacity planning standpoint, a work job may progress in different ways including offset hours. These hours that can always be offset to another job, and can help save time and resources. Knowing ahead of time of how one can plan for operations that can be offset can make a massive impact on the manufacturing capacity planning.

7. Concurrent Resources

Many times manufacturers need more than two or three resources to be available at the same time to complete a job operation. Also, the ability of the worker to run all three together may also impact the completion of the job. Sometimes it may need multiple labour resources to run each operation. This can further get complicated once all of the jobs are multiplied and therefore concurrent resources are an important aspect to consider.

With a strong Planning Software, manufacturers can ensure a structured approach to strategic material planning and avoid surprises along the operations value chain.

2.6.4Benefits of Strategic Material planning:

Following are the benefits of Strategic Material planning:

1. Monitor Operations Costs

Capacity Planning Strategies incorporates all relevant aspects including personnel, facilities, budgets, production schedules and supplies. This can help manufacturers carefully monitor all production costs especially during periods of growth and recession. When manufacturers are able to foresee projected capacity needs, it allows them to accurately budget for upcoming changes, and apply financial resources where needed. This can also help develop relevant delivery schedules for supplies and shipping schedules for completed products.

2. Ensure Adequate Availability

With a Capacity Planning Strategy in place, manufacturers can ensure they have the necessary resources to deliver work even before a contract is signed. The Capacity Planning Strategy guides manufacturers on the scope available to undertake new projects along with inputs on sufficient resources to cater to the requirements. Using actionable analytics, manufacturers get access to key data points which accurately report the possibility of overtime based on current work schedules.

3. Maintain Production Cycles

Manufacturers can maintain proper production levels as per expected business cycles with a good Capacity Planning Strategy. Seasonal demand fluctuations can be planned for using historical data and production capacity can be easily managed to handle the rise in demand. Capacity Planning Strategy also identifies when the business cycle might deteriorate so that seasonal workers can be employed accordingly and unnecessary expenses can be avoided.

4. Identify Skill Gaps

Adequate capacity planning can help identify the relevant skills required to deliver key projects and plan for any skill shortages well in advance. Manufacturers can plan work accordingly and forecast skill requirements and also make decisions regarding in-house skills vs outsourced skills. Manufacturers can easily plan employee training needs and decide how projects will get delivered in the future.

5. Plan New Production Facilities

As your company grows, you may find the need to open new production facilities. Using your capacity planning information from your existing locations, you can develop a more accurate projection of needs for facilities and personnel levels, and of the kind of production that can be expected from the new location. This is a valuable tool when putting together the business plan and budgets for your company's growth.

6. Meet operations budget:

When manufacturers use appropriate capacity planning tools, they are able to meet demand with the least amount of waste and increase their utilization rates. It also helps them meet their budgetary requirements based on their projected sales or demand forecast and reduce additional expenses.

Capacity Planning strategies can help increase operational performance and move closer toward achieving output targets. However, if your Capacity Planning Strategies are not customized to your company's business model, you might land into a crisis.

2.6.5 Challenges involved in Strategic Material planning

Most manufacturers go through some commonStrategic Material planning challenges, irrespective of the operational strategy used. These challenges could impact the production flow no matter the level or scale or the complexity of the organization.

1. **Useless data and collection methods**

Traditional manufacturing processes have mostly relied on usless data to plan the production capacity. Disparate, unconnected systems imply manual reconciliation of data before consumption. These results in higher time consumption and data could get outdated even before it can be applied and used. Since most capacity planning tools rely on inputs from demand forecasts, supply chain, warehouse management etc., a disconnected system can be risky as it increases reliance on manual reports and human capability to identify and manage trends.

2. **Inferior data quality**

Very often, manufacturing operations involve capacity data arising in the form of records and reports which then must be manually aggregated before the final information can be consumed. After this is done, planners add in the much needed supply and demand data and develop a formula to arrive at the available capacity. During this process, if at any step, these multiple data inputs are inaccurate or outdated or if they exist in multiple formats, this again needs to be formatted and standardized before they can be utilized for planning purposes. And since most of these data points are not connected, any new iteration must go through the same process all over again.

3. **Complex formulae and calculations**

Planners use many complex formulae and calculations to arrive at the final capacity plan. This can include several aspects like the material availability, load by work center, alternate sourcing, attribute-based planning rules and more. To accommodate all of this, manual spreadsheets have long been the "go-to" for planners to calculate these elements, as accurate calculations are crucial. While doing this, if the data entry errors or bad data are present, the entire capacity plan could be wrong. In addition to this, a lag based on the time needed to assemble the data, new information and changes must be input into several sources, again lengthening the time to produce a plan and creating the risk of errors.

4. **Multi Level planning**

In most manufacturing environments, capacity planning is often done at different levels. A rough cut planning is usually done at the master schedule level and this is used for short-term planning may be for a week to two months. Medium or aggregate planning uses a 12-18-month planning window to provide a longer view that allows the organization to ensure that demand can be met long-term. It also helps smoothen supply chain challenges to look at production cost reductions. Each of these levels need larger data sets and longer time periods as they are used for multiple decision-making tasks. Due to this, the challenges of data collection, data quality and formulae and calculations are multiplied in complexity, creating possibilities of errors with those issues.

5. **Gap in Communication**

As the capacity planning process involves so many dynamic and moving parts, and since very few of them interconnected, there is a chance of a possible breakdown or gap in communication which can be risky to the integrity of the capacity plan. This is true for supplier communication and is also true internally where siloed systems for purchasing may not communicate with those in production or scheduling. This can end up reducing the collaboration and leaving capacity planners open to being blind-sided by new data, missing data or errors in existing data.

Test Your Progress

1. What do you mean by JIT production planning?

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2. What do you understand by Strategic material planning?

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3. Name a few Challenges involved in Strategic Material planning.

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4. List a few advantages of Strategic Material planning.

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2.7 Summary

Inventory management is the act of keeping track of a company's stocked goods and monitoring their weight, dimensions, amounts, and location.

Just-in-time (JIT) inventory system is a management strategy that aligns raw-material orders from suppliers directly with production schedules. Companies employ this inventory strategy to increase efficiency and decrease waste by receiving goods only as they need them for the

production process, which reduces inventory costs. This method requires producers to forecast demand accurately.

Production planning is concerned with decision making relating to processes for producing goods and services in accordance with the pre-determined specifications and standards by incurring minimum costs.

Strategic Material Planning involves the process used to determine the resources manufacturers need to meet the demand for their products or services. The level of capacity directly relates to the amount of output in the form of goods and services manufacturers can produce to satisfy customer demand.

2.8 Test Your Progress

1. What do you understand by inventory management?
2. Explain the types of inventory in detail.
3. Explain the techniques of inventory management.
4. Can you explain Just In Time management (JIT) with a few practical examples?
5. What do you understand by:

a) Advantages of Just in time management.
b) Disdvantages of Just in time management.

6. What are the main objectives of production planning?
7. What is the importance of production planning and control?
8. Explain in detail:

a) Advantages of Strategic Material planning
b) Challenges involved in Strategic Material planning

9. What are the types of Strategic Material planning?
10. Give a quick Checklist for making Strategic Material planning.
11. Explain the process of Strategic Material planning.
12. Are there any challenges faced by industries while doing strategic material planning? If yes, state them.

2.9 Suggested Readings

1. https://searcherp.techtarget.com/
2. https://www.rfgen.com/blog
3. https://efinancemanagement.com/
4. https://www.shopify.in/

5. https://www.warehouseanywhere.com/
6. https://kanbanize.com/
7. https://www.tradegecko.com/
8. https://www.investopedia.com/
9. https://www.tandfonline.com/
10. https://www.ilearnlot.com/
11. https://www.yourarticlelibrary.com/
12. https://cleartax.in/

UNIT 3 : MATERIAL CONTROL

Unit Structure

3.0 Objectives

After completing this unit students will be able to:

- Get thorough knowledge of Material Control.
- Gather information about Material Acceptance.
- Analyze about Material Sampling.
- Get a deep understanding of Material Inspection.
- Understand the concept of Make or Buy Decision.
- Get complete understanding of Simple Cost Analysis.
- Get a clear knowledge of Economic Analysis.

3.1 Introduction

Materials constitutes major portion of the total cost of the product. Supplies are also used for the manufacture of product. Both materials and supplies are collectively called as stores. The finished goods are termed as stock.
Commodities that are supplied to an undertaking to be utilized in the manufacturing process or to be transformed into products are called "Materials".

The terms materials and stores are sometimes used interchangeably, but they are not identical. Stores is a wider term and covers items like sundry supplies, maintenance stores, tools, jigs, equipment besides material consumed in production. The raw materials and supplies are equivalent to cash. Hence, the management should exercise control over the materials and stores.

3.2 Material Control

"Material control is a systematic control over purchasing, storing and consumption of materials, so as to maintain a regular and timely supply of materials, at the same time, avoiding overstocking."

"Material control refers to the management function concerned with acquisition, storage, handling and use of materials so as to minimise wastage and losses, derive maximum economy and establish responsibility for various operations through physical checks, record keeping, accounting and other devices. "

In simple words, material control refers to the various measures adopted to reduce the amount of loss of materials at the time of receiving, storing and issuing the raw materials. Material control in practice is exercised through periodical records and reports relating to purchase, receipt, inspection, storage and issuing direct and indirect materials. Proper control over material can contribute substantially to the efficiency of a business.

3.2.1 Scope of Material Control

A **material control** involves the functioning of the operation enumerated below with efficiency.

1. Purchasing or Procurement of Materials.
2. Receiving of Materials.
3. Inspection of Materials.
4. Storage of Materials
5. Issuing of Materials.
6. Maintenance of Material Records.
7. Materials or Stock Audit.

3.2.2 Basic Requirements of Material Control

As we already know that the functions of a good system of material control include scheduling of the requirements, purchasing, receiving, inspecting, maintaining stock records etc.
To ensure effective and efficient working of the material control system, the following principles should be observed:

(i) There should be proper co-ordination among various departments, particularly production department, purchases department, inspection department, stores department, cost department etc.

(ii) There should be a centralized purchasing set up under the authority of an experienced and competent Purchase Manager.

(iii) Standard printed forms should be in use for making requisitions, placing orders, receiving materials, inspection of materials, issue of materials for consumption etc.

(iv) There should be a proper system for classification, codification and standardisation of materials.

(v) There should be an efficient arrangement for storing materials in order to avoid the possibility of deterioration of quality, theft, wastage, etc.

(vi) There should be an effective system of internal check for every aspect so that there is proper control over transactions at every stage. Each transaction in respect of materials must be approved by proper authority.

(vii) Different stock levels (e.g., maximum level, re-order level, minimum level etc.) should be fixed for each item of material in the stores.

(viii) There should be a proper system for the valuation of materials issued to production since it considerably affects the costing records.

(ix) The use of Perpetual Inventory System should be made so that the stock of various items of material is recorded after each transaction.

(x) Regular reports on the quantity and value of materials received, issued and balance in hand, should be prepared.

(xi) There should be regular reconciliation of the reports on materials with corresponding accounting records.

3.2.3 Objectives of Material Control

As a major portion of cost of production consists of material cost, the cost accounting system can be effective only when there is an efficient material control. The following are the objectives of material control.

1. Ensuring Supply of Adequate Quantity of Materials:

Sufficient quantity of material should be made available for all the activities and departments in the organization so that uninterrupted production can be carried on and work does not stop due to non-availability of materials.

2. Optimum Investment in Materials:

Keeping the amount invested in materials under control is a central objective of material control. Locking up of funds in stocks results in mismanagement of working capital. Overstocking should be avoided in view of its disadvantages. Excessive investment and over stocking can be avoided by fixing maximum stock level for all major items of materials.

3. Favorable Terms of Purchase:

The purchase price and other terms of purchase should be of maximum advantage to the firm. At the same time, quality and specifications of the materials should be as per requirements.

4. Control of Wastage:

Wastage of material during storage and handling on the production floor should be minimized. Standards can be fixed for wastage and efforts can be made to keep the actual wastage below the standard level. Pilferage, theft, etc., should be minimized to keep material cost within control.

5. Control of Obsolescence and Spoilage:

Loss due to materials becoming out of date or getting spoiled and unusable is a major cause for material losses. Fixing stock levels and utilizing materials in time can minimize such losses.

6. Proper Reporting to Management:
Management has to be informed frequently about stock of raw materials so that production is planned. This is possible only if there is proper reporting system and updating of records by the store keeper.

7. Prevention of Misappropriation of Materials:

Proper internal check of receipts, issues and consumption of raw materials helps in prevention of misappropriation of materials by the employees.

8. Proper Control System for Settlement of Invoices:

Suppliers' invoice is to be paid only after verifying the physical receipt of materials to avoid excess payment to the suppliers.

3.2.4 Necessity And Importance of Material Control

In a productive undertaking the need of materials control arises on account of the following reasons:

1. For keeping the stock of raw materials within limits in the stores i.e., to avoid overstocking and understocking of raw materials, materials control is significant.

2. It ensures proper storage of materials. For the proper preservation and safety of materials, adequate storage facilities are to be provided. With the help of proper storing of materials, quantity of materials as and when required can be issued to various jobs.

3. For knowing proper cost of production, control over materials is indispensable.

4. Certain techniques and methods are developed under the system of materials control thereby ensuring optimum utilization of materials.

5. In order to undertake continuous checking of materials, the necessity of a proper system of materials control cannot be ignored.

6. A well-managed system of materials control ensures the availability of different kinds of materials without delay.

As already pointed out while explaining the scope of material management that it includes purchases of materials, storekeeping and inventory control etc.

3.2.5 Process of Material Control

The process of material control is divided into four stages – Purchase control, Stores control, Issue control and Control of material losses.

A brief outline of various aspects of material control is discussed below:

1. Co-Ordination:

Effective control of material requires effective co-ordination among the departments involved in purchasing – receiving, and inspection, storage, production, sales and accounting departments so that adequate materials are available for continuous production and sales. At the same time excessive investment in materials and over stocking are avoided.

2. Centralized Purchasing:

In order to economize the buying and to avoid reckless buying of raw materials the purchasing function is to be centralized.

3. Proper Schedule:

Proper scheduling of materials requirements ensures availability of materials at the right time.

4. Classification and codification:

Classification and codification of material leads to easy identification and proper control of materials.

5. Receipt of Materials:

Checking and inspection of material by receiving department ensure correct quantity and quality of material as ordered by the organization.

6. Usage of Forms:

Standard forms are to be designed and used for purchase requisition, purchase order, receiving of materials, requisition of materials and transfer of material from jobs to stores or to other jobs.

7. Storage:

Storage of materials should be entrusted to a qualified store keeper to plan effective storage and avoid losses due to obsolescence, pilferage and theft.

8. Issue of Materials:

A good method of issue of materials to various jobs, processes and orders should be devised to ensure delivery of right material at the right time and right quantity and quality for smooth flow of production.

9. Stock Taking:

Perpetual inventory should be followed for stock verification to reveal differences in stock due to pilferage theft and wastage. Moreover perpetual inventory system avoids closing down of factory for stock verification and valuation.

10.Leveling of Stock:

Levels of stocks are to be maintained in the form of reorder level, maximum level and minimum level to avoid shortage and over stocking of materials.

11. EOQ:

Economic ordering quantity is to be operated for each type of materials to optimise the cost of buying and storage.

12. Pricing of Issues:

A suitable method of pricing is to be followed for correct, valuation of material cost of jobs, orders, processes and valuation of closing stocks.

13. Control of Materials during the Production Process:

Proper Accounting and records are to be maintained to avoid wastage of materials during consumption.

14. Reporting:

Suitable reporting system helps management to take decisions regarding investment in materials and avoidance of obsolete, dormant and slow moving materials.

Test Your Progress

1. What do you understand by

3.3 Acceptance of Material Control

Acceptance of material controlmeans to receive the deliveries from suppliers according to the Purchasing Order or Subcontract Order planned through MRP or other systems, where whether or not the delivery date or the quantity meets the conditions set at the time of placing the order is checked, while some actions for installment delivery, if any, are taken.

It comprises of following components:

A. Scheduled delivery date:

It is the date when items are scheduled to be delivered from suppliers based on the released order. In terms of suppliers, this date means the delivery date.

B. Installment Delivery:

It is a type of delivery where suppliers or subcontractors deliver the specified quantity of items not at a time but by splitting it in a several times. The company placing a certain volume of order may give instructions to deliver by installment according to the status of manufacturing work.

C. Not-Yet Delivery:

Generally speaking, "Not-Yet Delivery" has different interpretations depending on the order release or order receipt. In terms of order release, "Not-Yet Delivery" refers to the not-yet-delivered quantity of items when less quantity of items are delivered from suppliers. On the other hand, in terms of order receipt, Not-Yet Delivery" refers to the not-yet-delivered quantity of items when less quantity of items are delivered to customers.

3.4 Sampling of Material Control

Sampling is the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole populations.
Important factors that determine the design and implementation of a sampling program involve shipment size, ingredient variability, laboratory accuracy, cost of the essay and value of the ingredient.
Therefore, when defining the sampling procedures one should consider the purpose of sampling, the laboratory analysis through which samples will undergo and the characteristic of the ingredients and finished products.
Sampling protocols should meet scientifically recognized principles and procedures. Laboratory methods should be developed and validated according to scientifically recognized principles.
Sampling procedures will depend on the nature of the raw material, in process or finished product lots, conveying and sampling equipment.
Prior knowledge of the product data and sampling resources allows the assignment of the appropriate sampling procedures.
The use of recognized international sampling methods will ensure a standardized administrative and technical approach and will facilitate the interpretation of results of analysis related to lots or consignments of feed.

The following aspects should be considered with respect to Sampling ofMaterials Control:

- Human factors;
- Poorly skilled work force;
- Unconscious and conscious incompetence;
- What would happen if the wrong material was used in the wrong place; and
- What would happen if contaminated or out of specification material was used.

The following issues may contribute towards a major accident or hazard.

- Human error during acceptance of delivery and sampling;
- Incompetent quality control staff;
- Contaminant entering the plant for example, flammables in non-flameproof areas, oxidisers mixing with flammable solvents;
- Failure to understand the properties of substances handled;
- Failure of quality assurance procedures; and
- Failure to identify all credible contaminants and resultant reaction pathways that could disrupt the integrity of the plant involved.

Test Your Progress

1. What do you understand by material control? Explain its importance and process.

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2. What is acceptance of material control and what are its components?

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3. What are the issues in sampling of material control that lead to hazard?

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3.5 Inspection of Material Control

An incoming **inspection**, also known as a receiving **inspection** or **material inspection**, validates the quality of purchased raw **materials** based on set acceptance criteria. It is performed by quality assurance personnel in the manufacturing facility to resolve quality issues during pre-production.

Materials Inspections are similar to taking a flight on an airplane. The ideal scenario for both is an uneventful outcome – they are both means to a greater end. If an issue arises, it creates a series of headaches for all parties involved. While we can't prevent issues with your next flight, we can help streamline your Materials Inspections and build a repeatable process to success.

For those who don't have regulatory reasons to conduct Materials Inspections, one may be wondering why it's worth the hassle. The simple answer is that it will help the team deliver the best results to the customers.

Regardless of the industry, it's increasingly becoming more important to perform a quality audit on your suppliers. Even markets like Amazon are dealing with increased rates of fraud on items that were previously very trustworthy to bypass an inspection upon receipt. Based on the type of materials one is bringing in, one may find it useful to build a few unique materials inspection checklists on what is important to check.

Checklist for Inspection of material control:

1.Don't take your supplier quality for granted, always perform random inspections

2. It is important to inspect ISO certified supplies occasionally, don't let their potential mistake become your business's mistake.

3. Material inspections are necessary when audit checks aren't done by the supplier.

3.5.1 Importance of Inspection of Material Control

Whether your product is bound for an end consumer or another manufacturer in the supply chain, it's critical to test the materials coming in so the product you ship out meets quality and safety standards.

A materials inspection will help to catch defects before production starts. And remember, a business with quality material inspections is a business that grows.

3.5.2Need for Material Inspection

There are several situations where one wants to be sure, so they carry out a material inspection. Thus, it is important for:

1. Foreign Suppliers

Chances are some of your suppliers are foreign. And many foreign countries simply don't have the same standards we have in North America.

Assuming the raw materials you source from these countries will meet the type of quality standards you have could be a grave mistake. If your organization is in the habit of renegotiating your cost down (and really, who isn't trying to do that), you may set yourself up for a situation where the supplier is can't afford to provide you with their best quality materials or parts.

The money you squeezed out of them has to come from somewhere. If you end up paying the price with unsatisfied customers, material inspections might be worth the time after all.

2. Quality Fade

Never be fooled into thinking it's only your foreign suppliers you need to be prepared for.

Quality fade, sometimes also called quality creep, is something most of us have faced, at least as consumers. We purchase a product that we've been buying for years only to find that it doesn't quite hold up and perform the way it used to.

This is because the manufacturer is either knowingly cutting costs or they've received substandard materials and haven't been doing their own proper materials inspections.

While quality fade is known to be a problem with material sourced internationally, it has been increasing domestically as well.

Over time there is a very subtle but progressive degeneration of quality. If your company isn't diligent about materials quality management you could miss this slow-moving trend toward substandard materials.

3. The Costs

Make no mistake. There will be costs involved when you implement a materials inspection strategy. Time to put in effective inspection protocols and then the time required to perform them isn't free.

However, the money you ultimately save could far outweigh your initial outlay in setting up and implementing your inspection strategy. For example, The Jesse Garant Metrology Center points out that the aerospace industry saves $1,000 for every $1 it spends inspecting for material defects before they make it to the production stage. It's not hard to imagine how even years of non-incidents with inspections can be offset by catching an issue that prevents a large scale disaster.

Clearly, a material inspection is imperative to the quality control process.

3.5.3 Objectives of Inspection

The following are the main **objectives of the Inspection** of materials.

1. To maintain the quality of the product.
2. To receive only the right quantity of materials.
3. To make the supplier efficient and careful.
4. To make right utilization of the money invested.
5. To make the purchase and store staff more watchful and careful.

3.5.4 Advantages of Inspection or Materials

The following are the main **advantages of inspection**:

1. Ensure the right quality helps in maintaining a steady development and a high standard of living.

2. Enhanced goodwill because of high-quality production, that too, at a lower cost since the inspection assures quality production.

3. Procurement of statement items, again affecting favorably the cost curve because of lesser wear and tear and wastage, etc.

4. Increase in profitability.

3.5.5 Certified Off-Site Material Testing

Since material testing is a critical step, it should be noted that in some cases it's not feasible or reliable to have certain materials tested in house. For example, is your facility set up for, and do your local employees have the training to do a complete analysis of chemical components? This could include testing for trace contamination and the process of identifying unknown substances.

If your answer to that is no then you need to have your materials checked and tested at a certified lab that can handle the job.

So understand that there will be circumstances when third-party material inspections are necessary.

The method you use to test and inspect can and may vary by product but inspections will help you verify that your incoming components and materials meet the requirements of your final product.

Methods of component or material testing:

1. Chemical analysis
2. Testing of physical properties and measurements
3. Testing of mechanical properties
4. Regulatory testing

3.5.6 Steps involved in Material Inspection

1. Pre-inspection Steps

Since the materials inspection is also commonly called an inbound or receiving inspection, there are some steps preformed before the actual inspection.

Your receiving department will have its process which will include things like verifying and recording the quantity received, the referencing purchase order number and whether or not the material order is complete.

2. Photos

It's a very good idea to capture photos or videos upon receipt of materials. An easy way to do this is to use a tool such as MaintainX that enables you to capture photos, tag them, and store them within each inspection form.

3. Review Project Specifications

This is a critical step, and it needs to be done before you start your physical inspection. You need to know the set specifications of your project in order to know if the materials you received fall within tolerances. Receiving a part or component—whether it's a piece of metal or a liquid chemical—that falls outside of agreed-upon characteristics should never pass inspection.

Once you know the project specifications the materials are required for, you can confirm whether they comply with the requirements of the contract and purchase order.

4. Physical Condition of Material

How this is handled will clearly depend on the material, and it doesn't necessarily mean you have to eyeball every single piece that was delivered. Have a sampling process where you randomly pull materials and check their physical condition.

Have a set criterion, which if isn't met, means the shipment isn't fit for production.

5. Make & Manufacturer

This is a fairly simple step. Confirm that what you received is from the confirmed manufacturer or trademark holder.

6. Confirm Certifications

If the materials you are receiving should meet certain standards—for example, UL or CSA—make sure they are appropriately marked.

7. Storage Requirements

Assuming your materials have passed inspection, check for any special storage requirements. If so, materials should be marked or tagged appropriately. It may even be wise to include a final photo requirement to show the materials in the place where they need to be – if a shipment of

refrigerated produce arrives cold, but sits in receiving for 24 hours before being stored away properly, that defeats the purpose of the whole inspection.

3.6 Make Or Buy Decision

The make-or-buy decision is the act of making a strategic choice between producing an item internally (in-house) or buying it externally (from an outside supplier). The buy side of the decision also is referred to as outsourcing. Make-or-buy decisions usually arise when a firm that has developed a product or part—or significantly modified a product or part—is having trouble with current suppliers, or has diminishing capacity or changing demand.

Make-or-buy analysis is conducted at the strategic and operational level. Obviously, the strategic level is the more long-range of the two. Variables considered at the strategic level include analysis of the future, as well as the current environment. Issues like government regulation, competing firms, and market trends all have a strategic impact on the make-or-buy decision. Of course, firms should make items that reinforce or are in-line with their core competencies. These are areas in which the firm is strongest and which give the firm a competitive advantage.

The majority of the make or buy decisions are made on the basis of price. But this is only one of the criteria, which is to be evaluated in this strategic decision. Many non cost factors encourage long term contracts with the suppliers to aid in the achievement of production and quality levels and encourage investments in appropriate resources and new ideas.

This results in excellent, mutually beneficial customer-supplier relationships developed over long periods based on trust and achievement of common objectives. Most have the make or buy decisions are complex, time consuming and affect many parts of the organization. Senior management involvement is required in a number of the stages of this strategic decision.

3.6.1 Need of Make or Buy Decision

1. When the organization introduces new products.
2. The fluctuating demand for the company's products.
3. When the organization carries out value analysis or cost reduction programs.
4. Deteriorating quality and delivery commitment of the supplier if presently the item is bought.
5. The scarcity of funds for investment in additional plant and equipment.

3.6.2 Factors Influencing Make or Buy Decision

Following are the factors influencing Make or Buy Decision:

1. Volume of Production:

The quantity or volume of production affects the make or buy decision to the greater extent. If the volume of production is high, it favors the make decision and low volume favors buy decisions.

2. Cost Analysis:

The cost analysis refers to the determination of costs to make an item as well as the cost to buy it. The cost to make include – the material cost, direct lab our cost, set up and tooling up costs, depreciation, administrative overheads, interest, insurance, taxes and inventory carrying costs of raw materials and work in process. The cost to make also includes the appropriate allowances, spoilage of work or scrap, and the risk associated with doing business.

The cost to buy an item should include -purchase price of the item or component, transportation cost, sales tax and octopi, procurement cost, carrying cost, receiving and incoming inspection costs. The analysis of these two costs helps take decision whether to make or buy.

3. Utilization of Production Capacity:

The organization, which has created large production capacity, favors the decision to make

4. Integration of Production System:

The vertical integration favors the make decision where as horizontal integration favors buy decision.

5. Availability of Manpower:

Availability of skilled and competent manpower favors makes decision where as scarce manpower prefers buy decision.

6. Secrecy or Protection of Patent Right:

This condition favors the make decision.

7. Fixed Cost:

A lower fixed cost favors the decision to make and higher fixed cost the make decision.

8. Availability of competent suppliers or vendors:

When competent suppliers are available in the market the firm decides whether it will be feasible to buy some of the production parts from the market or will it be cheaper to make it itself.

9. Quality and reliability of vendors:

As per the quality and reliability of vendors make or buy decision is affected.

3.6.3 Functional Aspects of Make or Buy Decision:

Make or buy decision should be viewed with both long term and short term perspectives in mind. Some of the effects are tangible and others are intangible.

These are classified as follows:

1. Financial aspects
2. Technological Aspects
3. Marketing Aspects
4. Purchasing Aspects
5. Strategic Aspects

1. Financial Aspects:

The make decision is always demands an investment in plant, machineries and equipment. The investments can be categorized in to fixed cost and variable cost. The buy decision is associated with only variable cost. Expressing all factors in to money terms carries out a thorough and comparative analysis. Then the decision is to be taken based on which one is more economical, to make or to buy.

2. Technological Aspects:

The make or buy decision is influenced by:

(a) The access to the latest technology to the organization.
(b) Feasibility and terms and conditions of technology transfer
(c) Outdating of technology
(d) Product life cycle.

3. Marketing Aspects:

The marketing aspects have the influence on make or buy decision. When there is a fierce competition, an organization tries to enhance the quality and cut down the costs. The make decision assures the quality and reliability of the parts. Under the situation of increasing market share and a good future sales potential company can have an additional investment potential and hence can opt for make decision.

When there is a doubt about the market potential, the company should opt for buy decision. The large organizations pay greater attention to quality which favors the make decision to maintain quality and reliability of items.

4. Purchasing Aspects:

The decision is influenced by:

a. The availability of items or components in sufficient quantities

b. The delivery commitments must be reliably met.

c. The acceptable quality and price level of the product

d. Economy in transportation from the source to the organization

e. Competence and reliability of vendors.

5. Strategic Aspects:

Economic and no Economic Factors Influencing Make or Buy Decisions:

Decisions regarding whether to make or buy the components involve both economic and non economic factors. Economically, an item or component is a candidate for in house production, if the company has sufficient capacity and if the components value is high enough to cover the variable costs of production and make some contribution towards the fixed cost. Low volumes favor buying, which incurs very little or no fixed costs. Fig 2.9.shows the relationship between cost factors.

The non-economic factors are:

a. Availability of infrastructure and skilled personnel

b. Desire for alternate sources of supply

c. Employee preferences and stability concerns

d. Need to maintain trade secrets

e. Desire to expand in to new product line

f. Forward or backward integration

g. Long lasting and mutually rewarding relationships with vendors

Test Your Progress

1. Why inspection of material control important. Also state its objectives.

2. State the steps involved in material inspection.

3. What are the factors that influence make or buy decision?

4. What are the functional aspects of make or buy decision?

3.7 Simple Cost Analysis

A simple cost analysis is a process businesses use to analyze decisions. The business or analyst sums the benefits of a situation or action and then subtracts the costs associated with taking that action. Some consultants or analysts also build models to assign a dollar value on intangible items, such as the benefits and costs associated with living in a certain town.

Before building a new plant or taking on a new project, prudent managers conduct a cost-benefit analysis to evaluate all the potential costs and revenues that a company might generate from the project. The outcome of the analysis will determine whether the project is financially feasible or if the company should pursue another project.

By considering all options and the potential missed opportunities, the simple cost analysis is more thorough and allows for better decision-making.

A cost-benefit analysis (CBA) should begin with compiling a comprehensive list of all the costs and benefits associated with the project or decision.

The costs involved in a CBA might include the following:

1. Direct costs would be direct labor involved in manufacturing, inventory, raw materials, manufacturing expenses.
2. Indirect costs might include electricity, overhead costs from management, rent, utilities.
3. Intangible costs of a decision, such as the impact on customers, employees, or delivery times.
4. Opportunity costs such as alternative investments, or buying a plant versus building one.
5. Cost of potential risks such as regulatory risks, competition, and environmental impacts.

3.7.1 Steps of Simple Cost Analysis

These include:

Step One: Calculate All-Inclusive Cost

It is critical for managers to calculate an all-inclusive cost for project analysis. These costs include, but should not be limited to:

Direct Costs

1. Actual capital investment
2. Any change in tax or licensing costs
3. Consulting fees (if applicable)
4. Subscription fees
5. Annual Maintenance Costs

Indirect Costs

1. Initial and ongoing training

2. Changes in space or facility requirements (leasing costs)

3. Labor hours for implementation

4. Changes in utilities rates or transportation costs

5. Other downstream or cross-unit costs

These costs should be calculated at current rates plus projected inflation/expansion costs and collated into a simple cost benefit analysis template.

Step Two: Calculate Benefits

Similar to the cost calculation, it is critical to be all inclusive in your approach to project benefits. A solid cost benefit analysis with a positive material return provides a Return on Investment (ROI) period. Some types of benefits are harder to quantify than others.

Some examples of benefits may be:

1. Increased output

2. Reduced inventory costs

3. Reduced labor cost

4. Reduced supply chain costs

5. Reduced taxes or fees

Step Three: Incorporate Time to the Equation

Cash flow is king in today's business world. The key is collecting the discrete cost and benefit numbers, then place it in a template, generally in a spreadsheet such as Microsoft Excel, and determine the net result on cash flow over time.

3.7.2 Advantages of Simple Cost Analysis

1. Revenue and sales increases from increased production or new product.
2. Intangible benefits, such as improved employee safety and morale, as well as customer satisfaction due to enhanced product offerings or faster delivery.
3. Competitive advantage or market share gained as a result of the decision.

An analyst or project manager should apply a monetary measurement to all of the items on the cost-benefit list, taking special care not to underestimate costs or overestimate benefits. A conservative approach with a conscious effort to avoid any subjective tendencies

whencalculating estimates is best suited when assigning a value to both costs and benefits for a cost-benefit analysis.

Finally, the results of the aggregate costs and benefits should be compared quantitatively to determine if the benefits outweigh the costs. If so, then the rational decision is to go forward with the project. If not, the business should review the project to see if it can make adjustments to either increase benefits or decrease costs to make the project viable. Otherwise, the company should likely avoid the project.

3.7.3 Limitations of Cost-Benefit Analysis

For projects that involve small- to mid-level capital expenditures and are short to intermediate in terms of time to completion, an in-depth cost-benefit analysis may be sufficient enough to make a well-informed, rational decision. For very large projects with a long-term time horizon, a cost-benefit analysis might fail to account for important financial concerns such as inflation, interest rates, varying cash flows, and the present value of money.

Alternative capital budgeting analysis methods, including net present value, could be more appropriate for these situations. The concept of present value states that an amount of money or cash in the present day is worth more than receiving the amount in the future since today's money could be invested and earn income.

One of the benefits of using net present value for deciding on a project is that it uses an alternative rate of return that could be earned if the project had never been done. That return is discounted from the results. In other words, the project needs to earn at least more than the rate of return that could be earned elsewhere or the discount rate.

However, with any type of model used in performing a cost-benefit analysis, there are a significant amount of forecasts built into the models. The forecasts used in any CBA might include future revenue or sales, alternative rates of return, expected costs, and expected future cash flows. If one or two of the forecasts are off, the CBA results would likely be thrown into question, thus highlighting the limitations in performing a cost-benefit analysis.

3.8 Economic Analysis

An economic analysis is a process in which business owners gain a clear picture of the existing economic climate, as it relates to their company’s ability to thrive. Economists, statisticians, and mathematicians often carry out this analysis on behalf of for-profit and nonprofit businesses. These types of economic evaluation consist of an in-depth appraisal of the strengths and weaknesses of the market. An economic analysis isn’t limited to medium or large-sized businesses, it’s valuable for small companies as well. In fact, small businesses probably need to perform economic analysis more often than businesses that have enough built-in capital and resources to sustain an economic downturn. There are several types of

economic evaluation methods business owners can use to gain a comprehensive view of how their companies will fare in the future.

3.8.1 Types of Economic Analysis

The types of Economic Analysis are:

1. Cost/benefit analysis

One of the most effective types of economic evaluation is the cost-benefit analysis, also referred to as a benefit-cost analysis. This is a technique used to determine whether a project or activity is feasible by weighing the monetary cost of doing the project or activity versus the benefits. A cost-benefit analysis will always compare the cost of the effort against the benefits that result from that effort. Because it deals solely in monetary terms, a cost-benefit analysis is one of the most bottom-line types of economic evaluation. It can provide valuable insight in comparing and contrasting work projects, help determine whether an investment opportunity is ideal, and help assess the consequences of implementing changes to your business. However, there is a drawback to this analysis as it is difficult to place a monetary value on some activities such as the benefits of increased public safety versus the cost to increase law enforcement presence in major cities. After performing the cost-benefit analysis, a small business owner can make an educated business decision.

2. Cost/Effectiveness

In a cost-effective analysis, you weigh the effectiveness of a project against its price. Unlike with cost-benefit analysis, however, a low cost doesn't mean high effectiveness, and the reverse is also true. For example, let's say you've determined that installing an automated system that can handle customer orders 24-hours a day, seven days a week, is the cheapest way to boost your incoming orders. After research, however, you determine that many calls that come into the automated system are not complete, because callers hang up when they hear the automated voice on the system. Your market research also indicates that your customers want to speak to a live representative. A cost-effective analysis would tell you that the cheaper route of installing an automated system is not effective in processing more orders. Depending on the type of business you own, you may find that saving money doesn't result in creating a desirable effect on your business.

3. Cost-Minimization Analysis

As the term suggests, cost-minimization analysis focuses on finding the cheapest cost to complete a project. This is one of the economic evaluation methods that business owners use when cost savings are at a premium and outweigh all other considerations. It is also used when there are two or more ways to accomplish the same task. Cost-minimization analysis is most often used in healthcare. For example, drug manufacturers may compare two drugs that have been shown to produce the same effect in patients, or a pharmaceutical company may implement cost-minimization analysis, to determine which of two medications that treat the same illness will cost the least amount of money to produce. In many instances, the generic

equivalent of a name-brand drug is the least expensive drug to manufacture, especially if it produces the same therapeutic effect in patients.

Test Your Progress

1. What are the steps involved in Simple cost analysis?

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2. What do you understand by economic analysis?

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3. Explain the types of economic analysis.

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3.9 Summary

Material Control is a system which ensures required quantity of material of the required quality at the right time and place with minimum investment of capital.

Acceptance of Material Controlis an inspection made when accepting the purchased parts or subcontract goods, including raw materials and parts necessary for production activities, from suppliers.

Sampling is the act, process, or technique of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole populations.

Make-or-buy decision refers to an act of using cost-benefit to **make** a strategic choice between manufacturing a product in-house or **purchasing** from an external supplier. It arises when a producing company faces a diminishing capacity, experiences problems with the current suppliers, or sees changing demand.

Simple Cost Analysis is the process used to measure the benefits of a decision or taking action minus the costs associated with taking that action.

Economic analysis is the study of **economic** systems. It may also be a study of a production process or an industry. The **analysis** aims to determine how effectively the **economy** or something within it is operating. For example, an **economic analysis** of a company focuses mainly on how much profit it is making.

3.10 Test Your Progress

1. What do you understand by material control? What is its scope?
2. What are the requirements of material control?
3. What are the objectives of material control?
4. What is the importance and process of material control?
5. What do you understand by acceptance of material control?
6. What are the components of acceptance of material control?
7. What is sampling of material control?
8. What are the aspects to be considered while carrying out sampling of material control? Also what are the issues that lead to the hazard?
9. What do you understand by Inspection of material control?
10. What is the need and importance of inspection of material control?
11. State the objectives of inspection of material control.
12. What are the steps involved in inspection of material control?
13. What are the advantages and limitations of inspection ofmaterial control?
14. What do you understand by make or buy decision? State its need.
15. What are the factors influencing make or buy decision?
16. What do you understand by simple cost analysis? What are its steps?
17. State the advantages and limitations of simple cost analysis in brief.
18. What do you understand by economic analysis? What are its types?

3.11 Suggested Readings

1. https://accountlearning.com/
2. https://www.playaccounting.com/
3. https://www.accountingnotes.net/
4. https://marketbusinessnews.com/
5. https://www.sciencedirect.com/
6. https://www.yourarticlelibrary.com/
7. https://www.asprova.jp/
8. https://www.getmaintainx.com/
9. https://infodreamgroup.com/
10. https://www.playaccounting.com/
11. https://www.referenceforbusiness.com/
12. https://www.yourarticlelibrary.com/
13. https://www.referenceforbusiness.com/
14. https://www.investopedia.com/
15. https://www.purchasing-procurement-center.com/

UNIT 4 : BREAK EVEN ANALYSIS

Unit Structure

4.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge of Break Even Analysis.
- Completely understand Break Even Point Theory.
- Get an idea Whether To Add Or Drop A Product Line
- Learn about Store Management And Warehousing.
- Understand the concept of Product Explosion.

4.1 Introduction

Starting a business often carries risk. As the saying goes, "You have to spend money to make money."While that's not always true, there is one very effective way to lower your risk: **do a** break-even analysis. A break-even analysis will tell you exactly what you need to do in order to break even and make back your initial investment.

If you run a business—or you're thinking about starting one—you should know how to do a break-even analysis. It's a crucial activity for making important business decisions.

4.2 Break Even Analysis

A break-even analysis is a financial tool which helps a company to determine the stage at which the company, or a new service or a product, will be profitable. In other words, it is a financial calculation for determining the number of products or services a company should sell or provide to cover its costs (particularly fixed costs). Break-even is a situation where an organization is neither making money nor losing money, but all the costs have been covered.

4.2.1 Importance of Break Even Analysis:

1. Starting a new business: To start a new business, a break-even analysis is a must. Not only it helps in deciding whether the idea of starting a new business is viable, but it will force the startup to be realistic about the costs, as well as provide a basis for the pricing strategy.

2. Creating a new product: In the case of an existing business, the company should still peform a break-even analysis before launching a new product—particularly if such a product is going to add a significant expenditure.

3. Changing the business model: If the company is about to the change the business model, like, switching from wholesale business to retail business, then a break-even analysis must be performed. The costs could change considerably and breakeven analysis will help in setting the selling price.

4. Financial Tool: The Break Even Analysis is a handy tool to decide if a company should or should not start producing and selling a product. In addition, you can calculate the **Break Even Point** (BEP), also known as the **critical point**. It is the turnover at which the total revenue would equal the total costs. In that case, the organisation would break even and both the fixed and variable costs will be earned back. If the turnover is lower than the total costs, it's a loss. Everything over this critical point can be booked as profit.

Fig. 4.1: Break Even analysis

4.2.3 Components of Break Even Analysis

1. Fixed costs

Fixed costs are also called overhead costs. These overhead costs occur after the decision to start an economic activity is taken and these costs are directly related to the level of production, but not the quantity of production. Fixed costs include (but are not limited to) interest, taxes, salaries, rent, depreciation costs, labour costs, energy costs etc. These costs are fixed respective of the production. In case of no production also the costs must be incurred.

2. Variable costs

Variable costs are costs that will increase or decrease in direct relation to the production volume. These costs include cost of raw material, packaging cost, fuel and other costs that are directly related to the production.

Illustration:1

Variable costs per unit: Rs. 400 Sale price per unit: Rs. 600 Desired profits: Rs. 4,00,000 Total fixed costs: Rs. 10,00,000.

First we need to calculate the break-even point per unit, so we will divide the Rs.10,00,000 of fixed costs by the Rs. 200 which is the contribution per unit (Rs. 600 – Rs. 200).

Break Even Point = Rs. 10,00,000/ Rs. 200 = 5000 units.

Next, this number of units can be shown in rupees by multiplying the 5,000 units with the selling price of Rs. 600 per unit. We get Break Even Sales at 5000 units x Rs. 600 = Rs. 30,00,000. (Break-even point in rupees)

3. Contribution Margin

Break-even analysis also deals with the contribution margin of a product. The excess between the selling price and total variable costs is known as contribution margin.

Illustration: 2

If the price of a product is Rs.100, total variable costs are Rs. 60 per product and fixed cost is Rs. 25 per product, the contribution margin of the product is Rs. 40 (Rs. 100 – Rs. 60). This Rs. 40 represents the revenue collected to cover the fixed costs. In the calculation of the contribution margin, fixed costs are not considered.

4.2.2Formula for Break Even Analysis

The formula for break-even analysis is as follows:

Break even quantity = Fixed costs / (Sales price per unit – Variable cost per unit)

Where:

- **Fixed costs** are costs that do not change with varying output (e.g., salary, rent, building machinery).
- **Sales price per unit** is the selling price (unit selling price) per unit.
- **Variable cost per unit** is the variable costs incurred to create a unit.

It is also helpful to note that sales price per unit minus variable cost per unit is the contribution margin per unit. For example, if a book's selling price is $100 and its variable costs are $5 to make the book, $95 is the contribution margin per unit and contributes to offsetting the fixed costs.

Calculation of Break-Even Analysis

The basic formula for break-even analysis is derived by dividing the total fixed costs of production by the contribution per unit (price per unit less the variable costs).

Fig. 4.2: Contribution Per Unit Formula

4.2.4Uses of Break Even Analysis

1. It helps to determine remaining/unused capacity of the company once the breakeven is reached. This will help to show the maximum profit on a particular product/service that can be generated.

2. It helps to determine the impact on profit on changing to automation from manual (a fixed cost replaces a variable cost).

3. It helps to determine the change in profits if the price of a product is altered.

4. It helps to determine the amount of losses that could be sustained if there is a sales downturn.

Additionally, break-even analysis is very useful for knowing the overall ability of a business to generate a profit. In the case of a company whose breakeven point is near to the maximum sales level, this signifies that it is nearly impractical for the business to earn a profit even under the best of circumstances.
Therefore, it's the management responsibility to monitor the breakeven point constantly. This monitoring certainly reduces the breakeven point whenever possible.

4.2.5 Strategies to lower your break-even point

What if you complete your break-even analysis and find out that the number of units you need to sell is too high? If the number seems unrealistic or unattainable, don't panic. You may be able to make some adjustments to lower your break-even point.

1. Lower fixed costs

See if there's an opportunity to lower your fixed costs. The lower you can get them, the fewer units you'll need to sell in order to break-even. For example, if you're thinking about opening a

retail store and numbers aren't working out, consider selling online instead. How does that affect your fixed costs?

2. Raise your prices

If you raise your prices, you won't need to sell as many units to break even. The marginal contribution per unit sold will be higher. When thinking about raising your prices, be mindful of what the market is willing to pay, and expectations that come with a price. You won't need to sell as many units, but you'll still need to sell enough—and if you charge more, buyers may expect a better product or better customer service.

3. Lower variable costs

Lowering your variable costs is often the most difficult option, especially if you're just going into business. But the more you scale, the easier it will be to reduce variable costs. It's worth trying to lower your costs by negotiating with your suppliers, changing suppliers, or changing your process. For example, maybe you'll find that packing peanuts are cheaper than bubble wrap for shipping fragile products.

4.2.6Benefits of Break-even analysis

1. Catch missing expenses: When you're thinking about a new business, it's very much possible that you may forget about a few expenses. Therefore, a break-even analysis can help you to review all financial commitments to figure out your break-even point. This analysis certainly restricts the number of surprises down the road or atleast prepares a company for them.

2. Set revenue targets: Once the break-even analysis is complete, you will get to know how much you need to sell to be profitable. This will help you and your sales team to set more concrete sales goals.

3. Make smarter decisions: Entrepreneurs often take decisions in relation to their business based on emotion. Emotion is important i.e. how you feel, though it's not enough. In order to be a successful entrepreneur, decisions should be based on facts.

4. Fund your business: This analysis is a key component in any business plan. It's generally a requirement if you want outsiders to fund your business. In order to fund your business, you have to prove that your plan is viable. Furthermore, if the analysis looks good, you will be comfortable enough to take the burden of various ways of financing.

5. Better Pricing: Finding the break-even point will help in pricing the products better. This tool is highly used for providing the best price of a product that can fetch maximum profit without increasing the existing price.

6. Cover fixed costs: Doing a break-even analysis helps in covering all fixed cost.

4.2.7 Limitations of Break-even analysis

Break-even analysis plays an important role in making business decisions, but it's limited in the type of information it can provide.**Following are the limitations of break-even analysis:**

1. Not a predictor of demand

It's important to note that a break-even analysis is not a predictor of demand. It won't tell you what your sales are going to be, or how many people will want what you're selling. It will only tell you how many units you need to sell in order to break even. It's also important to note that demand isn't stable. As you change your price, the number of people willing to buy your product will change as well.

2. Dependent on reliable data

Sometimes costs fall into both fixed and variable categories. This can make calculations complicated and you'll likely need to wedge them into one or the other. For example, you may have a baseline labour cost no matter what, as well as an additional labour cost top that could fluctuate based on how much product you sell.

The accuracy of your break-even point depends on accurate data. If you don't feed good data into the formula, you won't get a reliable result.

3. Simplistic

The break-even point formula is simplistic. Many businesses have multiple products with multiple prices. It won't be able to pick up that nuance. You'll likely need to work with one product at a time or estimate an average price based on all the products you might sell. If this is the case, it's best to run a few different scenarios to be better prepared.

As prices fluctuate, so do costs. This model assumes that only one thing changes at a time. Instead, if you lower your price and sell more, your variable costs might decrease because you have more buying power or are able to work more efficiently. Ultimately it's only an estimate.

4. Ignores time

The break-even analysis ignores fluctuations over time. The time frame will be dependent on the period you use to calculate fixed costs (monthly is most common). Although you'll see how many units you need to sell over the course of the month, you won't see how things change if

your sales fluctuate week to week, or seasonally over the course of a year. For this, you'll need to rely on good cash flow management, and possibly a solid sales forecast.

It also doesn't take the future into account. Break-even analysis only looks at here and now. If your raw materials cost doubles next year, your break-even point will be a lot of higher unless you raise your prices. If you raise your prices, you could lose customers. This delicate balance is always in flux.

5. Ignores competitors

As a new entrant to the market, you're going to affect competitors and vice versa. They could change their prices, which could affect demand for your product, causing you to change your prices too. If they grow quickly and a raw material you both use becomes more scarce, the cost could go up.
Ultimately, break-even analysis will give you a very solid understanding of the baseline conditions for being successful. It is a must. But it's not the only research you need to do before you starting or making changes to a business.

4.3 Break Even Point Theory

The point at which total of fixed and variable costs of a business becomes equal to its total revenue is known as **break-even point (BEP)**. At this point, a business neither earns any profit nor suffers any loss. Break-even point is therefore also known as no-profit, no-loss point or zero profit point. Calculation of break-even point is important for every business because it tells business owners and managers how much sales are needed to cover all fixed as well as variable expenses of the business or the sales volume after which the business will start generating profit. The computation of sales volume required to break-even is known as *break-even analysis*. The concept explained above can also be presented as follows:

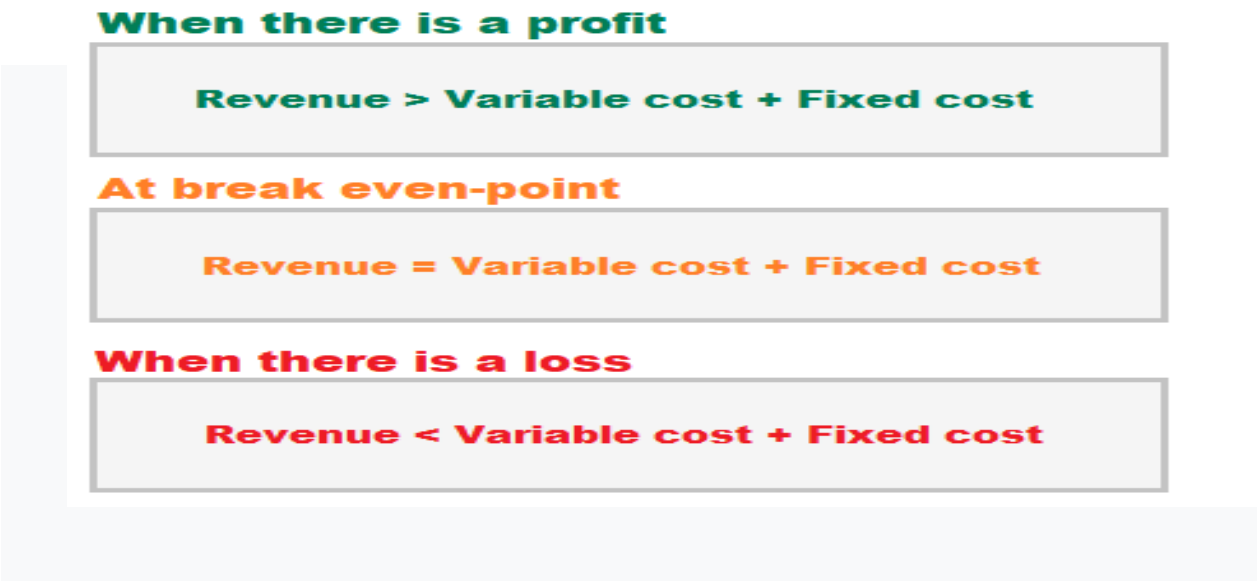

Fig. 4.3: Break Even Point Theory

4.3.1 Calculations for Break-Even Point

In addition to Fixed Costs, Variable Costs, Contribution Margin, there are two more terms to understand:

1. Contribution margin ratio:

This figure, usually expressed as a percentage, is calculated by subtracting your fixed costs from your contribution margin. From there, you can determine what you need to do to break even, like cutting production costs or raising your prices.

2. Profit earned following your break-even:

Once your sales equal your fixed and variable costs, you have reached the break-even point, and the company will report a net profit or loss of $0. Any sales beyond that point contribute to your net profit.

There are a few basic formulas for determining a business's break-even point. One is based on the number of units of product sold and the other is based on points in sales dollars.

So, break-even point (N) is equal

N = Fixed costs / (Price per unit - Variable costs)

- **To calculate a break-even point based on units:** It is also known as Equation Method. Divide fixed costs by the revenue per unit minus the variable cost per unit. The fixed costs are those that do not change no matter how many units are sold. The revenue is the price for which you're selling the product minus the variable costs, like labor and materials.

  Break-even point is the number of units (N) produced which make zero profit.
  Revenue – Total costs = 0
  Total costs = Variable costs * N + Fixed costs
  Revenue = Price per unit * N
  Price per unit * N – (Variable costs * N + Fixed costs) = 0

Break-Even Point (Units) = Fixed Costs ÷ (Revenue per Unit – Variable Cost per Unit)

Or,
Equation Method

Sp × Q = Ve × Q + FeOrSpQ = VeQ + Fe

Where;

Sp = Sales price per unit.
Q = Number (quantity) of units to be manufactured and sold during the period.
Ve = Variable expenses to manufacture and sell a single unit of product.
Fe = Total fixed expenses for the period.

Illustration:3

Suppose, for example, you run a manufacturing business that is involved in manufacturing and selling a single product. The annual fixed expenses to run the business are $15,000 and variable expenses are $7.50 per unit. The sale price of your product is $15 per unit. The number of units to be sold to break even can be easily calculated using equation method:

Sp × Q = Ve × Q + Fe
15 × Q = 7.5 × Q + 15,000
15 Q = 7.5 Q + 15,000
15Q – 7.5Q = 15,000
7.5Q = 15,000
Q = 15,000 / 7.5
Q = 2,000 units

The break-even point in units is 2,000 units and the break-even point in dollars can be computed as follows:

= (2,000 units) × ($15)
= $30,000

- **When determining a break-even point based on sales dollars:** It is also known as Contribution Margin Method.Divide the fixed costs by the contribution margin. The contribution margin is determined by subtracting the variable costs from the price of a product. This amount is then used to cover the fixed costs.

Break-Even Point (sales dollars) = Fixed Costs ÷ Contribution Margin

Contribution Margin = Price of Product – Variable Costs

With same illustration in consideration, under this method, the total fixed expenses are divided by contribution margin per unit. Consider the following computations:

Total fixed expenses/Contribution margin per unit
= 15,000/7.5*
= 2,000 units
or
= (2,000 units) × ($15)
= $30,000

*$15 – $7.5

A little variation of this method is to divide the total fixed expenses by the contribution margin ratio (CM ratio). Doing so results in break-even point in dollars. It is shown below:

Total fixed expenses / Contribution margin ratio
= $15,000 / 0.5*
= $30,000

4.3.2 Graphical Representation of the Break Even Point

The break-even point can be defined as a point where total costs (expenses) and total sales (revenue) are equal. Break-even point can be described as a point where there is no net profit or loss. The firm just "breaks even." Any company which wants to make abnormal profit, desires to have a break-even point. Graphically, it is the point where the total cost and the total revenue curves meet.

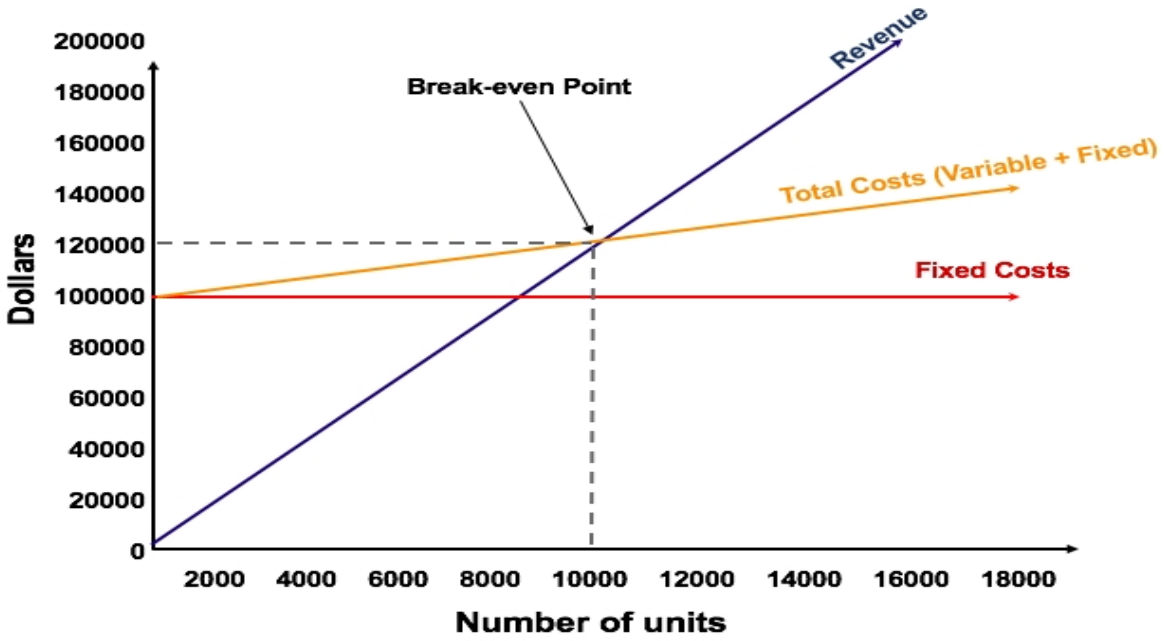

Fig. 4.4: Break Even Point

Explanation:

1. The number of units is on the X-axis (horizontal) and the dollar amount is on the Y-axis (vertical).

2. The red line represents the total fixed costs of $100,000.

3. The blue line represents revenue per unit sold. For example, selling 10,000 units would generate 10,000 x $12 = $120,000 in revenue.

4. The yellow line represents total costs (fixed and variable costs). For example, if the company sells 0 units, then the company would incur $0 in variable costs but $100,000 in fixed costs for total costs of $100,000. If the company sells 10,000 units, the company would incur 10,000 x $2 = $20,000 in variable costs and $100,000 in fixed costs for total costs of $120,000.

5. The break-even point is at 10,000 units. At this point, revenue would be 10,000 x $12 = $120,000 and costs would be 10,000 x 2 = $20,000 in variable costs and $100,000 in fixed costs.

6. When the number of units exceeds 10,000, the company would be making a profit on the units sold. Note that the blue revenue line is greater than the yellow total costs line after 10,000 units are produced. Likewise, if the number of units is below 10,000, the company would be incurring a loss. From 0-9,999 units, the total costs line is above the revenue line.

4.3.3Ways to monitor Break-even point

1. Pricing analysis: Minimize or eliminate the use of coupons or other price reductions offers, since such promotional strategies increase the breakeven point.

2. Technology analysis: Implementing any technology that can enhance the business efficiency, thus increasing capacity with no extra cost.

3. Cost analysis: Reviewing all fixed costs constantly to verify if any can be eliminated can surely help. Also, review the total variable costs to see if they can be eliminated. This analysis will increase the margin and reduce the breakeven point.

4. Margin analysis: Push sales of the highest-margin (high contribution earning) items and pay close attention to product margins, thus reducing the breakeven point.

5. Outsourcing: If an activity consists of a fixed cost, try to outsource such activity (whenever possible), which reduces the breakeven point.

4.3.4 Margin of Safety

If a company's current sales are more than its break-even point, it has a margin of safety equal to current sales minus break-even sales. The **margin of safety** is the amount by which sales can decrease before the company incurs a loss.

A margin of safety (MoS) is a difference between actual/budgeted sales and level of breakeven sales.

For example, assume Videocon Productions currently has sales of USD 120,000 and its break-even sales are USD 100,000. The margin of safety is USD 20,000, computed as follows:

Margin safety = Current sales – Break-even sales

= USD 120,000 – USD 100,000

= USD 20,000

Sometimes people express the margin of safety as a percentage, called the margin of safety rate. The **margin of safety rate** is equal to (Current sales−Break-even sales)Current sales(Current sales−Break-even sales)Current sales. Using the data just presented, we compute the margin of safety rate as follows:

Margin of safety rate = (Current sales−Break-even sales)Current sales(Current sales−Break-even sales)Current sales

(USD 120,000−USD 100,000)USD 120,000=16.67percent(USD 120,000−USD 100,000)USD 120,000=16.67percent

This means that sales volume could drop by 16.67 percent before the company would incur a loss.

Test Your Progress

1. What are the components and importance of break-even analysis?

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2. What is the formula and calculation of break-even analysis? Explain with an example.

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3.What do you understand by margin of safety?

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4. What are the ways to monitor break-even point?

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4.4 Whether To Add Or Drop A Product Line

Add or drop product line is the method which the company uses to evaluate the performance of any product line (segment) before drop any underperform product and focus on the best performing one. Most of the companies are highly likely to drop any product or segment which is not making any profit for the company.

That is right to analyze all products that are making a loss, but it does not mean that we need to stop production of all of them. The products may not have profit, but they generate sales which enables the company to cover the fixed expense. However, if the product sale is less than its variable cost, there is no point to keep producing it.
We need to prepare a proper report of each product revenue and cost, this information must be separate base on the actual situation.

Illustration:4

Company A has three product lines, X, Y, and Z. The performance of all products can be seen below:

Item	X	Y	Z	Total
Sale	**1,00,000**	**70,000**	**1,30,000**	**3,00,000**
Variable Cost	**60,000**	**50,000**	**60,000**	**1,70,000**
Fixed Cost	**20,000**	**30,000**	**40,000**	**90,000**
Net Income	**20,000**	**(10,000)**	**30,000**	**40,000**

The company is considering dropping the product Y which is making lose around $ 10,000 every month.

As the cost accountant, please advise the company if they should drop produce Y.

Solution:

By dropping product Y, we will lose both revenue and variable cost from this product. However, we still need to pay for the fixed cost which is unavoidable. Even the product Y is making losses, but then it still generates contribution $ 20,000 (Sale less variable cost) which will help to cover the fixed cost $ 30,000. Without product Y, the company will lose $ 30,000 due to the fixed cost.

To be clear, we will prepare a report as the comparison below:

	With Y	Without Y
Sale	**3,00,000**	**2,30,000**
Variable Cost	**1,70,000**	**1,20,000**
Fixed Cost	**90,000**	**90,000**

As we can see, If we stop the production of Y, the whole company will decrease its profit as the fixed cost still the same.

Illustration:5

XYZ Company has three product lines. The company is considering dropping Product 2 because it has been operating at a loss. The following summarizes the income of the three product lines.

	Product 1($)	Product 2($)	Product 3($)	Total($)
Sales	**15,000**	**22,000**	**37,000**	**74,000**
Less: Variable Costs	**9,000**	**10,000**	**19,000**	**38,000**
Contribution Margin	**6,000**	**12,000**	**18,000**	**36,000**
Less: Fixed costs				
Traceable	**3,000**	**10,000**	**6,000**	**19,000**
Allocated	**1,000**	**3,500**	**5,000**	**9,500**
Net Income	**2,000**	**(1,500)**	**7,000**	**7,500**

Solution:

The allocated fixed costs should be removed when analyzing segment income. Hence, Product 2 should not be dropped since it has a positive segment margin.

	Product 1($)	Product 2($)	Product 3($)
Sales	**15,000**	**22,000**	**37,000**
Less: Variable Costs	**9,000**	**10,000**	**19,000**
Contribution Margin	**6,000**	**12,000**	**18,000**
Less: Traceable Fixed costs	**3,000**	**10,000**	**6,000**
Segment Income	**3,000**	**2,500**	**12,000**

Why are we removing the **allocated fixed costs** in our analysis? Because the company would still incur the entire allocated fixed costs with or without Product 2. A portion of these costs is actually absorbed by Product 2's segment income. If Product 2 is dropped, it will result in lesser overall profits.

	With Product 2	Without Product 2
Sales	**74,000**	**52,000**
Less: Variable Costs	**38,000**	**28,000**

Contribution Margin	**36,000**	**24,000**
Less: Fixed costs		
Traceable	**19,000**	**9,000**
Allocated	**9,500**	**9,500**
Net Income	**7,500**	**5,500**

The allocated fixed costs are **unavoidable** costs. The entire $9,500 would be incurred with or without Product 2. If Product 2 is dropped, it will result in lower overall net income. Hence, the product line should not be dropped.

4.5Store Management And Warehousing

Store management is concerned with ensuring that all the activities involved in storekeeping and stock control are carried out efficiently and economically by the store personnel. In many cases this also encompasses the recruitment, selection, induction and the training of store personnel, and much more.

4.5.1 Objectives of Stores Management

The Objectives of Stores management play a vital role in the operations of company. It is in direct touch with the user departments in its day-to-day activities. The most important purpose served by the stores is to provide uninterrupted service to the manufacturing divisions. Further, stores are often equated directly with money, as money is locked up in the stores.

4.5.2 FUNCTIONS OF STORES

The functions of stores can be classified as follows:

1. To receive raw materials, components, tools, equipment's and other items and account for them.
2. To provide adequate and proper storage and preservation to the various items.
3. To meet the demands of the consuming departments by proper issues and account for the consumption.
4. To minimize obsolescence, surplus and scrap through proper codification, preservation and handling.
5. To highlight stock accumulation, discrepancies and abnormal consumption and effect control measures.
6. To ensure good house keeping so that material handling, material preservation, stocking, receipt and issue can be done adequately.
7. To assist in verification and provide supporting information for effective purchase action.

4.5.3 Warehousing

Warehousing is the act of organising and controlling everything within your warehouse – and making sure it all runs in the most optimal way possible.
This includes:

- Arranging the warehouse and its inventory.
- Having and maintaining the appropriate equipment.
- Managing new stock coming into the facility.

It is the process of storing inventory in a manner that products are easily traceable in a good condition before they are sent into an order fulfillment cycle or sold or distributed to smaller warehouses or retail brick and mortar stores.

Small retailers or startups with fewer funds may have a room or a storeroom as a warehouse, however, large businesses rent big buildings that are designed to store products.

Poorly-managed warehouses run into a host of problems, all of which impact profitability:

- Disjointed teams and employees
- Inaccessible inventory and equipment
- Counterintuitive and redundant processes
- Rigid and restrained lay-outs that undercut productivity

None of this is good for business. If warehouse operations aren't in order, it becomes near-impossible to serve customers, vendors, and your own organization. Smart warehouse management, particularly the right warehouse management software (WMS), lets you do more while working less.
In saving time, money, and energy, you can reinvest these resources into spurring your business to further growth. Throughout this guide, we'll take a close look at everything that goes into effective warehouse management. Before we get ahead of ourselves, though, let's spell out some of the basics first.

4.5.4 Warehouse Management benefits

It benefits in:

1. Organize warehouse space

2. Manage inventory

3. Make transportation management easier

4. Improve warehouse performance

5. Apply better warehousing logistics

4.6 Process Explosion and Requirements Explosion

Below are the detailed information related to process explosion and requirements explosion:

4.6.1 Process Explosion

In MRP, an order by item (what, by when, how many/much) is generated by obtaining the item data using Bill of Materials according to the production plan. At this point, a concept of process does not still exist. But an object is, actually, produced through a number of processes. It is called Process Explosion to refer to Routings (Bill of Operation), take the manufacturing order to processes, and then issue an operation order by process. By performing the Process Explosion, the necessary processes to produce an item, the order for performing them, the labor hours in each process, and etc. are fixed. Process Explosion is the first function of the manufacturing process control, and based on the operation order issued at this point, loading or leveling is performed.

4.6.1 Requirements Explosion

It is a MRP's function to calculate the requirements of each item by exploring the issued order to its child orders, referring to the bill of materials. The Requirements Explosion has mainly two functions: Single Level Explosion and Extraction. The former function is to calculate the requirements of the child item along with its parts" explosion, and to enter the result in items in the ascending order of level code. Meanwhile the latter function is to extract items in the descending order of level code. These functions operate along with each other as a pair and perform each explosion level by level using level table and activity chain.

Test Your Progress

1. What are the objective and functions of store management?

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2. What do you understand by process explosion?

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3. Explain the concept of warehousing.

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4.7Summary

Break-even analysis is a technique widely used by production management and management accountants. It is based on categorizing production costs between those which are "variable" (costs that change when the production output changes) and those that are "fixed" (costs not directly related to the volume of production).

The Break-even point can be considered as the point in time when revenue forecasts are exactly equal to the estimated total costs. This is where a company's losses end and its profits start to accumulate. At this point, a project, product or business is financially viable.

A decision **whether** or not to continue an old **product line** or department, or to start a new one is called an **add-or-drop** decision. An **add-or-drop** decision must be based only on relevant information. Relevant information includes the revenues and costs which are directly related to a **product line** or department.

Store management is concerned with ensuring that all the activities involved in storekeeping and stock control are carried out efficiently and economically by the **store** personnel. In many cases this also encompasses the recruitment, selection, induction and the training of **store** personnel, and much more.

Warehousing is the process of storing inventory in a manner that products are easily traceable in a good condition before they are sent into an order fulfillment cycle or sold or distributed to smaller warehouses or retail brick and mortar stores.

Small retailers or startups with fewer funds may have a room or a storeroom as a warehouse, however, large businesses rent big buildings that are designed to store products.

Process Explosion is the first function of the manufacturing process control, and based on the operation order issued at this point, loading or leveling is performed.

4.8Test Your Progress

1. Define:

a. Break-even analysis.

b. Break-even point theory.

c. Store Management.

d. Warehousing.

e. Process Explosion.

2. What is the importance of break-even analysis?

3. What are the components of break-even analysis?

4. Explain the formula and calculation of break-even analysis with an example.

5. Explain the benefits and limitations of Break-even analysis.

6. Given:

Variable Costs = INR 400

Selling Price per unit = INR 600

Desired Profit = INR 4,00,000

Fixed Costs = INR 1,000,000

Calculate :

a. Break-even cost.
b. Total Sales.
c. Contribution Per Unit.
d. Units required to achieve break-even.

7. Briefly give explanation of uses and strategies to lower break-even point.

8. What is break-even point theory? How is it calculated?

9. Give a graphical representation of break- even point theory.

10. What are the ways to monitor break-even point theory?

11. ABC Company calculates that its fixed costs consist of executives' salaries, depreciation of its assets, property taxes and its lease. The company's fixed costs of production of its main product, the widget, add up to $60,000. There are also variable costs involved in the production of the widget, including factory labor, raw materials and sales commissions. The company

calculates that these variable costs add up to 80 cents per widget. Each unit is sold at $2. Calculate the break-even point.

12. What do you understand by:

a. Stores Management

b. Warehousing

c. Process Explosion

d. Requirements Explosion.

13. What are the objectives and functions of stores management?

14. What does it mean when a business plans to continue a product line or not?

15. Give an example to explain how does a business decides to continue or discontinue a product.

16. The Noor enterprises, a single product company, provide you the following data for the Month of June 2015.

Sales (3,500 units @ $20/unit): $70,000
Contribution margin per unit: $12
Total fixed expenses for the month: $15,000

There was no opening and closing finished goods inventory in stock.

Calculate break-even point in units and in dollars and margin of safety for Noor enterprises using above data.

Also draw a CVP graph and show the sales volume representing break-even point and margin of safety on the graph.

Answers:

6A. Break even cost = INR 5,000

6B. Total Sales = INR 3,000,000

6C. Contribution per unit = INR 200

6D. Units required to achieve break-even= 5,000 units.

11. 50,000 units.

16. Break-even point in units: 1,250 units

Break even point in dollars: $25,000

Margin of safety in dollars: $45,000

4.9Suggested Readings

1. https://www.shopify.in/
2. https://www.asprova.jp/
3. https://corporatefinanceinstitute.com/
4. https://www.investopedia.com/
5. https://www.shopify.in/'
6. https://www.tutor2u.net/
7. https://www.wisdomjobs.com/
8. https://app.croneri.co.uk/
9. https://www.patriotsoftware.com/
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11. https://courses.lumenlearning.com/
12. https://www.bankrate.com/
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14. https://accountinguide.com/
15. https://courses.lumenlearning.com/
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Block II :Purchasing Decisions and Research

In **Block II**you will learn about purchasing, importance of a good purchasing system, organization of purchasing functions, purchase policy and procedures, responsibility and limitations material planning. You will also see how purchasing decisions play a role in development of new product. Besides this you will also learn about purchasing research, identification of right sources of supply and developing new source of supply in detail.

In **Unit 5** you will learn about Purchasing: Importance Of Good Purchasing System, Organization Of Purchasing Functions, Purchase Policy And Procedures, Responsibility And Limitations.

In **Unit 6** you will gather extensive information about Purchasing Decisions, Purchasing Role In New Product Development, Role Of Purchasing In Cost Reduction, Negotiations And Purchase.

In **Unit 7** students will get a deep understanding about Purchasing Research: Identification Of Right Sources Of Supply, Vendor Rating, Standardization, Vendor Certification Plans, Vendor And Supply Reliability, Developing New Source Of Supply.

UNIT 5 :PURCHASING

Unit Structure

5.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofpurchasing.
- Completely understandimportance of a good purchasing system.
- Get an idea of organization of purchasing functions.
- Get knowledge ofpurchase policy and procedures.
- Understandresponsibility of purchase policy.
- Learn aboutlimitations of purchase policy.

5.1 Introduction

Purchasing is the process a business or organization uses to acquire goods or services to accomplish its goals. Although there are several organizations that attempt to set standards in the purchasing process, processes can vary greatly between organizations.

Purchasing is part of the wider procurement process, which typically also includes expediting, supplier quality, transportation, and logistics.

Purchasing managers/directors, and procurement managers/directors guide the organization's acquisition procedures and standards. Most organizations use a three-way check as the foundation of their purchasing programs[citation needed]. This involves three departments in the organization completing separate parts of the acquisition process. The three departments do not all report to the same senior manager, to prevent unethical practices and lend credibility to the process. These departments can be purchasing, receiving and accounts payable; or engineering, purchasing and accounts payable; or a plant manager, purchasing and accounts payable. Combinations can vary significantly, but a purchasing department and accounts payable are usually two of the three departments involved.

5.2 Purchasing

A purchasing system is a process for buying products and services encompassing purchase from requisition and purchase order through product receipt and payment. Purchasing systems are a key component of effective inventory management in that they monitor existing stock and help companies determine what to buy, how much to buy and when to buy it. Purchasing systems may be based on economic order quantity models.

A purchasing system is essentially a set of processes a business can use to acquire goods and services for the company. Purchasing system software can help streamline the following:

- Placing purchase orders
- Managing orders and invoices
- Keeping a list of suppliers
- Forecasting future spending
- Finding purchase information (e.g., date of purchase and cost)
- Updating inventory stock levels
- Maintaining accurate records of purchases

More complex purchasing systems may even have the capability of automatically ordering needed inventory, managing supplier contracts, and integrating with your basic accounting software to record transactions.

5.2.1 Objectives of Purchasing

The purchasing objective is sometimes understood as buying materials of the right quality, in the right quantity, at the right time, at the right price, and from the right source. This is a broad generalisation, indicating the scope of purchasing function, which involves policy decisions and analysis of various alternative possibilities prior to their act of purchase.

Some objectives of purchasing are:

1. To pay reasonably low prices for the best values obtainable, negotiating and executing all company commitments.

2. To keep inventories as low as is consistent with maintaining production.

3. To develop satisfactory sources of supply and maintain good relations with them.

4. To secure good vendor performance including prompt deliveries and acceptable quality.

5. To locate new materials or products as required.

6. To develop good procedures, together with adequate controls and purchasing policy.

7. To implement such programmes as value analysis, cost analysis, and make-or-buy to reduce cost of purchases.

8. To secure high caliber personnel and allow each to develop to his maximum ability.

9. To maintain as economical a department as is possible, commensurate with good performance.

10. To keep top management informed of material development which could affect company profit or performance.

11. To achieve a high degree of co-operation and co-ordination with other departments in the organisation.

5.2.2 Importance of Purchasing:

1. Purchasing function provides materials to the factory without which wheels of machines cannot move.

2. A one percent saving in materials cost is equivalent to a 10 percent increase in turnover. Efficient buying can achieve this.

3. Purchasing manager is the custodian of his firm's is purse as he spends more than 50 per cent of his company's earnings on purchases.

Increasing proportion of one's requirements are now bought instead of being made as was the practice in the earlier days. Buying, therefore, assumes significance.

5. Purchasing can contribute to import substitution and save foreign exchange.

6. Purchasing is the main factor in timely execution of industrial projects.

7. Materials management organisations that exist now have evolved out or purchasing departments.

8. Other factors are:

(i) Post-war shortages,
(ii) Cyclical swings of surpluses and shortages and the fast rising materials costs,
(iii) heavy competition, and
(iv) Growing worldwide markets have contributed to the importance of purchasing.

5.2.3 Steps of Purchasing Process

Traditionally, the purchasing process is a cycle, with each step requiring the exchange of information and various approvals to move forward. Every business will have its own unique touches to add, but generally speaking, the purchasing process follows a well-established pattern of events.

Fig.5.1: Steps of Purchasing Process

1. Needs Analysis

At this stage, the company recognizes and documents a need for goods or services to solve a particular problem. The procurement team describes the need to be met, and works with others to determine how best to do so. For example, a company facing high travel expenses might invest in more fuel-efficient company transportation for its sales staff, or reduce the amount of travel required for remote employees by investing in advanced telecommunication software.

2. Purchase Requisition to Purchase Order

The "purchasing" portion of the purchasing process kicks off with a purchase requisition submitted to the purchasing department or purchasing manager by the individual, team, or department requesting the goods or services. The purchase requisition contains full details on the items or services to be obtained.

Purchase requests below established budget thresholds are automatically updated to purchase orders, and submitted to the preferred supplier for that item or service. More expensive purchases, or unexpected purchases not in the budget, will be forwarded to the appropriate individuals for review and approval before they can be transferred to POs.

Rejected purchase requisitions are returned to the issuing party for review and correction or clarification as needed.

3. Purchase Order Review and Approval

Approved purchase orders are sent to accounting to verify the funds exist in the appropriate budget to cover the requested goods and services.

4. Requests for Proposal

POs that receive budget approval are returned to the procurement department and, as required, used to create *requests for proposal* (RFPs), also known as *requests for quotation*, or *RFQ*s. These are dispatched to vendors to solicit bids to fulfill the order for goods or services.

Potential suppliers submit their bids, and are carefully reviewed based on their performance history, compliance records, and important characteristics such as average lead times, reputation, and price.

5. Contract Negotiation and Approval

The vendor with the winning bid is then awarded a contract, which is further refined before signing to ensure optimal terms and conditions and to ensure a mutually satisfactory arrangement for both parties.

Once the contract is signed, the purchase order is a legally binding agreement between buyer and seller.

6. Shipping and Receiving

The supplier delivers the goods or services within the agreed-upon timeframe. Once they've been received (in the case of goods) or performed (in the case of services), the purchaser carefully reviews the goods and services to ensure they've received what was promised, and notifies the vendor of any issues.

7. Three-Way Matching

A cornerstone of spend management, three-way-matching is the comparison of shipping documents/packing slips with the original purchase order and the invoice issued by the supplier. This comparison is used to ensure all the information related to the transaction is accurate.

Discrepancies must be rectified as soon as possible to avoid additional charges, delays in production and payment, or damage to supplier relationships.

8. Invoice Approval and Payment
Successfully matched orders are approved for payment. Any modifications or additional charges may require another layer of approvals before payment can be issued. Once approved, payment is issued to the vendor. Ideally, such payments are made with the goal of capturing early payment discounts and other incentives while avoiding late payment fees.

9. Accounting Records Update
Completed orders are recorded in the company's books, and all documents related to the transaction are securely stored in a centralized location.

5.3 Importance of Good Purchasing System

A good purchasing system keeps a concern going smoothly. Thus, it holds a very important place in any concern.

5.3.1 Purpose of purchasing system

There are many perks of purchasing systems that small businesses can take advantage of. For starters, purchasing systems can make the purchasing process much easier and more efficient for businesses. Not to mention, purchasing systems can help reduce supply costs and prevent inventory shrinkage.

An online purchasing system can cut down costs, shorten the length of the purchase cycle, and help reduce human errors. Additionally, purchasing system reports can make it easier to manage your inventory budget and forecast what supplies you need for the future.

Overall, purchasing systems can play a huge role in controlling what your business spends on goods and services. Purchasing systems can help you:

- Ensure that you only make necessary purchases
- Make sure you're paying reasonable prices on goods and services
- Better budget for goods and services

5.3.2 Types of purchasing systems

The type of purchasing system you get for your business depends on the data you need to record and track. Here are some types of purchasing systems you may want to look into for your company:

1. Forward Buying:
This is not to be confused with speculative buying. This special purchasing system commits an organization far into the future, usually for a year. The terms of such a forward buying depend

upon the availability of the materials, the financial policies, the economic order quantity, the quantitative discounts and the staggered delivery.

2. Tender Buying:
This type of special buying is undertaken generally by the government departments and public sector undertakings to avoid favouritism and corruption.

Sealed tenders are accepted and opened by the authorized personnel and the lowest tender is accepted provided other things are alright. The process of such a buying, therefore, consists of establishing a bidder's list, soliciting bids, evaluating bids by comparing quotation and placement of the order with the lowest bidder.

Public sector generally invite tender through advertisements in the news dailies but private organizations only buy from established suppliers.

3. Blanket Order:
It is an agreement for a required quantity of specified items, over a period of time -at an agreed price. This economizes expenses and relieves the buyer from routine work. It also reduces clerical work because of fewer purchase orders.
The blanket order purchasing system provides for grouping of the requirement and avails of lower prices through quantity discounts. The supplier, too, is benefited. He does not incur selling costs.

4. Zero Stock System:
This system functions on the basis of zero stock and the stock is held by the supplier for the firms. A huge amount of capital is not locked up under this system but the buyer has to pay a slightly higher price because of inventory carrying cost included of the price. Other benefits derived are significant reduction of obsolescence of inventory, lead time and clerical efforts in paper work.
The supplier, too, benefits by having more time to devote to marketing work for other buyers. Production scheduling also becomes easy.

5. Rate Contract System:
It is generally followed by the public sector undertakings and government departments. Usually the suppliers advertise that they are on 'rate contract' with the DGS & D for the specific period. This system helps organizations to save prices by cutting down the internal administrative lead time.

For prompt delivery, suppliers usually demand higher prices and to avoid this difficultly, a minimum quantity at the agreed rates is ensured. This is known as running contract.

6. Reciprocity:
This means purchasing from one's customers in preference to others.
The principals involved are **"if you kill my cat, I will kill your dog,"** and **"Do unto your customers as you would have them do unto you."** Other things being equal, reciprocity principles hold good. In this buying system, there is the scope and possibility for the less

efficient manufactures and distribution to gain if the purchasing executive indulges in reciprocity on his initiative even with the supplier on such terms and conditions that are not equal with other suppliers. Reciprocity buying should be resorted to only on selective basis as it discourages competition and leads to higher prices and fewer suppliers.

7. System Contract:
In this system, the original indent is shipped back with the items. It is invariably a simple contract. It avoids the usual documents like purchase orders, materials requisitions, expediting letters and acknowledgment, goods in words report etc..

The administrative expenses of both the buyer and the seller are reduced and at the same time suitable contracts are ensured. Such a contract system covers only the devilry period, price and invoicing procedure. In such a system buyers are relived of the routine work.

5.3.3Qualities of a Good Purchasing System

If you plan on using a good purchasing system for inventory management, do your homework beforehand. Research various purchasing systems and compare your options to find one that is the best fit for your business.

When you're on the hunt for a good purchasing system, consider the following:

- Type of system you need (e.g., blanket order)
- Features
- Cost and fees
- Contracts
- Flexibility (e.g., can use on-the-go)
- Ease-of-use
- Software or system security

5.3.4 Importance of a good purchasing system

A good purchasing system is important because it caters the following:

1. Controlling the costs
The purchasing management has to analyze and decide the best suppliers as per the quality of products and most reasonable cost. They also review many other factors like if the vendor or supplier can guarantee timely shipments, what's their reputation in the industry and relevant experience. Changing the vendors again and again is expensive; therefore, finding the best and reliable vendor is very important for controlling costs.

Stabilizing the prices
Another important role that purchasing management has to achieve price stability. In case the production cost goes up and down, other functions face roadblocks. For example, the marketing function gets confused about what price should be charged to the customers, the finance department faces problem in calculating profits and the accounts cannot gauge the company's cash flow. Purchasing managers are the ones who are responsible for stabilizing the production

cost by negotiating with suppliers and making long contracts for mutual benefit. They also hedge some items with banks in the form of a forward contract.

Supply Chain Management
Buyers also ensure that the material or supplies are received on time and are of the expected quality. In case the shipment is delayed or is not of the expected standard, it would affect the complete production chain. Hence, this function is of utmost importance across all industries.

Customer Satisfaction
Wondering how purchasing department is related to customer satisfaction? Purchase management is responsible for customer satisfaction in the following ways: working towards the best quality of the products and ensuring on-time deliveries. When the purchase department opts for highest quality of supplies or ingredients at reasonable costs, it results in cost savings, which are further passed on to the customers. Therefore, purchasing management has a critical role to play in customer's experience with the final products and the organization.

Test Your Progress

1. List the Qualities of a Good Purchasing System.

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2. Explain in brief the types of purchasing functions.

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3. What do you understand by Purchase Policy and Procedures? What are its objectives?

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4. What are the responsibilities of purchase functions?

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5. What are the objectives and importance of purchasing?Explain in brief.

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5.4 Organization of Purchasing Functions

For any organization to function properly and smoothly it is essential to have an organized system. In the same way it is important to organize all the purchasing functions well. A superintendent is appointed in an organization to look after this work.
The superintendent shall organize the purchasing function in a manner intended to meet the purchasing goals of the board. The purchasing function includes the following responsibilities:

1. Making purchases for all departments in accordance with applicable laws and regulations, including the requirements of the State Division of Purchase and Contract when applicable, board policy, the superintendent's directives, good purchasing practices and ethical principles;

2. Establishing and enforcing a system for approving and accounting for purchases;

3. Maintaining appropriate records on price quotations of supplies most frequently purchased;

4. Maintaining other supplemental data to assist in making purchases at the most economical prices possible;

5. Maintaining NC E-Procurement compliance and making purchases through the E-Procurement Service to the extent appropriate to maximize savings and efficiency in the purchasing function;

6. Establishing a practical degree of standardization of equipment, supplies and materials with sufficient flexibility to meet unique needs of schools and departments;

7. Operating a central inventory warehouse;

8. Supervising the receiving of all materials, including establishing procedures to ensure received goods are properly inspected, counted and documented;

9. Maintaining lists of potential bidders for various types of materials, equipment and supplies;

10. Providing information regarding bidding opportunities to vendors;

11. Providing information and service to schools and departments that wish to make purchases;

12. Maintaining current information on all applicable laws, regulations, board policies and administrative procedures.

5.5 Purchase Policy and Procedures

The most important activity of materials management is the purchase policy of an organisation. There are different systems available to the purchase. The system to be adopted depends on a number of factors, viz., demand, supply, price, vendor, type of material, consumption pattern,

organisational set up, past precedents, procedures, decision making, spares and seasonal commodities, etc.

Purchasing policy removes the ambiguity around purchasing products and services from your vendors.

When you are a small company, purchasing activity is performed by very few employees. So you already have shared norms and you probably don't need a written policy.

However, as the company grows from a few employees to a large number of employees or to multiple locations, this approach doesn't work.

As the company continues to grow, these individual policies become the new norm and it becomes difficult if not impossible to consolidate these into one cohesive policy.

Having a purchasing policy from start affords you the opportunity to establish a standard set of guidelines across the different locations.

As you scale the operations, you can update the purchasing policy to accommodate any specific requirements for a location.

5.5.1 Objectives of a Purchase Policy

The objective of the purchase policy should be to purchase the required material in the right quantity from right source at the right time and price, to obtain the maximum advantage from the amount invested in the purchases.

The organisation's Purchasing Policy exists for a number of discrete but often interconnected purposes. These objectives are listed below, and are reflected in the detailed Procedures that follow. The Policy commits the organisation, and every individual involved in purchasing and supply management processes within the organisation, to use their best endeavours to ensure that our purchasing and contracting activities are:

- legal
- accountable and auditable
- ethically, environmentally and socially responsible
- economically effective
- conducive to maintaining the organisation's ability to exploit appropriate technological, commercial and organisational developments as they arise
- capable of identifying, minimising and managing risks that may threaten the supply chain or the wider organization
- open to continuous improvement and development, in particular by the training, development and support of staff.

5.5.2 Procedures of Purchase Policy

Purchasing policy is not just for your employees but it also provides standard guidelines for your suppliers on how to engage with your company.
If there is no purchasing policy, there are no guidelines for your suppliers.
If you are using a purchasing system then a purchasing policy can help drive adoption for that system.

1. The objective of the purchasing policy

Keep the objective simple. You should cover the why and scope of the purchasing policy.The role of the purchasing policy is to define standard methods and procedures for the Company to purchase products and services from different vendors. This policy covers all expenses for the company including items like taxes, payroll payments, etc.

2. Role of purchasing department

The purchasing policy is not the only document where you should talk about the role of the procurement or purchasing department. But certainly doesn't hurt to talk about the role of purchasing in your company.

3. Vendor setup and onboarding process

The intent of this section is to communicate to the company regarding the vendor setup and onboarding process.

4. Contract signing authority

The intent of this section is to define two things

a) who can sign a contract and commit the company on behalf of the organization.

b) Are there different levels or individuals who can sign contracts based on the total contract value (TCV).

5. Purchasing authority levels

Purchasing authority levels specify what amount is authorized at what level of the organization before the payment can be made to the supplier. This is applicable to both purchase orders and other expenses / Invoice payments (without a purchase order).

6. Delegation of authority

The intent of Delegation of authority is to define a process for an approver to delegate their approval authority levels to someone else.

A delegation of authority can be temporary – for example, someone is on vacation, or it could be a permanent delegation of authority, for example, an executive permanently delegates the approval authority to her executive admin.

7. Purchasing process and accepted norms

This section is an opportunity for you to define a standard purchasing process you would like your employees to follow.

Things which should be covered in this section

- Requisition process
- Process for approval
- Purchase order process
- Blanket purchase orders

8. Invoices and accepted norms

This section defines how the company is going to accept the invoices from the vendors.

9. Competitive Bidding

Simply put competitive bidding is the process to get bids from different suppliers so that you can pick up the best deal for your company. Best a deal doesn't always mean the lowest price. The best deal or best value means the product or service which meets your expectations at the lowest value possible.

10. Ethical purchasing and conflict of Interest

This is an important topic and you should not only spend time adding this to your purchasing policy but also ensure that you are often communicating this to your stakeholders and purchasing department.

11. Supplier diversity

Supplier diversity is not a good corporate practice but it is also a way for your company to improve the community in which you live.

12. Record retention

This may or may not be a part of the purchasing policy document at your company because certain companies maintain a separate document retention policy that covers all documents across the board.

5.5.3 Types of Purchase Policy

Generally, the following purchasing policies are adopted in an industrial enterprise according to specific requirements and prevalent market conditions;

1. Conservative buying policy

Under this policy, purchases are made **strictly on the basis of current needs** of Industrial concerns. Small lot purchases are made through small and frequent orders, of course, the buyer has to sacrifice quantity discount. But he incurs minimum risk of loss, when he adopts this policy of hand-to-mouth purchases.

A conservative buying policy is obviously suitable and always preferable when there are plenty of materials available in the market or when prices are falling i.e., in a buyer's market. When the stock position in the near future is expected to be quite satisfactory, the manufacturer can follow this hand-to-mouth policy of buying with advantage.

2. Concentrated buying policy

The number of sources on which a manufacturer may depend for has supplies may be very few or limited. It is called concentrated buying policy. Such policy offers the following benefits:

- Patronage given to a limited number of suppliers will enable the buyer to secure the status of a privileged customer even in a rising market and to get better services, special treatment, prompt delivery, reasonable prices etc.
- Reduction in the cost of contractual function — efforts in searching sources of suppliers and maintaining contacts with them — is possible.
- Large orders on a few suppliers yields the benefit of lower prices and quantity discounts. Bulk purchases reduce cost of handling and transport per unit of purchases.

3. Diversified Buying policy

Under this policy, instead of depending on one source of supply, purchases are made from a large number of sources. This policy is also known as **scattered buying policy**.

4. Reciprocal buying policy

It is a good policy to place an order with the seller who is the customer of the firm. For example, a sugar factory agrees to buy sugarcane from a farmers' cooperative society, provided the society also agrees to buy sugar from the sugar factory.

Reciprocity is industry's version of "*you scratch my back and I will scratch yours*". Reciprocal buying, "*If you buy from me, I buy from you*" provides a return consideration wherever possible and it helps to build connections and goodwill. A careful buyer can get better quality at a reasonable price. It may increase sales and simplify purchasing.
However, such a policy may reduce the choice of suppliers. He may have to buy at higher prices and under unfavorable terms. In short, reciprocal buying should be limited and not widespread. The gains from such a policy should be more than the losses. The main limitation of this policy is that it puts a premium on inefficiency of both buyers and suppliers.

Test Your Progress

1. List the procedures of purchase policy.

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2. List the types of Purchase policy.

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3. What do you understand by Purchase Policy and Procedures? What are its objectives?

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4. What are the responsibilities of purchase functions?

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5.6 Responsibility of Purchase Policy

The purchasing function is usually performed most economically and efficiently by a specialised, centralized purchasing department, directed by a skilled purchasing manager. And he is the one responsible for carrying out responsibilities of a purchase policy.

Following are the responsibilities of a purchase policy:

1. Receiving indents:

The first and foremost function of purchasing is receiving demand/requisition of material from different departments of the organisation, such as from production, stores, maintenance, administrative, drawing office, planning, tool room, packing, painting, heat treatment etc.

After receiving the indent from users' departments it examines in details and takes action according to the need and urgency of any item. This is called 'recognition of need'.

2. Assessment of demand or description of need:

After recognising the need with appropriate description, i.e., qualitative as well as quantitative, is necessary for the sound and successful purchasing. An improperly described demand can cost heavily money-wise as well as time-wise.

3. Selection of sources of supply:

Most important function of a purchasing department or officer is the selection of the sources for the requisitioned items of stores. There are different sources of supply which have no similarity between them.

4. Receiving of quotation:

As soon as the purchase requisition is received in the purchase division, sources of supply will be located; a decision is then taken in respect of the method of tendering/limitation of quotations from prospective suppliers.

Prices are also ascertained by preparing a comparative statement with the help of either of the following documents supplied either by the supplier or taken from the previous records of advertisements, like:

(a) Catalogues, price lists etc.
(b) Telephonic quotations.
(c) Previous purchase records.
(d) Quotation letter or tender i.e., letter of inquiry.
(e) Sample and related price cards.
(f) Negotiation between suppliers and the purchase department like catalogue, price lists etc.

5. Placing order:

Placing a purchase order is the next function of purchasing officer. Since purchase order is a legal binding between the two parties, it should always be accurate, clear and acceptable to both.

6. Making delivery at the proper time by following up the orders:

Every purchasing department has the responsibility for follow-up of the orders it places on different suppliers. All items do not require extensive follow-up. For some less important and low value items follow-up would be costly and wastage of money and time only.

7. Verification of invoices:

In normal course, it is also the responsibility of purchase department to check the invoices and accordingly advise the accounts department for clearing the payment to the parties concerned. Contradictory statements have been given as to who should be assigned this function.

8. Inspection of incoming materials:

The purchasing department should have a close contact with inspection department. On receipt of the materials from different suppliers, they are to be inspected as per specifications indicated in the purchase order to verify their quality and quantity.

9. Meeting transport requirements of incoming and outgoing materials:

The purchasing officer must make goods/materials available at the right time they are required, at the place they are needed, and at the lowest possible cost. It is a big responsibility, and even a slight error amounts to delay in consignment required at a particular time.

10. Maintaining purchasing records and files:

Purchasing involves a lot of paper work. Daily a number of letters, bills, quotations, notes, challans, railway receipts, parcel, way bills, bills of ladings, goods received notes, lorry receipt, goods receipt (transport delivery notes), inspection notes have to be dealt with. It involves a lot of clerical work.

11. Reporting to top management:

It is also an important function of the purchasing department to prepare weekly, monthly, quarterly, bi-annually and yearly reports regarding expenditures of this department and send the same to top management along with details of purchases made and suggestions or improvements, if any.

12. Developing coordination among departments:

A purchasing department has to fulfill the needs of other departments in the organisation. It is the function of purchasing department to work in close coordination and cooperation with other departments of the company.

13. Creating goodwill of the organisation in the eyes of the suppliers:

Good vendor relationship has to be maintained and developed to reflect enterprise's image and goodwill. Maintaining such relations requires mutual trust and confidence which grows out of dealings between the two parties over a period of time. Worth of a purchasing department can be measured by the amount of goodwill it has with its vendors.

5.7 Benefits and Limitations of Purchase Policy

Following are the benefits and limitations of purchase policy:

5.7.1 Benefits of a Purchasing policy

This image shows all the benefits of a purchasing policy.

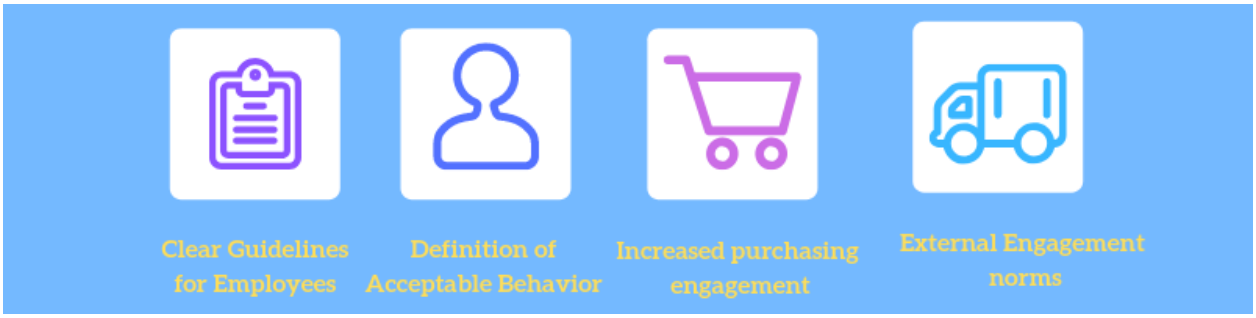

Fig. 5.2: Benefits of Purchase Policy

Besides this, having written and implied policies is an opportunity to define and clarify top management objectives. Policy statements are a means for executive management to communicate its leadership and views.

Executive management should develop a series of high-level policy statements that provide guidance to employees at all levels.

Another advantage is that policies provide a framework for consistent decision making and action. In fact, one of the primary objectives of a policy is to ensure that personnel act in a manner consistent with executive or functional management's expectations. Finally, an effective policy provides an additional advantage by defining the rules and procedures that apply to all employees.

5.7.2 Limitations of Purchase Policy

In addition to advantages there are a few limitations of purchase policy too. These are listed below:

First, a policy is often difficult to communicate throughout large organizations.

Second, employees might view policies as a substitute for effective management. Policy statements are guidelines that outline management's belief or position on a topic. They are not a set of how-to instructions designed to provide specific answers for every business decision.

Third, policy development can also restrict innovation and flexibility.

Fourth, too many policies accompanied by cumbersome procedures can become an organization's worst enemy.

Test Your Progress

1. Give a quick comparison of the benefits and limitations of purchase policy?

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2. What responsibilities are catered to by purchasing policy?

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5.8 Summary

Purchasing is the first phase of Materials Management. Purchasing means procurement of goods and services from some external agencies. The object of purchase department is to arrange the supply of materials, spare parts and services or semi-finished goods, required by the organisation to produce the desired product, from some agency or source outside the organisation.

Purchasing system is a component of inventory management that can help businesses monitor and manage inventory. With a purchasing system, you track the goods and services you purchase as well as your company's overall inventory levels.

Types of purchasing systems are: 1. Forward Buying 2. Tender Buying 3. Blanket Order 4. Zero Stock 5. Rate Control 6.Reciprocity 7.System Contract.

Purchase Policy: The system should be such, which suits to the requirements of an organisation. The objective of the purchase policy should be to purchase the required material in the right quantity from right source at the right time and price, to obtain the maximum advantage from the amount invested in the purchases.

5.9 Test Your Progress

1. What is purchasing? Explain in detail.
2. What are the objectives of purchasing?
3. Why is purchasing important in an organization?
4. What are the major steps in the purchasing process?
5. What is a purchasing system?
6 What is the procedure of purchase policy? Explain in detail.
7. What are the purposes of an effective purchasing system?
8. What is the importance of main objectives of an effective purchasing?
9. What are the qualities of a good purchasing system?
10. What do you understand by organization of purchase function?
11. What are the objectives of purchase policy?
12. What are the types of purchase policy?
13. What is the responsibility of purchase policy? Explain in detail.
14. What are the benefits and limitations of purchase policy?

5.10 Suggested Readings

1. https://www.yourarticlelibrary.com/
2. https://www.kbresearch.com/
3. https://www.hcusd2.org/
4. https://kawazhang.gitbooks.io/
5. https://www.procuredesk.com/
6. https://pcspolicy.com/
7. https://www.scribd.com/
8. https://smallbusiness.chron.com/
9. https://www.yourarticlelibrary.com/
10. https://en.wikipedia.org/
11. https://supplychaingamechanger.com/
12. https://www.tradegecko.com/supply-chain-management

13. https://www.purchasecontrol.com/
14. https://www.merriam-webster.com/
15. https://www.patriotsoftware.com/
16. https://www.yourarticlelibrary.com/
17. https://www.investopedia.com/
18. https://www.yourarticlelibrary.com/

UNIT 6 : Purchasing Decisions

Unit Structure

6.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge of PurchasingDecisions.
- Completely understand Purchasing Role In New Product Development.
- Get an idea of Role of Purchasing In Cost Reduction.
- Get knowledge of Negotiations and Purchase.

6.1 Introduction

Individual consumers are not the only buyers in a market. Companies and other organizations also need goods and services to operate, run their businesses, and produce the offerings they

provide to one another and to consumers. These organizations, which include producers, resellers, government and nonprofit groups, buy a huge variety of products including equipment, raw materials, finished goods, labor, and other services. Some organizations sell exclusively to other organizations and never come into contact with consumer buyers.

B2B markets have their own patterns of behavior and decision-making dynamics that are important to understand for two major reasons. First, when you are a member of an organization, it's helpful to appreciate how and why organization buying decisions are different from the decisions you make as an individual consumer. Second, many marketing roles focus on B2B rather than B2C marketing, or they may be a combination of the two. If you have opportunities to work in B2B marketing, you need to recognize how the decision-making process differs in order to create effective marketing for B2B customers and target segments.

6.2 Purchasing Decisions

Before moving to purchasing decisions directly we need to know about organizational buying.

6.2.1 Concept of Organizational buying

Unlike the consumer buying process, multiple individuals are usually involved in making B2B buying decisions. A purchasing agent or procurement team (also called a *buying center*) may also be involved to help move the decision through the organization's decision process and to negotiate advantageous terms of sale.

Organizations define and enforce rules for making buying decisions with purchasing policies, processes, and systems designed to ensure the right people have oversight and final approval of these decisions. Typically, more levels of consideration, review, and approval are required for more expensive purchases.

For anyone involved in B2B marketing or selling, it is important to know:

- Who will take part in the buying process?
- What criteria does each person use to evaluate prospective suppliers?
- What level of influence does each member of the process have?
- What interpersonal, psychological, or other factors about the decision team might influence this buying process?
- How well do the individuals work together as a group?
- Who makes the final decision to buy?

Because every organization is unique, the answers to these questions will be different for every organization and every sale. Marketers should understand their target segments well enough to

identify commonalities where they exist and then create effective marketing to address the common roles and decision makers identified.

6.2.2 B2B Buying Situations

Who makes the buying decision depends, in part, on the situation. Common types of buying situations include the straight rebuy, the modified rebuy, and the new task.

The *straight rebuy* is the simplest situation: the organization reorders a good or service without any modifications. These transactions are usually routine and may handle entirely by the purchasing department because the initial selection of the product and supplier already took place. With the *modified rebuy*, the buyer wants to reorder a product but with some modification to the product specifications, prices, or other aspects of the order. In this situation, a purchasing agent may be involved in negotiating the terms for the new order, and several other participants who will use the product may participate in the buying decision.

The buying situation is a *new task* when an organization considers buying a product for the first time. The number of participants and the amount of information sought tend to increase with the cost and risks associated with the transaction.

For sales opportunities that are new tasks, there may be an opportunity for a *solution sale* (sometimes called *system selling*). In these opportunities, the buyer may be interested in a provider that offers a complete package or solution for the business problem, rather than individual components that address separate aspects of the problem.

6.2.3 Characteristics of Organizational Buying

B2B purchasing decisions include levels of complexity that are unique to organizations and the environments in which they operate. Following are its characteristics:

1. Timing Complexity

The organizational decision process frequently spans a long period of time, which creates a significant lag between the marketer's initial contact with the customer and the purchasing decision. In some situations, organizational buying can move very quickly, but it is more likely to be slow. When personnel change, go on leave, or get reassigned to other projects, the decision process can take even longer as new players and new priorities or requirements are introduced. Since a variety of factors can enter the picture during the longer decision cycles of B2B transactions, the marketer's ability to monitor and adjust to these changes is critical.

2. Technical Complexity

Organizational buying decisions frequently involve a range of complex technical dimensions. These could be complex technical specifications of the physical products, or complex technical specifications associated with services, timing, and terms of delivery and payment. Purchases need to fit into the broader supply chain an organization uses to operate and produce its own

products, and the payment schedule needs to align with the organization's budget and fiscal plans.

3. Organizational Complexity

Because every organization is unique, it is nearly impossible to group them into precise categories with regard to dynamics of buying decisions. Each organization has a characteristic way of functioning, as well as a personality and unique culture. Each organization has its own business philosophy that guides its actions in resolving conflicts, handling uncertainty and risk, searching for solutions, and adapting to change. Marketing and sales staff need to learn about each customer or prospect and how to work with them to effectively navigate the product selection process.

6.2.4 Factors Influencing B2B Buying Behavior

Because organizations are made up of individual people, many of the same influencing factors discussed earlier in this module apply in B2B settings: situational, personal, psychological, and social factors. At the same time, B2B purchasing decisions are influenced by a variety of factors that are unique to organizations, the people they employ, and the broader business environment.

Four main influences impact the business buying decision process: environmental factors, organizational factors, interpersonal factors, and individual factors.

1. Environmental Factors

Competitive conditions may enable a company's short-term success, where the organization is able to operate irrespective of customer desires, suppliers, or other organizations in their market environment. Early entrants into emerging industries are likely to be internally focused due to few competitors. During these formative years, customer demand for new products will likely outstrips supply, while production problems and resource constraints represent more immediate threats to the survival of new businesses.

Nevertheless, as industries grow, these sectors become more competitive. New entrants are attracted to potential growth opportunities, and existing producers attempt to differentiate themselves through improved products and more efficient production processes. As a result, industry capacity often grows faster than demand and the environment shifts from a seller's market to a buyer's market. Firms respond to changes with aggressive promotional techniques such as advertising or price reductions to maintain market share and stabilize unit costs.

Different levels of economic development across industries or countries may favor different business philosophies.

2. Organizational Factors

Organizational factors such as the company's objectives, purchasing policies, and resources can influence the buying process.The size and composition of the buying center also plays a role in the business buying decision process.

3. Interpersonal Factors

The interpersonal relationships between people working in the company's buying center can hinder the buying process. Buying center members need to trust each other and operate under full disclosure.

4. Individual Factors

The personal characteristics of people in the buying center can influence the buying decision process. Individual factors including age, education level, personality, job tenure, and position within the company all play a role in how a person influences the buying process.

6.2.5 Stages of the Business Buying Decision Process

The main difference between B2B and B2C is who the buyer of a product or service is. The purchasing process is different in both cases and the following is a list of the stages involved in B2B buying:

Step 1: Recognize the Problem

- Machine malfunction, firm introduces or modifies a product, etc.

Step 2: Develop product specifications to solve the problem

- Buying center participants assess problem and need to determine what is necessary to resolve/satisfy it

Step 3: Search for and evaluate possible products and suppliers

- look in company files and trade directories, contact suppliers for information, solicit proposals from known vendors, examine websites, catalogs, and trade publications
- conduct a value analysis – an evaluation of each component of a potential purchase; examine quality, design, materials, item reduction/deletion to save costs, etc.
- conduct vendor analysis – a formal and systematic evaluation of current and potential vendors; focuses on price, quality, delivery service, availability and overall reliability

Step 4: Select product and supplier and order product

- This step uses the results from Step 3

- An organization can decide to use several suppliers, called multiple sourcing. Multiple sourcing reduces the possibility of a shortage by strike or bankruptcy.
- An organization can decide to use one supplier, called sole sourcing. This is often discouraged unless only one supplier exists for the product; however it is fairly common because of the improved communication and stability between buyer and supplier.

Step 5: Evaluate Product and supplier performance

- Compare products with specs
- Results become feedback for other stages in future business purchasing decisions

This 5 step process is mainly used with new-task purchases and several stages are used for modified rebuy and straight rebuy.

Understanding the stages of business buying and the nature of customers' buying behavior is important to a marketing firm if it is to market its product properly. In order to entice and persuade a consumer to buy a product, marketers try to determine the behavioral process of how a given product is purchased.

6.3 Purchasing Role In New Product Development

Purchasing is responsible for the procurement process. This means it ensures the supply of goods, production materials and equipment so that a smooth production and sales process can take place. For this, goods must be procured at the right time, in the right quantity, and of the right quantity. If the purchasing process falls down, there's a risk that the business will not be able to manufacture products or keep the shelves stocked with sufficient volume to meet customer demand.

The role itself is a broad one, covering such areas as market analysis, negotiations with suppliers and producers, transport, storage options, procurement technologies and order times to ensure that goods are bought as economically and time-efficiently as possible. Specific functions include:

- Identifying requirements for goods, materials and services.
- Identifying reliable suppliers.
- Price negotiations.
- Comparison of delivery terms.
- Establishing order quantities.
- Writing requests for bids and awarding supply contracts.
- Coordinating delivery with the warehouse against storage capacities.
- Product testing and quality control.
- Managing budgets and payments.

6.3.1 Key Roles of Purchase Department

Now that you know what the purchase department is, let's look at some of its key roles and functions.

1. Needs and Supplier Analysis

The starting point for strategic purchasing is to benchmark how the business is currently performing, how resources are being used, and what the purchasing costs are per department, team or job function. The purchase department will then look at the company's growth trajectory and come up with a plan to help the business perform better and/ or save costs.

At the same time, the purchasing department will analyze the supplier's market to see if the company is using the right supplier, at the right price point, to meet its business needs. The team might compare multiple suppliers, including those based in other countries, to prepare a shortlist of possible suppliers.

2. Award Supplier Contracts

Each business will have its own requirements but generally, the team will be looking at each supplier's cost, quality, reputation, reliability, production capacity and delivery schedules before awarding a supplier contract. Technological capability may be a consideration in some industries. A supplier's inability to meet any of these requirements could result in significant losses for the company so it's important to get these decisions right. In large companies, the department might also be making decisions about whether to make the products in-house.

Finding the right goods at the right price can be complex and time-consuming, and the purchasing department may use a competitive tender (bidding) process to choose a supplier. This normally involves the issue of a "Request for Proposal" which invites interested suppliers to submit a quote or bid and explain how they meet the selection criteria.

The team might also call for financial statements, references and credit reports so they can assess the health of the bidding company. Price negotiations may follow as the purchasing department tries to achieve the best possible unit price. This might include negotiating discounts based on volume, tiered or graduated pricing depending on the company's needs.

3. Supplier Selection and Relationships

It's not unusual for larger companies to have multiple suppliers on their books, and an essential role of the purchase department is to manage and maintain these relationships. Close cooperation with key suppliers means you can share knowledge about market shifts, new products and technologies or other factors that could help you stay ahead of the competition.

A retail business, for example, should be sharing feedback from customers about existing products and using this knowledge to innovate new and improved product offerings.

4. Ordering and Inventory Control

At the operational level, it's essential to have the right quantities of raw materials in the warehouse or the right quantities of products on the shelf at exactly the time when the customer walks through the door. Running out of products means you lose sales and your customers may turn to competitors to get the products they needs. Overstocking means you potentially will have to pay more in storage costs and you run the risk of the product becoming obsolete before you have the opportunity to use or sell it.

Generally, the purchasing department will have systems in place which trigger a stock order whenever a certain quantity of inventory is reached. For those that use merchandise management systems, the minimum stock and the order quantity are generally predefined and are automatically ordered by the software.

This means a well-stocked warehouse is guaranteed, and the purchase department can focus on checking items and invoices for accuracy, and coordinating delivery dates with the warehouse team.

5. Compliance and Quality Control

Quality control is an essential part of the procurement process. The purchase department needs to continually inspect the quality, performance and reliability of the supplier to ensure they do not lapse into complacency. For suppliers in other countries, this might include monitoring workers' right, compensation and working conditions. It's important to be clear where accountability lies.

It's often said that "what gets measured gets done." One essential role of the purchasing department is to analyze and measure performance data to ensure that suppliers are achieving the desired outcomes, in accordance with the company's procurement strategy. For example, the department might measure:

- The percentage of products delivered on time.
- The number of suppliers used and how much product they supply.
- Supplier availability.
- Lead times.
- Product defect rates.

These metrics enable the purchase department to assess how well suppliers are fulfilling the company's requirements, how well they respond to urgent demand, and whether to company is over-relying on just one or two key suppliers which could leave the company vulnerable if the supplier goes bust. Armed with this data, the purchasing department can then revisit the strategic plan and make adjustments as necessary.

6.3.2 Role of Purchasing in New Product Development

Market globalization and the rapid advancement of technologies require that companies differentiate themselves with innovative products and services to create competitive advantage. Increasingly, manufacturers face shortened product life cycles and increased pressure to shorten their time to market.

The main role of purchasing and supply management professionals in the procedure andprocesses of new product development is that of concept and design "lock in" as much as80 percent of the total cost of a project.

For this reason, it is crucial for firms to bring inas much product, process and technical expertise as possible early in thenew productdevelopment stage. The supplier often possesses much of this critical expertise.Purchasing specialists are frequently tasked with facilitating the transfer of supplierexpertise. Purchasing and supply management professionals have many roles to do in theprocess.

The purchasing and supply management will have to work with the engineers ateach level to see what is needed in each stage. These management professionals areresponsible for the identifying, screening, and selection of needed suppliers. This positionis very important for it can make or break a company's budget and if done wrong canmake a new product fail before it even starts. There are many hats that this person orperson would be wearing in addition to just the ones I stated above.

The purchasing andsupply management has to be able to work in teams, have skills in project management, agood understanding of finance and cost accounting, and great written and verbal skills. CFT can be used for development of new products by bringing together people fromdifferent areas of the company which allows for more insight and ideas to the table.Cross-functionalteamsoften function as self-directed teams assigned to a specific taskwhich calls for the input and expertise of numerous departments. Assigning a task to ateam composed of multi-disciplinary individuals increases the level of creativity and outof the box thinking. Each member offers an alternative perspective to the problem andpotential solution to the task. In business today, innovation is a leading competitiveadvantage and cross-functional teams promote innovation through a creativecollaboration process.

Members of a cross-functional team must be well versed in multi-tasking as they are simultaneously responsible for their cross-functional team duties aswell as their normal day-to-day work tasks. With the use of CFT you will cut down ontime to market as well as reducing overall cost in regards to the new productdevelopment. Each member would bring their expertise to the table which would helpmake the product better in the long run. The person from marketing have target marketknowledge which would be vital, the supply person would bring knowledge of suppliesavailable for use, and so own. All the skill sets would be valuable in making of a newproduct.

Test Your Progress

1. List the characteristics of organizational buying.

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2. Explain the stages of business buying decisions process in brief.

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3. State the role of purchasing in new product development.

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4. What role does purchasing department play in an organization?

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5. Define purchasing decisions. Also state its concept.

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6.4 Role of Purchasing In Cost Reduction

Cost reduction usually refers to cost savings made during a purchasing process. It is much more than that. It includes savings made through re-negotiation of contract terms and conditions, administrative and operational process improvements, and the intelligent use of data and technology. Herein, you will acknowledgethe concept of cost reduction actions you can take in the short-term, as well as strategies you can take in the longer term requiring thought, planning and possible investment in resources.

6.4.1 Short-term initiatives are:

1. Revisit current contract terms

It's an acceptable practice to challenge the terms of an existing contract. Any contract not reviewed for more than three years should offer some savings opportunities. It is likely that some pricing has become uncompetitive and that there is scope for revisiting payment terms.

Opening discussions with your suppliers about potential changes to purchasing frequency can lead to volume discounts. Economic environments change, consumer consumption patterns shift, and technology moves on. Market research and benchmarking provide an opening to discuss pricing with your suppliers.

2. Challenge specifications

The first step is to ask the question – do we really need this product or service? Once that is settled, analyze the extent of the need and, on that basis, review the specifications or design. Product specifications and packaging are often based on supplier proposals or set with one particular supplier or brand in mind. Requirements based on expected performance or outcome allow for increased competition by a broader range of suppliers.

3. Eliminate maverick spending

Maverick spending refers to unauthorized purchasing outside agreed contracts. It is also sometimes termed rogue spending or spend leakage. It can account for a large percentage of all purchases where there is no centralized purchase-to-pay (P2P) procurement process and can be a significant challenge to cost savings initiatives. Visibility from full spend analysis will highlight this uncontrolled spending so that controls such as e-catalogues and purchase requisitions can be implemented to reduce maverick spending.

4.Challenge operational costs

Proper procurement planning helps reduce costs by ensuring the best use of administrative resources. Poor planning leads to expensive emergency procurement actions and high transport costs. By streamlining internal P2P processes, whether automated or not, you can reduce transactional costs and additional documentation.

5. Review uncompetitive suppliers

The benchmarking process done when reviewing contracts can highlight other similar suppliers in your database that are not competitive. These suppliers can be approached to reduce their costs in line with the market or failing that, can be removed by moving that spend to more competitive suppliers. Active management of strategic suppliers and consolidating the total number of suppliers is critical to maximizing procurement savings. Fewer suppliers to manage leads to a more efficient process.

6.Use the data you have

Clean, complete and timely data is critical for embarking on any savings initiative. Reliable information on past purchases and supplier performance can highlight opportunities and drive re-negotiation efforts.

6.4.2 Medium- and longer-term initiatives

1. Investigate outsourcing

Outsourcing is a strategy through which non-core procurement activities or functions are transferred to specialist external providers. It is especially suited to indirect procurement categories such as facilities management, security, transportation and logistics. The cost reduction benefits are:

- Lower costs due to the outsource partner's economies of scale by aggregating customers' requirements
- Outsourcing low value/high volume purchases free up expensive internal resources
- Access to global expertise and market knowledge in categories where there is little in-house capacity or experience
- Time-consuming negotiations and contracting are managed by specialists

2.Using technology

There are many software solutions that address all or part of the procurement process with the aim of generating savings. There are opportunities for cost reduction in implementing P2P, spend analysis, e-procurement including RFP management, e-catalogues and e-auctions. Less obvious is the area of supplier relationship management (SRM) where on-line self-service portals streamline the communication process between buyer and seller. It is possible to reduce costs by cutting down on human intervention in the process of onboarding suppliers, assessing supplier performance and managing day-to-day operational issues.

3. Implement category management

The main objective of category management is to group and manage each type of expenditure holistically, through the entire procurement lifecycle. Implementing a category management structure requires careful planning. When in place, this strategy allows procurement to focus their time wisely and not waste resources on repetitive transactional buying. Total spend on a commodity or a service can be leveraged to offer larger volumes or scope to key suppliers. Category-based analysis can highlight cost avoidance opportunities and potential quick wins.

4. Centralize procurement (or your procurement analytics)

In a decentralized procurement structure, the areas of opportunity for savings are not visible. The chance of duplication of purchases and maverick spending is high even if the global procurement organization is center-led. Centralizing procurement enables a unified global sourcing strategy. However, implementing a spend analysis tool globally can offer many of the same benefits. A rationalized supplier database leads to increased competition among suppliers and reduced supply costs.

5. Reduce procurement risk

Risk management is a broad strategy often managed at the corporate level. The role of risk management within procurement means ensuring that the correct management controls are in

place, especially for ad-hoc and emergency purchases. The dependence on a sole supplier for a critical item or service is one of the biggest risks in procurement and there should always be a mitigation plan in place. Part of risk management also means focusing on cost avoidance - which is a type of savings. This can be achieved, for example, by limiting the rate of price increases or obtaining more value from existing contracts.

In the current challenging economic environment, every organization is striving to reduce costs. Key suppliers should be developed as valuable partners working with you to keep costs down with the objective of e-catalogues both businesses financially sustainable.

6.5 Negotiations and Purchase

Negotiation refers to trading deliberations which generally lead to lowering of prices by the vendors. However, it would not be proper to think that **negotiation** supply refers to **bargaining** for lower prices. In a broad sense, **negotiation** aims at obtaining the maximum value of money spent on **purchasing**.

6.5.1 Objectives of Negotiation

Purchasing staff should enter all negotiations with clearly defined objectives. Without having objectives the possibility for the purchasing professional to concede on price, quality or service is significantly raised. The negotiator should enter into discussions with the vendor with precise objectives that they wish to achieve for their company.

The objective should not be absolute and should allow for some flexibility. However, the negotiator should also ensure that they do not deviate from the objectives and allow themselves to negotiate on areas that were not part of the discussion. For example, a negotiator may have worked with the vendor on their objectives on price and service, but not quality. When the vendor starts to discuss quality, the negotiator should refrain from any agreement where they are without a set objective.

Negotiation is an important part of the role of the purchasing professional. It is a skill that is learned, and training can help purchasing staff in understanding what is needed when negotiating with vendors.

6.5.2 Steps of Negotiation

This five-step process will help to build the foundation critical negotiations with critical suppliers of all types.

1. Understand your mission and business drivers

It is essential to understand the fundamentals of your own business so you can develop a negotiation strategy that complements the overall strategy. What are the essential business objectives of your company? What markets do you serve, who are your customers, what are their requirements and what are the operational goals of your business? Without a strong

understanding of the business issues that makes your organization tick, you will never be able to successfully negotiate at any level.

A company that is quickly trying to build market share may be less focused on cost and more concerned with rapid deliveries. A negotiation based purely on low cost would not offer the proper business alignment. Suppliers will do their best to understand your business and craft a negotiation strategy to exploit your areas of weakness. It is your obligation to know more about your own business than they do to offset their potential advantage.

2. Understand their mission and business drivers

Understanding what business issues drive your suppliers will allow you to develop successful situational negotiation strategies. It is easy to compile intelligence on your suppliers so you can understand their pressures. This process can also be a good way to determine pricing trends, market constraints, regulatory issues or other important issues that the supplier may not quickly share.

3. Be authentic to build credibility and trust

Negotiation can be an emotional exercise, with the pressure of the bottom line creating an environment of conflict and mistrust both inside and outside of the company. Those emotions are not limited to the usual buyer and supplier dust-ups, but internal judgments and misconceptions as well, as the importance of the supply chain gain greater company recognition. Avoid posturing, bluffing, lies or deceit. These are tactics of a bygone era. Be yourself, adhere to your personal and organizational values and proudly represent your company. Trust is an underappreciated business and personal attribute. Gain it and keep it.

4. Work towards a positive outcome for all parties

Win-win negotiations are a bit of a misnomer. It does not mean each party gets exactly what they want, or there is one giant compromise in the "let's split the difference" model. In a win-win negotiation, both parties can compromise so each side captures some level of value. Win-win negotiations in a relationship-based environment take on a long-term approach with a balance of success for both sides over time. One-off negotiations, perhaps for a piece of capital equipment, may lend itself to less of a relationship-based win-win model, replaced with a more traditional style of negotiation. Experienced buyers can negotiate over range of business situations.

5. Create a plan for evaluation and assessment

Negotiations are not singular events, but continuous efforts that need ground rules and communication frameworks. Leave little to chance and revisit performance often. Identify issues early to avoid conflict later. Establish key performance indicators in the contract that will form a basis for discussion.

Focus on cost, delivery performance, quality levels and a kaleidoscope of customer support initiatives. The indicators provide a great framework for regular contract reviews. But note in a

relationship-based environment, the buyer has key performance indicators as well, including adherence to payment to terms, consistent forecasting and a resolution format for operational issues.

Most negotiations occur over and over again. We tend to deal with the same suppliers for a long time. It is important to recognize and give proper weight to the context in which a negotiation is taking place. If it is within an on-going relationship, the significance of that relationship must be considered as you craft your negotiation strategies.

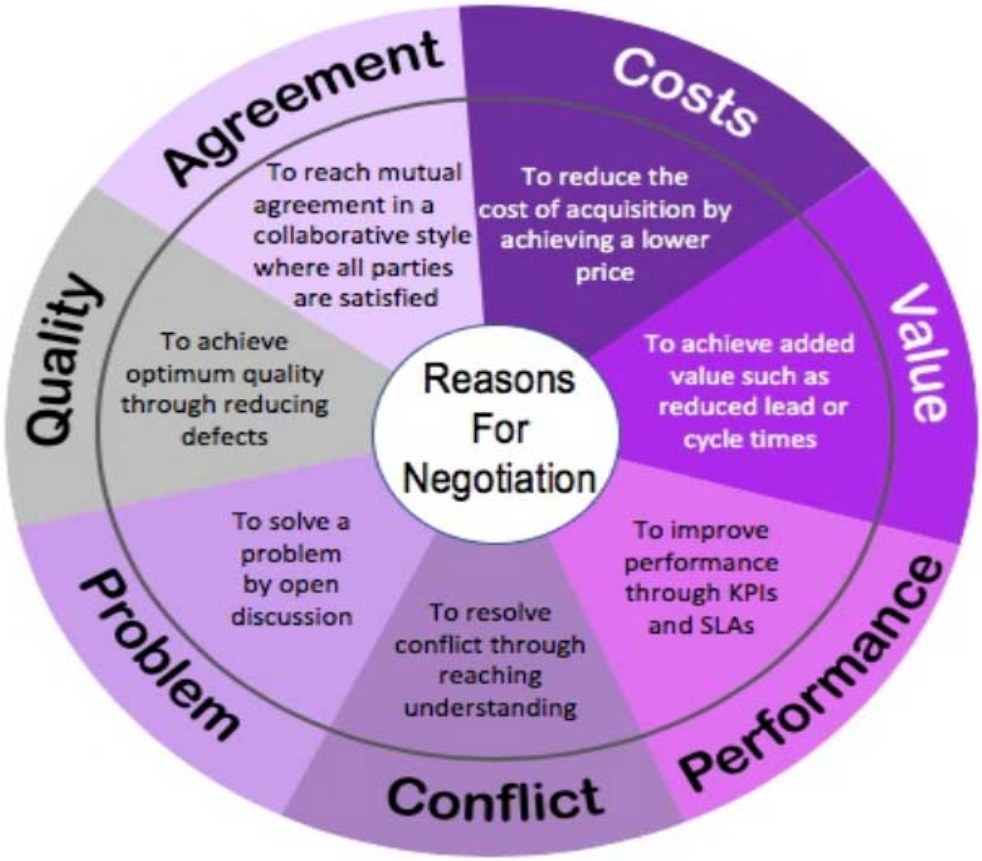

Fig. 6.1: Reasons for Negotiation

6.5.3 Guide forA Successful Negotiation

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.

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.

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

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. But tread carefully - if you push too far you may erode its goodwill, which could damage the service you get. There's also the risk they could drop the product you require, or even go out of business.

Try to identify the key staff in the supplier's business to negotiate with. There's no point trying to squeeze concessions out of a junior member of staff who doesn't have the authority to grant them.

Negotiating at the right time can be an important strategic tool. For example, a salesperson may need to meet a monthly sales quota.

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.

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**.
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 **check credit** 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.

8. Drawing up a contract for your purchase

Once all the points have been negotiated and a deal has been agreed to it's best to get a **writtencontract** drawn up and signed by both parties.
Although verbal 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. 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. 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.

Test Your Progress

1. Explain in short the guide for a successful negotiation.

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2. What are the medium term initiatives in terms of cost reduction?

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3. Explain the short term initiatives in terms of cost reduction.

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4. What are the objectives of negotiation?

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5. State the steps of negotiation in brief.

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6.6 Summary

Purchase decision is the thought process that leads a consumer from identifying a need, generating options, and choosing a specific product and brand. Some **purchase decisions** are minor, like buying toothpaste, while other **purchases** are major, like buying a house.

Characteristics of Organizational Buying

1. Timing Complexity
2. Technical Complexity
3. Organizational Complexity

Factors Influencing B2B Buying Behavior

1. Environmental Factors
2. Organizational Factors
3. Interpersonal Factors
4. Individual Factors

Stages of the Business Buying Decision Process

Step 1: Recognize the Problem
Step 3: Search for and evaluate possible products and suppliers
Step 2: Develop product specifications to solve the problem
Step 4: Select product and supplier and order product
Step 5: Evaluate Product and supplier performance

Purchase departments play an important role in an organization and help them to be financially healthy. They procure goods and services designed to meet operational needs while providing the highest possible value. They established procurement policies and procedures to ensure their organization operates with integrity and the marketplace.

Key Roles of Purchase Department

1. Needs and Supplier Analysis
2. Award Supplier Contracts
3. Supplier Selection and Relationships
4. Ordering and Inventory Control
5. Compliance and Quality Control

Role of Purchasing In Cost Reduction

Short-term initiatives are

1. Revisit current contract terms
2. Challenge specifications
3. Eliminate maverick spending
4. Challenge operational costs
5. Review uncompetitive suppliers
6. Use the data you have

Medium- and longer-term initiatives

1. Investigate outsourcing
2. Using technology
3. Implement category management
4. Centralize procurement (or your procurement analytics)
5. Reduce procurement risk

Negotiation refers to trading deliberations which generally lead to lowering of prices by the vendors. However, it would not be proper to think that **negotiation** supply refers to **bargaining** for lower prices. In a broad sense, **negotiation** aims at obtaining the maximum value of money spent on **purchasing**.

Steps of Negotiation are:

1. Understand your mission and business drivers.
2. Understand their mission and business drivers.
3. Be authentic to build credibility and trust.
4. Work towards a positive outcome for all parties.
5. Create a plan for evaluation and assessment.

6.7 Test Your Progress

1. What do you understand by purchasing decisions? Explain its concept.

2. What is B2B buying situation?

3. What are the characteristics of organizational buying?

4. What are the factors that influence B2B behavior?

5. Explain in detail the various stages of business buying decisions process.

6. What do you understand by purchasing role in new product development? What are its functions?

7. What is the role of purchase in new product development?

8. What is the role of purchasing in cost reduction?

9. What do you understand by:

a. Short term initiatives.

b. Medium and Long term initiatives.

10. What is negotiation? Also state its objectives.

11. What are the steps of negotiation?

12. What do you understand by the guide for successful negotiation?

6.8 Suggested Readings

1. https://kwhs.wharton.upenn.edu/

2. https://courses.lumenlearning.com/

3. https://www.investopedia.com/

4. https://www.researchgate.net

5. https://smallbusiness.chron.com/

6. https://www.unboundb2b.com/

7. https://scm.ncsu.edu/

8. https://hbr.org/

9. https://www.shopify.in/

10. https://www.coursehero.com/

11. https://smallbusiness.chron.com/

12. https://nairaproject.com/

13. https://blog.sievo.com/

14. https://www.projectclue.com/

15. https://iproject.com.ng/

16. https://procurement-academy.com/

17. https://blog.procureport.com/

18. https://www.thebalancesmb.com/

19. https://hbr.org

20. https://www.purchasing-procurement-center.com/

21. https://www.supplychaindive.com/

22. https://www.infoentrepreneurs.org/

UNIT 7 :Purchasing Research

Unit Structure

7.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofPurchasing Research.
- Completely understandIdentification of Right Sources Of Supply.
- Get an idea about Vendor Rating.
- Get knowledge of Standardization.
- Understand Vendor Certification Plans.
- Analyze Vendor And Supply Reliability.
- Learn About Developing New Source Of Supply.

7.1 Introduction

Purchasing operates in an inherently unstable environment and it is all too easy for companies to lose touch with conditions in the market they service. Furthermore, in the quest for growth or even to defend existing market positions, the problem tends to be exacerbated by the fact that companies continually need to do something new. They develop new strategies launch new product, target new market and initiate new service packages all of which push them into increasingly unfamiliar purchasing territory. Purchasing knowledge is created from a number of inputs experience and expertise are critical, as are experimentation and analysis, but the key dynamic ingredient purchasing information derived from sources within the market place itself, notably customers, competitors and distributors.

7.2 Purchasing Research

Purchasing research is the purchasing information. It is defined by the American purchasing association as the systematic gathering, recording and analyzing of about problems relating to purchasing of goods and services. Purchasing research can also be defined Kolter as the systematic design, collection, analysis and reporting of data and findings relevant to a specific purchasing situation facing the company.
Purchasing research is very important to any organization or company because it is through it that we know the feelings, wants, needs, perceptions and preference of customers/consumers knowing that consumer/customer is the focal point of purchasing and every organization or company will always want to satisfy their customers/clients in other to continue in the business. It is a link between the customer and the general public to the individual, organization of the business firm and also identifies and defines purchasing opportunities, trends, threats and measurements.

7.2.1 Areas of Purchasing Research:

Following are the areas of purchasing research:

1. Quality:

One of the most important aspects to investigate into is to see whether one has not over specified the specifications. One can make the specification ideal, but at the same time make it uneconomical too. The specifications should be good enough for the purpose. They should be neither too rigid nor too lax.

2. Quantity:

The quantity to be purchased has an important bearing on inventory management. The forecasts of requirement have to be reasonably accurate to keep the inventory levels low without affecting the service. Latest forecasting methods, including exponential smoothing techniques, have to be adopted and the usual EOQ formula have to be applied.

3. Suppliers:

Vendors must be kept under close watch regarding their performance. Only such vendors who do not fail in supplying good quality material, who deliver on time and whose prices are competitive, may be retained on the approved list.

4. Time:

The best it to buy depends mainly on lead-time consideration a safety stock requirements. Any effort put in to reduce lead-time is well worth it. Safety stock provision depends upon service considerations. The higher the services level, greater will be the safety stock and, therefore, greater the inventory holdings.

5. Price:

Fostering competitive bidding can reduce prices. If current suppliers are not behind or form a ring, negotiations may be resorted to and in this case the research team should prepare the required data. If negotiations do not succeed, the research team must develop acceptable substitutes as a long-term solution.

7.3 Identification Of Right Sources Of Supply

The first step in the process of sourcing is to identifying the sources of supply. It needs to be decided at this time, whether the product will be sourced from the domestic market or from the international market.

Domestic sources of supply may be located by visiting central markets, trade shows or expositions. Usually, each city has its own central market where a large number of key suppliers are located. A visit to such a location enables the buyer to understand the trends in the market and to evaluate the new resources and merchandise offerings. Trade shows and expositions are also a good ground for finding new sources of supply.

The growth of the retail trade in India and the need among the Indian retailers to source products effectively for their stores have led to many retail chains reaching out to farmers and even investing in concepts like contract framing .

In addition to buying from the domestic market, an organization may seek out foreign sources from where merchandise can be purchased or made. This is a common trend in the West where trade barriers are considerably lower. As retailers today, operate in a global marketplace, the sourcing of products internationally is also a reality.

The prime reasons for looking at international sourcing could be the uniqueness of the merchandise, or the unavailability of the merchandise in the domestic market. In that case, a retailer may also source from a foreign market simply because the merchandise is unique and the

fact customers are always looking for a unique product. On the other hand, low cost and good quality are also factors which could affect this decision.

A decision that is closely associated with branding decisions is to determine where the merchandise would be made. Although retailers buying manufacturer's brands usually aren't responsible for determining where the merchandise is made, a product's country of origin is often use as a signal of quality.

Cost associated with global parameter includes:

1. Country of Origin effects:

Many a times, where the merchandise has been manufactured makes a difference in the final sale of the product.

2. Foreign Currency Fluctuations:

Fluctuations in the international currency rates will affect the buying price of the products. At times, due to violent fluctuations in the price, sourcing products internationally may suddenly become viable or unviable.

3. Tariffs:

Also known as duties, it is a list of taxes placed by a government on imports. Import tariffs shield domestic manufacturers from foreign competition and raise money for the government. GATT & MBA affect matters.

4. Foreign Trade Zones:

These are special areas within a country that can be used for warehousing, packaging, inspection, labeling, exhibition assembly, fabrication or transshipment of imports without being subject to that country's tariffs.

5. Cost of Carrying Inventory:

Purchase of goods is always at a price. Depending on when this merchandise is finally sold makes a very big difference on the varying costs.

6. Transportation Costs:

While sourcing products internationally it is essential; to keep in mind the cost that will be involved in transporting the goods to the various markets that the retailer operates in. This is a cost that has to be added to the cost of goods and eventually, affects the margins that can be earned.

7.3.1 Sourcing Tips to Identify Sources of Supply

Instead of solely focusing on cost, one must focus on quality by incorporating these tips into their sourcing strategy:

1. Check Certifications

Many buyers have minimal requirements when it comes to supplier quality certifications. However, suppliers do not always make it easy to view and verify their certifications.

2. Evaluate The Geo-Political Climate

While some overseas resources can provide rock bottom prices, tenuous labor relations or political upheaval can leave you without your required product. Take the time to thoroughly analyze the potential for unrest in the areas you will rely on for your supply chain success.

3. Finding Reputable Suppliers

Nowadays, variety of product discovery tools are available which are great places to find new, quality suppliers. Such leading sourcing platform for industrial buyers makes it easy to connect with suppliers, meaning it's a win-win for both.

4. Gauge Financial Stability

According to an informal survey, nearly half (50 percent) of all buyers have worked with a supplier that unexpectedly went out of business.

5. Assess Weather-Related Risk

As you select potential suppliers, identify the weather-related events that are typical to the region, and evaluate how they could dictate your ability to maintain business as usual.

6. Align Manufacturing and Shipping Locations To Your Needs

Depending on your manufacturing requirements, you should determine your need for a multi-location supplier or a single warehouse.

7. Ask For Accessible Inventory Information

Having visibility into your supplier's inventory can be advantageous. It is an indication of their commitment to you as a customer and their ability to provide what you need when you need it.

8. Know Their Scalability

Determine how flexible the supplier is when it comes to providing small quantity and high volume orders.

9. Check Their Commitment To Customer Service

A deeper understanding of the contract language about their return policy should be uncovered as well. You do not want to be stuck holding the bag.

10. Get Lead Time and Delivery Statistics

Delivery performance is key to industrial buyers. Ask for their lead time projections compared to on-time delivery rates. If these cannot be provided, then it is a good sign that they are not tracked or are not very good. Either reason is cause for concern.

11. Read Into The Payment Terms

Identify the suppliers that are willing to work with your payment requirements. As the long term need and delivery timelines can dictate PO or Net 30 billing options, don't be afraid to ask for what you need to run your business appropriately.

Test Your Progress

1. What do you understand by purchasing research?

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2. What are the areas covered by purchasing research?

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3. What do you understand by identification of right sources of supply?

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4. How are domestic sources of supply located?

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5. Give a few tips to identify sources of supply.

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7.4 Vendor Rating

Vendor rating is the result of a formal vendor evaluation system. Vendors or suppliers are given standing, status, or title according to their attainment of some level of performance, such as delivery, lead time, quality, price, or some combination of variables.

The motivation for the establishment of such a rating system is part of the effort of manufacturers and service firms to ensure that the desired characteristics of a purchased product or service is built in and not determined later by some after-the-fact indicator.

In order to accomplish the rating of vendors, some sort of review process must take place. The process begins with the identification of vendors who not only can supply the needed product or service but is a strategic match for the buying firm. Then important factors to be used as criteria for vendor evaluation are determined. These are usually variables that add value to the process through increased service or decreased cost. After determining which factors are critical, a method is devised that allows the vendor to be judged or rated on each individual factor.

It could be numeric rating or a Likert-scale ranking. The individual ratings can then be weighted according to importance, and pooled to arrive at an overall vendor rating. The process can be somewhat complex in that many factors can be complementary or conflicting. The process is further complicated by fact that some factors are quantitatively measured and others subjectively.

Once established, the rating system must be introduced to the supplying firm through some sort of formal education process. Once the buying firm is assured that the vendor understands what is expected and is able and willing to participate, the evaluation process can begin.

7.4.1 CRITERIA FOR EVALUATION

Vendor performance is usually evaluated in the areas of pricing, quality, delivery, and service. Each area has a number of factors that some firms deem critical to successful vendor performance.

Pricing factors include the following:

- Competitive pricing. The prices paid should be comparable to those of vendors providing similar product and services. Quote requests should compare favorably to other vendors.
- Price stability. Prices should be reasonably stable over time.
- Price accuracy. There should be a low number of variances from purchase-order prices on invoiced received.
- Advance notice of price changes. The vendor should provide adequate advance notice of price changes.
- Sensitive to costs. The vendor should demonstrate respect for the customer firm's bottom line and show an understanding of its needs.
- Billing. Effective vendor bills are timely and easy to read and understand.

Quality factors include:

- Compliance with purchase order.
- Conformity to specifications.
- Reliability
- Reliability of repairs.
- Durability.
- Support.
- Warranty. The length and provisions of warranty protection offered should be reasonable. Are warranty problems resolved in a timely manner?
- State-of-the-art product/service. The vendor should consistently refresh product life by adding enhancements. It should also work with the buying firm in new product development.

Delivery factors include the following:

- Time.
- Quantity.
- Lead time.
- Packaging should be sturdy, suitable, properly marked, and undamaged. Pallets should be the proper size with no overhang.
- Documentation.
- Emergency delivery.

Finally, these are service factors to consider:

- Good vendor representatives have sincere desire to serve.
- Inside sales should display knowledge of buying firmsneeds. It should also be helpful with customer inquiries involving order confirmation, shipping schedules, shipping discrepancies, and invoice errors.
- Technical support.
- Emergency support..

- Problem resolution-The vendor should respond in a timely manner to resolve problems. An excellent vendor provides follow-up on status of problem correction.

7.5 Standardization

Standardization is the process of creating standards to guide the creation of a good or service based on the consensus of all the relevant parties in the industry. The standards ensure that goods or services produced in a specific industry come with consistent quality and are equivalent to other comparable products or services in the same industry.

Standardization also helps in ensuring the safety, interoperability, and compatibility of goods produced. Some of the parties involved in the standardization processes include users, interest groups, governments, corporations, and standards organizations.

7.5.1 Goal of Standardization

The goal of standardization is to ensure uniformity to certain practices within the industry. Standardization focuses on the product creation process, operations of businesses, technology in use, and how specific compulsory processes are instituted or carried out.

7.5.2 Effects of Standardization

Some of the effects of standardization include the following:

1. Firms

When competing firms standardize their products and services, the competition shifts from integrated systems to the individual components. This means that companies whose main selling point is the integrated system must change strategy to focus on the individual components of the system.

Companies can create a competitive advantage by selling components or sub-systems of the integrated system to other businesses that are compatible with their business model.

2. Consumers

One of the benefits that consumers reap from standardization is increased compatibility and interoperability between products. For example, when communication gadgets and services are standardized, consumers can share information across a large number of people who are not limited by a specific service or product.

3. Technology

The effect of standardization on technology is mixed, and it may yield both positive and negative outcomes. The positive effect of standardization is that it can help weed out incompatible technologies in the market that slow the growth of technology.

On the downside, standardizing technology restricts the innovative quality of new and existing technologies.

7.6 Vendor Certification Plans

Most industry watchers agree that certification programs open doors into new job markets, create employment opportunities, increase earnings potential, improve skills and boost knowledge, facilitate career progression, and command respect from peers and management. Usually, the focus of certification programs center on the credential seekers and the many benefits they might gain from such certification. But it's also worth considering that cert programs provide many benefits to vendor companies or sponsor organizations as well.

Organizations that offer certifications, whether vendor-neutral or vendor-specific, provide a unique service to the IT community. The relationship between the IT professional and vendor certification programs is symbiotic—that is, one cannot exist without the other. On one hand, certification programs provide a one-stop-shopping experience where IT professionals can gain practical experience, knowledge, understanding, and mastery of key concepts, skills, and technologies in a specific IT area. All this comes wrapped up in a certificate that translates into a tidy long-term return on investment. On the other hand, certification programs provide vendors and sponsors with a lucrative revenue base and a pool of certified individuals who can be cultivated for repeat business.

7.6.1 Benefits of Vendor Certification Plans

Vendor certification is a supplier-customer partnership, and can only be successful with the full involvement and agreement of both partners. It is the combination of activities required to ensure that a vendor will meet the professional and regulatory expectation of the sponsor. It is the system that assures that a supplier's product is produced under controlled condition resulting in consistent quality conformance.

Generally, certification programs benefit three major types of players, be they technology vendors, professional associations or societies, or academic or educational institutions:

- Those who currently lead the market and want to continue in that position
- Those seeking to capture a share of the market and establish dominance
- Those seeking to compete with market leaders on equal terms, who are willing to bear the costs involved

When a vendor or sponsor organization creates a certification program, the goal is not only to provide the certification seeker with quality training and credentials, but also to build a reputation that will last well past the end of the examination and awarding a certification. Vendors strive to create programs that

- establish a standard of quality and excellence for the skills of its credential holders;
- are recognized globally by recruiters and employers a the "preferred" or "premier" certification to possess in some domain of IT knowledge.

7.6.2 Revenue Generation Opportunities

Certification programs generate revenue streams for their operators, which can be highly profitable. Some of the revenue-generating opportunities related to certification programs include the following:

- In-house training or preparation programs for credential seekers
- Multi-tiered approaches to certification ensuring repeat business as credential holders return to seek more advanced certifications
- Licenses to third-party players that provide training courses to credential seekers
- Developing an aftermarket by opening up an avenue to sell books, study guides, training materials, instructor guides, practice exams, labs, simulators, and so forth
- Refresher and continuing education courses
- Instructor support, including development and sale of course materials, instructor manuals, guides, test and quizzes, lab manuals, and other materials
- Fees from testing centers that administer examinations
- Examination fees
- Ongoing licensing fees

Steps Involved In Certification Process

Following are the steps involved in certification process:

Step1: Preparing For The Audit

It is the most critical part of the audit. It takes longer to complete than performing the actual audit. By putting more time into the preparation phase, the performance of the audit will proceed smoothly.

Effective audit plan will include the following elements:

- Purpose and scope of the audit.
- Resources required of the sponsor to complete the audit.
- Number of auditors.
- Type of auditor or expertise required.
- Assignment of a lead auditor to take responsibility for the audit.
- Reference documents to be used in planning and performing the audit.

Step 2: Performing The Audit

The performance of an audit begins with an introductory meeting where in all parties are introduced and the agenda is discussed. The performance of an audit is the collection of evidence and verification of information through the following means.

- Interviews.
- Examination of documents.
- Direct observation of activities, processes, and conditions.
- Review of raw data related to critical documents.

Step 3: Reporting The Results

Audit report should present a summary of the results or findings of the audit. This includes both positive findings and any areas identified for improvement. Written summary prior to leaving the vendor's facility allows the vendor to begin working on the corrective action plans. Formal audit report is the product of the audit. Lead auditor is responsible for submitting the formal report in a timely fashion. Final audit report should be prepared within 2 weeks from the date of the audit.

Step 4: Audit Closure, Correctiveaction, And Follow Up

After audit, vendor is responsible for developing a corrective action plan to address any weaknesses or deficiencies identified by the sponsor's auditors. It is the sponsor's responsibility to ensure that the corrective actions are effective and implemented in a timely manner.The sponsor must verify all commitments through the course of routine monitoring.

7.6.4 Requirements for Vendor Qualification

Divided into two sections:

1) Site Qualification

2) Site follow-up

1) Site Qualification

Vendors selected are evaluated for compliance with the appropriate set of regulations. The results of the audit will be reviewed and the need for a ''site follow-up visit'' Site qualification visits are generally performed on a cyclical basis; at least once every 24 months is suggested

unless the supplier becomes problematic. Continuous monitoring program is also an essential component.

2) Site Follow-Up

Carried out during the course of the project.Examples of issues that will usually result in site follow-up include:

• Lack of adherence to standard operating procedures.

• Lack of appropriate documentation of training, major renovations to the physical structure of the facility.

• If standard operating procedure (SOP) or data integrity questions arise during the course of the study or project.

Test Your Progress

1. What do you understand by vendor rating?

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2. Explain in brief the pricing factors criteria for evaluation of vendor rating.

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3. What are the goals of standardization?

4. What are the effects of standardization?

5. What are the revenue generation opportunities created by vendor certification plans?

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7.7 Vendor And Supply Reliability

Reliability is simply defined as the ability of a company to consistently supply an acceptable product at the required time. Supplier quality is a supplier's ability to deliver goods or services that will satisfy customers' needs. Supplier quality management is defined as the system in which supplier quality is managed by using a proactive and collaborative approach.

Large suppliers are generally reliable because they have enough resources and systems in place to make sure they can still deliver if anything goes wrong. However, you can often develop a closer relationship with small suppliers – especially if you are their main customer. In these cases your supplier may also respond better to different requests, such as rush orders or holding on to stock.

There are seven criteria by which reliability can be judged. These are:

1. **Quality**

A quality product must be consistently delivered that satisfies the customer's needs. Quality should be guaranteed through documented production practices and defined process controls.

2. **Process Equipment**

State-of-the-art equipment must be maintained and improved through organized maintenance procedures and capital investment to ensure that quality is maintained on a long-term basis.

3. **Research and Development**

Initiatives and resources must be continually invested to improve the product in response to market demands.

4. **Geography**

Plants must be located in countries where economic, political, or naturally occurring phenomena or infrastructure will not inhibit production or delivery.

5. **Financial Health**

A solid financial situation must be demonstrated, including good cash flow for flexible operation of the business and strong support for capital investment. The company cannot be financially burdened by either a second-party owner or subsidiary.

6. **Management Commitment**

Commitment to the future must be evident and supported by long-term business relationships.

7. **Raw Materials**

Reliable sources of raw materials must be available as well as strategies to maintain them.

7.7.1 Challenges to find the right vendor

There are a number of challenges. We need to look at:

- The product quality
- The production facility
- The vendor's financial capacity
- Brand value, and so on.

It takes a lot of time to find out the real position of a company in the market.

7.7.2 Selection Criteria ForVendor And Supplier Selection

Common vendor and supplier selection criteria includes:

- Previous experience and past performance with the product/service to be purchased
- Relative level of sophistication of the quality system, including meeting regulatory requirements or mandated quality system registration (e.g., ISO 9001)
- Ability to meet current and potential capacity requirements on the desired delivery schedule
- Financial stability
- Technical support availability and support in developing and optimizing processes
- Total cost of dealing with the supplier, including material cost, communications methods, inventory requirements, and incoming verification required
- The supplier's track record for business-performance improvement
- Total cost assessment.

7.8 Developing New Source of Supply

First of all it is essential to make a list of all the things that make a good supplier. Then compare your present suppliers with each item on your list. You will find that very few of your supplier measure up to the ideal. Those where you spend the most should be given priority for improvement efforts. Next on your action list are those that do the poorest in matching your criteria.

Look for new suppliers to replace your worst performers unless you are certain the existing suppliers can be improved within a reasonable time.

Let us look at some of the issues that call for improvement.

- Delivery on schedule.
- Low costs or competitive pricing.
- Quality that meets or exceeds specifications.
- Prompt service.
- Flexible terms and conditions.
- Dependability; always performs as promised.
- Maintains a stable and profitable business.
- Innovative; offers valuable ideas.
- Cooperative and reasonable with requests.
- Trustworthy; keeps buyer information confidential.

Make sure that your existing suppliers know exactly what you expect. Don't take this for granted, especially if you are new to your organization. Don't assume your predecessor conveyed what was expected. He may have had different expectations or he may not have communicated anything at all to the supplier about how to perform.

Although you look for new suppliers to replace your poor performing ones, it doesn't mean you necessarily are going to quickly replace them, if ever. It simply means you are preparing to do so if absolutely necessary. You never want to change suppliers hastily or without very good reasons. You certainly don't want to change to a new supplier unless you are reasonably sure that the new supplier will be better than your last.

You should pre-qualify new suppliers by obtaining financial information, references, and samples if appropriate. Make sure you actually check the references out. Your company may be willing to help the new supplier if you determine that the potential new supplier does not have sufficient financing or equipment to do the job but qualifies in every other respect.

You or others in your organization may need to do some training in order to obtain your ideal supplier. You may need to set up meetings with the supplier's financial or accounting personnel, with its operations personnel, with its marketing or service personnel, or with any other department that may be involved with your business. These sessions may only last a few hours each or may last for many days depending on the complexity of the products being purchased and other aspects of the purchase.

It is beneficial to go over product specification carefully and in detail. Assess the technical capabilities of the supplier. It may be necessary to enlist the help of your own technical personnel to help with this evaluation. The buyer may require the potential supplier to hire one or more specialists necessary to produce the type of product required.

Many companies require samples of the final product for testing or approval before giving a new supplier the go ahead for the full order quantity. It may be necessary to get new samples several times before final approval is given.

For some products, developing a new supplier may only take a few days or less. In other cases it may take many months to find, qualify, and train a supplier to meet your standards. Frequent and constant monitoring of new suppliers may be required. You can't assume that once the locating, qualifying, selection, training, and order placement is submitted that everything will then be satisfactory. Inspections and supplier audits are necessary to keep excellent suppliers although the amount of checking usually ends up being much less than with problem suppliers.

Test Your Progress

1. What are the improvement issues that occur in developing in new sources of supply?

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2. What are the challenges faced to find the right vendor?

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3. List at least 4 criteria for proving reliability of vendor and supply.

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4. What happens after developing new source of supply?

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5. On what selection criteria are vendors selected for supply? Explain in short.

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7.9 Summary

Purchasing research is the systematic design, collection, analysis and reporting of data and findings relevant to a specific purchasing situation facing the company.

Areas of Purchasing Research:

1. Quality
2. Quantity
3. Suppliers:
4. Time
5. Price

Identification Of Right Sources Of Supply : The first step in the process of sourcing is to identifying the sources of supply. It needs to be decided at this time, whether the product will be sourced from the domestic market or from the international market.

Cost associated with global parameter includes:

1. Country of Origin effects:
2. Foreign Currency Fluctuations:
3. Tariffs:
4. Foreign Trade Zones:
5. Cost of Carrying Inventory:
6. Transportation Costs

Sourcing Tips to Identify Sources of Supply

1. Check Certifications
2. Evaluate The Geo-Political Climate
3. Finding Reputable Suppliers
4. Gauge Financial Stability
5. Assess Weather-Related Risk
6. Align Manufacturing and Shipping Locations To Your Needs
7. Ask For Accessible Inventory Information
8. Know Their Scalability
9. Check Their Commitment To Customer Service
10. Get Lead Time and Delivery Statistics
11. Read Into The Payment Terms

Vendor rating is the result of a formal vendor evaluation system. Vendors or suppliers are given standing, status, or title according to their attainment of some level of performance, such as delivery, lead time, quality, price, or some combination of variables.

Criteria For Evaluation

- Pricing factors
- Quality factors
- Delivery factors

- Service factors

Standardization or standardization is the process of implementing and developing technical standards based on the consensus of different parties that include firms, users, interest groups, standards organizations and governments.

Effects of Standardization

1. Firms
2. Consumers
3. Technology

Vendor Certification Plans: Usually, the focus of certification programs center on the credential seekers and the many benefits they might gain from such certification. But it's also worth considering that cert programs provide many benefits to vendor companies or sponsor organizations as well.

Steps Involved In Certification Process

Step1: Preparing For The Audit
Step 2: Performing The Audit
Step 3: Reporting The Results
Step 4: Audit Closure, Correctiveaction, And Follow Up

Requirements for Vendor Qualification

Divided into two sections:
1) Site Qualification
2) Site follow-up

Seven criteria for vendor and supplier selection:

1. Quality
2. Process Equipment
3. Research and Development
4. Geography
5. Financial Health
6. Management Commitment
7. Raw Materials

Developing New Source of Supply: Look for new suppliers to replace your worst performers unless you are certain the existing suppliers can be improved within a reasonable time.

7.10 Test Your Progress

1. What is purchasing research?

2. What areas do purchasing research cover?

3. What are the tips to identify sources of supply?

4. What do you understand by identification of right sources of supply? Explain in detail.

5. What does Cost associated with global parameter includes?

6. What do you understand by sourcing tips to identify sources of supply?

7. What do you understand by vendor rating?

8. What is the criteria for evaluation of vendor rating in terms of following:

a. Pricing factors

b. Quality factors

c, Delivery factors

d. Service factors

9. What is standardization? Also define its goal.

10. What are the effects of standardization?

11. What do you understand by vendor certification? Also state its benefits.

12. What are the revenue generation opportunities with reference to vendor certification?

13. What are the steps involved in certification plans?

14. What are the requirements for qualifications of vendor?

15. What are the 7 criteria for vendor and supply reliability?

16. What are the challenges observed to find the right vendor?

17. What is the selection criteria for vendor and supplier selection?

18. How are new sources of supply developed?

19. What are the issues faced in improving the new sources of supply?

7.11 Suggested Readings

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Block III :Material Cost Management

In **Block III**you will learn about cost reduction, cost control v/s cost reduction, price analysis. You will also learn about material cost reduction techniques, variety reduction, standard costing. Besides this you will also learn about cost effectiveness, cost analysis for material management, and material flow of cost control in detail.

In **Unit 8**students will get a thorough knowledge of Cost Reduction: Cost Control V/S Cost Reduction, and Price Analysis.

In **Unit 9** you will be able to gather information about Material Cost Reduction Techniques, Variety Reduction, Cost Reduction And Value Improvement, Techniques Of Cost Controlor accounting, Standard Costing,

In **Unit 10**you will be able to analyseCost Effectiveness, Cost Analysis For Material Management, Material Flow Cost Control.

UNIT 8 :COST REDUCTION

Unit Structure

8.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofCost Reduction.
- Completely understandConcept of Cost Control.
- Get an idea of Cost ControlV/S Cost Reduction.
- UnderstandPrice Analysis.

8.1 Introduction

In any organization, the major objective is to maximize profit, but the main constraints facing them are the rise in cost of operation. Due to this, the cost of production increases and could lead to certain cost control and cost reduction which make it complex for many organizations to operate as well organized cost limit of knowledge.

In any business organization, the goal of most organizations is to achieve maximum profit. Since management is concerned with the profitability which is one of the tools to evaluate the business performance especially in a manufacturing company, the need of increasing sale will arise and this will eventually lead to increase in production capacity and as a result lead to increase in cost. Thus, the need for cost control and cost reduction is required to achieve maximum profit in competitive market where demand is affected by the price of goods and services.

8.2 Cost Reduction

Cost reduction, as related to any business, is just as it sounds. The definition of cost reduction, according to Wikipedia is:

"The process used by companies to reduce their costs and increase their profits. Depending on a company's services or product, the strategies can vary."

In this process, the essential features and quality of the product are kept intact and is limited to the constant savings in the cost of production, administration, selling and distribution. The basic purpose is to lower down the cost occurring at the time of production, storing, selling etc.

Cost Reduction is not related to fixing targets and standards, but it is about improving the standards. It is an ongoing process, which can be applied to all the activities of the concern.

It focuses on the two primary areas:

- **Reduction in Expenses**: Decrease in the expenditure in the given volume of output, leads to the decrease in unit cost
- **Increase in Productivity**: The overall decrease in unit cost, by increase in the output, for the given expenditure.

Cost reduction can be attained by the integration of these factors. Further, it is a bit difficult to find out the contribution made by each factor to the savings.

8.2.1 Need for Cost Reduction

It is important to employ a cost reduction strategy because:

- Cutting benefits and staffing costs can lead to employee frustration and dissatisfaction. Furthermore, hiring the cheapest employee may not lead to the best possible results for that position, ultimately leading to reduced quality and customer satisfaction.
- Cutting vendor costs can lead to lower quality, incorrect orders, and employee frustration because of the extra time spent dealing with vendor mistakes.
- Cutting administrative costs can reduce the quality of customer service for tasks such as billing, payments and other administrative duties that affect customer satisfaction.

8.2.2Assumptions of Cost Reduction

The three-fold assumptions of cost reduction are described below:

1. Savings in per unit cost
2. Savings is long lasting in nature.
3. Quality and utility of the products and services remain uninfluenced.

Cost reduction is possible by identifying and removing wasteful, unwarranted and unnecessary elements from the design and manufacturing techniques. It results in the maximization of profit, as the overall cost of production is reduced.

8.2.3Techniques of Cost Reduction

Cost Reduction results in the increase in savings of the company, i.e**. increased profitmargins**. The company may pass such savings to the customers as the decrease in the product prices or more quantity in the given price. The decrease in the overall pricing will lead to the increase in demand for the product.

However, while implementing cost reduction techniques, one must keep in mind that the quality of the product or service should not be sacrificed.

Following are the techniques of cost reduction:

1. Just-In-Time (JIT) System

The main aim of JIT is to produce the required items, at the required quality and quantity, at the precise time they are required. JIT purchasing requires for the items where too much carrying costs associated with holding high inventory levels. purchasing system reduces the investment in inventories because of frequent order of small quantities.

2. Target Costing

Target costing refers to the design of product, and the processes used to produce it, so that ultimately the product can be manufactured at a cost that will enable the firm to make profit

when the product is sold at an estimated market-driven price. This estimated price is called target price.

3. Activity Based Management(ABM)

Activity based management is the use of activity based costing to improve operations and to eliminate non-value added cost. The main goal of ABM is to identify and eliminate non-value added activities and costs.

4. Life Cycle Costing

Life cycle costing estimates and accumulates costs over a product's entire life cycle in order to determine whether the profits earned during the manufacturing phase will cover the costs incurred during the pre-and-post manufacturing stage.

5. Kaizen Costing

Kaizen costing is the process of cost reduction during the manufacturing phase of an existing product. The Japanese word 'Kaizen' refers to continual and gradual improvement through small activities, rather than large or radical improvement through innovation or large investment technology.

6. Business Precess-re-engineering

Re-engineering is a complete redesign of process with an emphasis on finding creative new ways to accomplish an objective.The aim of business process re-engineering is to improve the key business process in an organization by focusing on simplification, cost reduction, improved quality and enhanced customer satisfaction.

7. Total Quality Management(TQM)

Under the TQM approach, all business functions are involved in a process of continuous quality improvement.

8. Value chain

Value chain analysis is a means of achieving higher customer satisfaction and managing costs more effectively. The value chain is the linked set of value creating activities all the way from basic raw materials' sources, component suppliers, to the ultimate end-use product or service delivered to the customer.

9. Bench Marketing

Bench marketing is a continual search for the most effective method of accomplishing a task by comparing the existing methods and performance levels with those of other organizations or other sub-units within the same organization.

10. Management Audits

Management audits, also known as performance audits, can be used to facilitate cost reduction in both profit and non-profit organizations. Management audits are intended to help management to do a better job by identifying waste and inefficiency and recommending a corrective action.

8.3 Cost Control

Cost Control is a process in which we focus on controlling the total cost through competitive analysis. It is a practice which works to align the actual cost in agreement with the established norms.

It ensures that the cost incurred on production should not go beyond the pre-determined cost. Cost Control involves a chain of various activities, which starts with the preparation of the budget in relation to production.

Thereafter we evaluate the actual performance. After that we compute the variances between the actual cost & the budgeted cost and further, we find out the reasons for the same. Finally, we implement the necessary actions for correcting discrepancies.

The major techniques which used in cost control are standard costing and budgetary control. It is a continuous process which helps in analyzing the causes for variances.

It involves:

1. Determination of standards;
2. Ascertaining actual results comparing the standards;
3. An analysis of the variances;
4. Establishing the action that may be taken.

8.3.1 Characteristics of Cost Control

The characteristics of cost control are presented below:

1. Delineation of Centers of Responsibility:

Overlapping operations and responsibilities destroy the very essence of cost control.

2. **Delegation of Authority**

If persons are charged with responsibility without authority, the cost control will be ineffective. Hence, proper or adequate delegation of authority is necessary for proper cost control.

3. Measurement of Performance:

A performance is to be measured with the help of reasonable criteria. Standard costing can be used as reasonable criteria. The person whose performance is being measured should participate in setting the standards.

4. Relevance of Controllable Cost:

Only few costs are controllable at different levels of management. The management evaluates the performance of an employee with the help of costs incurred that are controllable.

5. Cost Reporting:

Cost report provides a basis for effective cost control. Hence, if the cost reports is not prepared and submitted in time, the cost control cannot be exercised.

6. Constant Efforts:

The measurement of performances, knowing functioning of manufacturing department and analysis of costs require constant efforts. This type of constant efforts leads to cost consciousness and result in cost control.

7. **Policies and General Objectives**:

All the employees of the organization are communicated the policies and general objectives. If so, cost control is very easy.
Cost control is exercised through various techniques like standard costing, budgetary control, inventory control, quality control, performance analysis and reporting.

8.3.2 Steps involved in Cost Control

The following steps have been adopted to exercise cost control:

1. Planning:

Planning may be done as in the form of budget, standard, estimate and the like. The past events have been considered for proper planning. The planning is expressed both in physical as well as monetary terms. The standards are used as yardsticks.

2. Communication:

The planning and policy should be communicated to the employees. If so, they can assume the responsibility and do the work properly. Communication has two directions. They are upward direction and downward direction. Instructions flow from the top level to lower level. Likewise, report on performance move towards upwards.

3. Motivation:

The performance is evaluated; costs are ascertained and reported to the management regarding the results of performance. Such report may be act as motivating force and leads to better performance in the days to come.

4. Appraisals and Reporting:

The actual performance is compared with preplanned standard and find the deviations. The causes for such deviations are also analyzed. Finally, the deviations with reasons are reported to the top level of management for cost control.

5. Decision Making:

The top management may review the report on many directions. Lastly, the management takes necessary corrective actions. Finally, the existing standard or budget may be revised according to the prevailing situations.

8.3.3 Advantages of Cost Control

The chief advantages of cost control are briefly explained below:

1. Return on capital employed may be increased.

2. The volume of profit is also increased with minimum output and sales.

3. Management can increase the productivity with available resources.

4. The employees are getting job continuously.

5. The employees can get reasonable remuneration with bonus.

6. The available factors of production and resources are effectively used.

7. The credit worthiness of the company is increased.

8. There is a possibility of prosperity and economic stability of the industry.

8.3.4 Tools of Cost Control:

Control has a regulatory effect. For better performance and better results certain means of control have been evolved. These are called control techniques.

Mainly two types of standards are established to control costs:

(i) External

(ii) Internal

External standards are applied for comparing performance with other organisations. The external standards are used for comparing the cost performance with the other firm take the shape of a set of cost ratios.

Internal standards, on the other hand, are used for the evaluation of intra firm cost elements like materials, labour, etc.

The internal standards used for cost control are:

(i) Budgetary control

(ii) Standard costing

(i) Budgetary Control:

Budgetary control is derived from the concept and use of budgets. A budget is an anticipated financial statement of revenue and expenses for a specified period. Budgeting refers to the formulation of plan for given period in numerical terms. Thus budgetary control is a system which uses budgets as a means for planning and controlling entire aspects of organisational activities or parts thereof.

Features of Budgetary Control:

(i) Budgetary control establishes a plan or target of performance.

(ii) It tries to measure the outcomes of activities in quantified terms.

(iii) It tries to focus attention of the management on deviation between what is planned and what is being achieved so that necessary action can be taken.

(ii) Standard Costing:

Standard costing is one of the prominently used systems of cost control. It aims at establishing standards of performance and target costs which are to be achieved under a given set up working conditions. It is a pre-determined cost which determines what each product or service should cost under certain situation.

Standard costing is defined as the preparation and use of standard costs, their comparison with actual costs and the measurement and analysis of variances to their causes and points of incidence. Standard costs should be obtained under efficient operations.

It starts with an estimate of what a product should cost during a future period given reasonable efficiency Standard costs are established by bringing together information collected from various sources within the company.

The degree of success is measured by a comparison of actual performance and standard performance. For example, if the standard material input for a unit of production is Rs. 500 and the actual cost is Rs 475 then the variance of Rs. (-) 25 is the measure of performance, which shows that the actual performance is an improvement over the standard.

This comparison of actual costs with standard cost will help in fixing responsibility for non-standard performance and will focus attention on areas in which cost improvement should be sought by showing the source of loss and inefficiency.

8.3.5 Basic Requirements in the Use of Standard Costing:

The basic requirements are the following:

(i) The ability to establish a meaningful standard.

(ii) A system for measuring actual quantities and costs at the same level as the standard costs and quantities.

(iii) The facilities to calculate variances over time, which will allow corrective action to be taken.

8.3.6 Advantages of Standard Costing:

Standard costing has the following merits:

(i) It helps in establishing a yardstick with which the efficiency of performance is measured that helps to exercise control.

(ii) It provides how the clear goal is to be achieved by providing incentive and motivation to work.

(iii) It provides the management the basic information to fix selling price, transfer pricing, etc.

(iv) It facilitates delegation of authority and fixation of responsibility.

(v) It helps in achieving optimum utilisation of plant capacity.

(vi) It provides means for cost reduction.

(vii) Variance analysis and reporting is helpful for taking corrective measures.

Test Your Progress

1. List the advantages of standard costing.

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2.What is budgetary control and its features.

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3. What are the steps of cost control?

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4. What is the need of cost reduction in an organization?

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5. What are the techniques of cost reduction?

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6. What is cost reduction and what are its assumptions?

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8.4 Cost Control V/S Cost Reduction

COST REDUCTION	COST CONTROL
• Real and permanent savings in cost	• Temporary savings
• Saving in cost per unit	• Saving either in total cost or cost per unit
• Quality of the product remains unaffected	• Quality of the product is not guaranteed
• Dynamic approach	• Lack of dynamism
• Value engineering, Market research, Job evaluation and Merit rating are tools for cost reduction	• Standard costing and Budgetary control are tools for cost control
• It can be achieved by way of continuous process of critical examination	• It is achieved through compliance with the standards
• Corrective Function	• Preventive Function

Fig. 8.1: Difference between Cost Control and Cost Reduction

8.4.1 Difference Between Cost Control and Cost Reduction

The following are the main differences between Cost Control and Cost Reduction:

1. Cost Control focuses on decreasing the total cost of production while cost reduction focuses on decreasing per unit cost of a product.
2. Cost Control is a temporary process in nature. Unlike Cost Reduction which is a permanent process.
3. The process of cost control will be completed when the specified target is achieved. Conversely, the process of cost reduction is a continuous process. It has no visible end. It targets for eliminating wasteful expenses.

4. Cost Control does not guarantee quality maintenance of products. However, cost reduction assured 100% quality maintenance.

5. Cost Control is a preventive function because it ascertains the cost before its occurrence. Cost Reduction is a corrective function

8.5 Price Analysis

Cost and price analysis are two interdependent methods of projecting project and program costs. Price analysis looks purely at the unit price from a vendor, while cost analysis incorporates the reasonable cost to the vendor of producing the item to determine the fairness and appropriateness of the price quoted.

Depending on the method of procurement and the items in question, cost and price analysis can have very similar or very different results in supply chain decision making. Cost and price analysis both start with cost per unit. Neither ends with that simple measure.

Price analysis has four basic components:

- Analysis of any existing price history
- Comparing price to internal projections
- Comparing competitive bids from multiple vendors
- Using existing catalog or government prices for an item

Price Analysis Solution Predictive Insights

- Gain better insight into the cost drivers of products
- Determine optimal price gaps with respect to competitor products
- Identify the impact of discounted prices on the sales
- Leverage the relative price points in the portfolio

According to Hauht, the price analysis strategy is effective when applied to products that can be contrasted to other, "similar" procurements. Essentially, the goal of this general analysis is to assess whether a price is reasonable, and this depends on the type of market where the supplier operates. Performing a price analysis typically involves a few additional key components, noted Hauht, which include historical prices, market prices, and published prices.

8.5.1 How to Use Price Analysis

- Perform a general Internet search on the item using various shopping sites and search engines to get an idea of the market and published prices.

- Contact the manufacturer directly for a suggested retail price, or seek pricing quotes on the same item from competitor brands or manufacturers and seek price indices. Hauht also

- suggests seeking advice from industry peers, to get a better sense of what others have paid for the same item.

- Using the aforementioned strategies can help identify whether there has been any escalation in the price.

Once these strategies have been applied, the purchaser may assess whether a specific product has been priced fairly and if necessary, negotiate a reasonable cost.

8.5.2 Pricing Strategy of the Seller

Sellers pursue different strategies or approaches that affect the pricing of their pro- ducts or services. Some sellers rely on a detailed analysis of internal cost structures to establish price, whereas others simply price at a level comparable to the competition.

The pricing strategy of the seller has a direct impact on quoted prices. In order to remain in business, suppliers must cover their costs and earn an overall profit in order to meet their corporate objectives. In many cases, however, the price charged by a seller may have little or no relationship to actual costs. As strange as this seems, pricing strat- egies are often based on other factors that are important to the seller. A seller may quote an unusually low price to secure a purchase contract, with the intention of raising the price once it drives competition from the marketplace. In other cases, the seller may exploit its position when it senses it has the purchaser over a barrel by charging an excessive price. In still other cases, the seller may simply not understand its own costs. Several questions should be asked when analyzing a seller's pricing strategy. These include the following:

• Does the seller have a long-term pricing strategy, or is it short-term in nature?

• Is the seller a price leader (sets new pricing levels in the market), or a price follower (only matches price increases/decreases when the competition does so)?

• Is the seller attempting to establish entry barriers to other competitors by establishing a low price initially, then preparing to raise prices in the future?

• Is the seller using a cost-based pricing approach, which develops price as a function of true costs, or a market-based pricing approach? If a market-based pricing approach is being used, there may be little need for conducting a detailed cost analysis, as the price charged may be unrelated to any elements of cost.

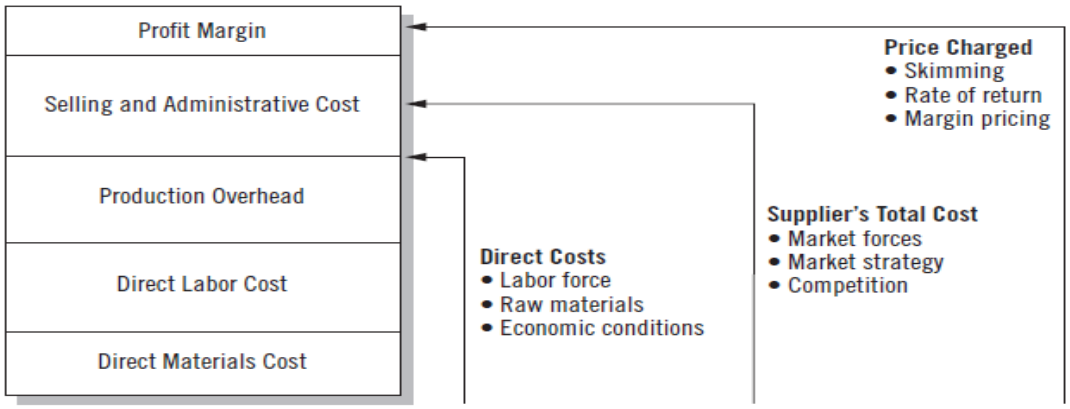

Fig.8.2 :Elements of Pricing Strategy

The elements that make up the price charged by a supplier are shown in the above figure. Essentially, the supplier's costs include materials and labor (which together make up manufacturing cost), plus overhead and sales, general and administrative expenses (which cumulatively establish the supplier's total cost), plus margin, which then equates to the price charged. Based on the interplay among these different elements, which may vary depending on the supplier's pricing model, the price charged to a buyer can vary significantly. Seller pricing strategies can be grouped into two categories: market-driven models and cost-based models. As we noted earlier, price analysis involves having the supply manager gauge the pricing strategy used by the supplier, without going into the details of how its detailed cost elements are established.

8.5.3 Price Analysis Techniques

With any purchase of goods or services, including sole source items, some type of cost analysis is required. A part of this analysis is verification of pricing. There are many ways to analyze the pricing of a product or service. Techniques for comparing price can be found in the Federal Acquisition Regulation (the FAR).

Some of the techniques recommended include:

1. Comparison of Competitive Bids

Obviously, this is one of the best means for validating price. By asking three or more suppliers of their prices for the same product, we can determine if a particular price is reasonable. However, this does not preclude total cost analysis. The lowest bid may not always represent the lowest cost. The total cost of acquisition must be analyzed. There may be cost associated with making

the lower cost product perform to standards, the additional cost of early replacement or the cost of redesign and/or testing required to make the lower cost product applicable. This "total cost of acquisition" is the real cost that must be compared. A brief statement as to why a particular quotation is selected is required.

2. Comparison of Prior Quotations

In some circumstances, it may be most effective to compare recent (with the past 24 months) quotations for the same product or service to determine the viability of the current quotation. This is particularly helpful when timing of the acquisition is critical and solicitation of the competitive quotes would delay the procurement. An explanation of why comparison of prior quotations was used must accompany this procedure.

3. Comparison of Published Price List

This method should only be used for materials that are sufficiently similar to items or services are available to the general public and whose price would appear in a published price list. However, when comparing these price lists, it is important to consider standard industry discounts for the items or services. As an example, most electrical supply houses will offer standard discounts to purchasers doing a particular dollar or quantity volume. Such discounts must be considered when comparing list prices and noted in the procurement documentation.

4. Prices Set by Law or Regulation

Sometimes, prices are set by a law or regulation. When this occurs, there is usually a "pronouncement" of some form type that references the pricing structure. This must be referenced when procuring such items.

5. Similar Item Comparison

When an item or service is fairly unique, it is possible to compare items that are similar to those being purchased. A statement as to why the common item will not meet the specification should accompany the price comparison.

6. Rough Yardstick Comparisons

This technique uses a rough comparison between like items based on measurable similarities such as price per pound, cost per horsepower or price per test sample. Again, an explanation of the similarities must accompany this analysis.

Many times, it is difficult to find comparable items or services. In these situations, it may be necessary to rely on a technical analysis. While time consuming, this is the best method to use when validating price for complicated sole source items. In this analysis, the supplier of the goods or services is asked to provide:

1. List of materials and their cost.

2. Number and kinds of labor hours required.
3. Any special tooling and facilities proposed.
4. A reasonable plan for use and disposal of scrap.
5. Any other cost, including profit, relevant to the cost of providing the service or item.

Each item on the supplier's bill of materials is then analyzed using the above noted techniques. Negotiation of variables such as overhead and profit can occur as well. Again the exercise must be documented.

In all price and cost analysis, time is required. We recommend beginning the process as early as possible, even if funding has not yet been guaranteed. In all circumstances, the Procurement staff will be happy to assist.

Fig. 8.3: Price Analysis Techniques

Test Your Progress

1. What do you understand by price analysis?

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2. What are the pricing strategies from the viewpoint of seller?

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3. What is the basic difference between cost control and cost reduction? Explain in short.

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4. What are the 4 basic components of price analysis?

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5.What do you understand by price analysis techniques?

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8.6 Summary

Cost Reduction is not related to fixing targets and standards, but it is about improving the standards. It is an ongoing process, which can be applied to all the activities of the concern.

Techniques of Cost Reduction

- Just-In-Time (JIT) System
- Target Costing
- Activity Based Management(ABM)
- Life Cycle Costing
- Kaizen Costing

- Business Precess-re-engineering
- Total Quality Management(TQM)
- Value chain
- Bench Marketing
- Management Audits

Cost Control is a process in which we focus on controlling the total cost through competitive analysis. It is a practice which works to align the actual cost in agreement with the established norms.

Characteristics of Cost Control

- **Delineation of Centers of Responsibility:**
- **Delegation of Authority:**
- **Measurement of Performance:**
- **Relevance of Controllable Cost:**
- **Cost Reporting:**
- **Constant Efforts**
- **Policies and General Objectives**

Steps involved in Cost Control

- **Planning**
- **Communication**
- **Motivation**
- **Appraisals and Reporting**
- **Decision Making**

Mainly two types of standards are established to control costs:

(i) External

(ii) Internal

Price analysis looks purely at the unit price from a vendor, while cost analysis incorporates the reasonable cost to the vendor of producing the item to determine the fairness and appropriateness of the price quoted.

Price analysis has four basic components:

- Analysis of any existing price history
- Comparing price to internal projections
- Comparing competitive bids from multiple vendors
- Using existing catalog or government prices for an item

Price Analysis Techniques

- **Comparison of Competitive Bids**
- **Comparison of Prior Quotations**
- **Comparison of Published Price List**
- **Prices Set by Law or Regulation**
- **Similar Item Comparison**
- **Rough Yardstick Comparisons**

8.7 Test Your Progress

1. What do you understand by cost reduction? What does it focus on?

2. What is the need for cost reduction?

3. What are the assumptions of cost reduction?

4. What are the techniques of cost reduction? Explain each technique in short.

5. What is cost control? What does it involve?

6. What are the characteristics of cost control?

7. What are the steps involved in cost control?

8. What are the advantages of cost control?

9. What are the tools of cost control?

10. What do you understand by budgetary control? Also state its features.

11. What do you understand by standard costing? What are its basic requirements?

12. State advantages of standard costing.

13. What is the difference between cost control and cost reduction?

14. What is price analysis? What are its 4 basic components?

15. What do you understand by price analysis solution predictive insights?

16. How can we use price analysis?

17. What are the pricing strategies of seller?

18. What are the techniques of price analysis?

8.8 Suggested Readings

1. https://www.yourarticlelibrary.com/
2. https://www.wiley.com/
3. https://www.slideshare.net/
4. http://manufacturship.com/
5. https://core.ac.uk/
6. https://businessjargons.com/
7. https://vmec.org/
8. https://www.toppr.com/
9. https://accountlearning.com/
10. https://www.wallstreetmojo.com/
11. https://www.accountingnotes.net/
12. http://elearning.nokomis.in/
13. https://kawazhang.gitbooks.io/
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UNIT 9 : MATERIAL COST REDUCTION

Unit Structure

9.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge of Material Cost Reduction Techniques.
- Completely understand Concept of Variety Reduction.
- Get an idea of Cost Reduction And Value Improvement.
- Understand Techniques Of Cost Control.
- Learn about Standard Costing.

9.1 Introduction

Small companies can feel overlooked and unwanted when dealing with larger suppliers. As a consequence, some small companies grudgingly accept the terms and treatment dictated by the supplier. But they really do not need to fall into that trap – suppliers are just as interested in sales as one should be. In fact, many suppliers prefer to work with a number of smaller purchasers than a single large account on which they become dependent.

Cutting costs is important and should be a perpetual effort in every small company. If one work with a supplier that will not work with seriousness to reduce the company costs, then it is time to find another one.

9.2 Material Cost Reduction Techniques

Whatever product a company makes, the cost of its materials is probably one of its largest expenses, directly affecting profitability. But how do one reduce material costs without impacting the quality of its final product and altering what its customers have come to expect and rely on?
Like most effective business cost-cutting measures, reducing the cost of goods starts with a thorough analysis of the various direct and ancillary ways in which one's base materials consume cash flow.

For example, if a company has incurred INR 40,000 in carrying cost of inventory in a year for 4,000 units of stored inventory on an average. Then the carrying cost per unit comes to INR 10 per unit. Yes, it's a significant cost. And, therefore demands reduction.

9.2.1 Ways to Reduce Material Cost

Following are the ways to reduce material cost:

1. Substitute Lower Cost Materials Where Possible

Products can usually be manufactured utilizing a variety of different materials, depending on marketplace requirements and the practices of the manufacturers. Technology is constantly improving older materials and creating new ones, prices move up and down due to political goals as much as supply and demand, and processing methods change.

When considering a change in the materials used in your products, be sure to recognize all factors involved. For example, substituting a carbon steel for a higher-cost stainless steel will save money, but will also reduce corrosion protection, which may be a valuable product feature for buyers.

In addition, different materials may require changing your method of manufacture by increasing cycle times, as well as labor costs. And in some cases, changing the composition of

a product may be worthwhile, even when the material costs are higher due to a simplified production process.

2. Reduce Waste

Product engineers typically design products without considering the production consequences, particularly how non-standard purchase units of size, volume, or weight must be modified to create the final product. Production methods are usually established to minimize the costs of the highest component of production, either labor or materials, at the time the method is established.

If, for example, the cost of the raw material is low, the volume of excess material or "scrap" may not be considered to be important relative to the labor cost. Over time, however, prices for materials and labor may shift. This alters the ratio between the two elements and their related expense, so that the cost of scrap material becomes excessive. Modifying product designs and altering production methods in order to utilize standard raw material units may reduce excessive scrap and its associated costs.

3. Eliminate Unnecessary Product Features

Custom products cost more to manufacture than mass-produced products, and any non-standard feature requires an additional step in the production process, increasing the expense.

Examine your customers' motives for purchasing your products: Do they buy your products because of their low cost, high quality, unique look, or some other reason? By determining what is important to your customers, you can selectively attack elements which are *not* as important to reduce cost.

4. Negotiate

The level of your profit depends upon your ability to receive the highest possible price for your products and pay the lowest possible price to your suppliers and vendors. Every participant in the supply chain is looking for business and will take unusual, often extraordinary steps to make or save a sale – this is especially true in a poor economy.

Ask for a discount every time you request an estimate or place an order, and keep asking until you actually place the order. If you do not get a reduction in price, ask for favorable financing terms, prepaid freight, or other freebies. By negotiating, you can maximize your position as a buyer – as your buyers do to you.

5. Leverage Suppliers

In many cases, a little research will turn up alternative suppliers of similar products available to you. Determine whether there are any different features between suppliers and whether these differentiating features benefit you or your customers. Is it worthwhile, for example, to have a faster delivery time or favorable financing at a slightly higher price? If not, purchase from the supplier offering the product at the lowest cost.

6. Buy Need, Not Potential

Toyota Motor Company of Japan is considered the father of the "just in time" (JIT) production system. Requiring suppliers to make frequent deliveries eliminates excess inventory and carrying costs. While JIT has been criticized in recent years due to the pressure placed on suppliers and the need for an accurate sales forecasting model, it remains one of the more popular cost-cutting methodologies around the world. The lesson for a small business here is to not buy inventory or equipment until you need it or can determine an immediate benefit in either lower costs or improved customer benefits.

7. Trade Time for Discounts

The opposite approach to JIT is to purchase and receive materials on the supplier's schedule, rather than when you will use the material. This means you will incur additional associated costs in excess inventory. However, allowing vendors and suppliers to deliver materials on their cycle times, rather than on your production schedule, may result in a lower price.

In order to decide which method is most beneficial to you – JIT or the supplier's schedule – consider the final delivered costs of the material, your carrying costs, and the impact of each delivery method on your internal production processes and schedule. If the discount using the manufacturer's schedule is greater than the expenses you'll incur, use the manufacturer's schedule. But be sure to confirm the delivery schedule with the vendor and the lower cost before placing an order.

8. Buy Bargains

From time to time, unbelievable bargains appear in the market. A vendor may need to dump inventory due to his or her banking relationship, for funds to fill other contracts, or because the company is going out of business. Whenever such opportunities arise, take advantage of them – many times the price will be less than the seller's actual manufactured cost.

9. Transform Buyers Into Suppliers

If your finished product is a component of an end product, ask the buyer of your component to contract directly with the raw material vendor to furnish raw materials to you for the processing of the component. In all likelihood, your profit margin on the raw materials is considerably less than the margin on your processing labor and overhead. Transferring material supply responsibilities to your buyer will eliminate a significant cost for you without substantially reducing your profit margin.

10. Barter Finished Goods for Raw Materials

If your products or services are used by any of your vendors, selectively approach them about a non-cash trade between your two companies. Usually, the exchange rate for two different products in a barter is the standard retail price of each. If the gross profit margin on your product is considerably higher than the gross profit margin of the exchanged product, it is to your benefit to make the exchange.

Remember: Bartered goods and services must be fully and accurately reflected in your company books and financial statements.

11. Provide Warehouse and Distribution Services

Manufacturers minimize their costs by volume purchasing, assembly line production, and concentrating operations in a single location. As a consequence, shipping and handling become more expensive when they are required to ship long distances to their customers.

If you have excess space, offer your main suppliers a regional warehousing capacity in return for reduced prices on your purchases. For example, a local custom upholstery firm became the regional warehouse for its main supplier, an Australian firm that manufactured Teflon membrane material, in return for a reduced price on materials, as well as a nominal payment each time the firm shipped an order to other companies in the region.

12. Offer Quick Payment for Lower Prices

For many companies, cash flow is more important than profits, particularly in the short-term. During periods of financial stress, companies simply cannot afford to keep excess inventory or allow the payments of accounts receivable to be delayed.

Inform your suppliers that you are willing to consider cash purchases in return for low prices. If your operation is financially capable of holding the inventory until it is needed, the use of cash is justified.

For example, a Texas shade structure manufacturer in 2010 produced a large number of prefabricated structures for a remodeling/rebranding program of a national food chain. Due to the economy, the remodeling program was delayed and extended from one to five years. Needing the cash tied up in the fast food inventory for other contracts, the company sold the prefabricated structures at-cost to the construction company responsible for the remodeling. The cost per unit to the construction firm was less than half of the initial price paid for each unit.

13. Enter Into Cooperative Purchase Agreements to Gain Buying Muscle

It is a truism that the larger the purchase, the more attentive the seller. Higher volume buys respect and discounts. Contact other companies that use your suppliers to combine orders, thus increasing the per-order quantity for the supplier. Since most suppliers treat sales and logistics separately, requiring the seller to ship different portions of the order to separate locations should not be an obstacle.
If necessary, team with your competitors to gain leverage with the supplier (or suppliers). Since you and your competitor will be paying the same price for the same material, neither will gain or lose an advantage over the other. It is a win-win for each company.

14. Negotiate Long-Term Supply Agreements

While a single order might be small, the total volume of material used over a period of time – a single quarter of the year, multiple quarters, or a full year – will be significantly larger. Offer to use a supplier exclusively for a specific period in return for a set lower price and better terms. While you will lose the opportunity to change suppliers during the contract term, the offsetting benefits of a lower price and a firm supply should compensate for your loss of flexibility.

15. Recycle and Take Advantage of Reverse Logistics

Recycling is a good way of reducing the amount of new raw materials to be used in manufacturing, but it may require a lot of technical expertise depending on the product being manufactured and the technology being used. You can take advantage of reverse logistics (the return of products from customers for disposal or repair) and re-use certain components back into production. You can even reuse raw material such as water through industrial water purification systems which can lower costs while also promoting sustainability.

9.2.2 Techniques of material cost reduction

To reduce the carrying cost of inventory, follow these time-tested techniques:

- Set the raw material order quantity using EOQ(Economic Order Quantity) method. EOQ refers to the quantity of material that should be ordered in a single lot. Purchasing at EOQ helps to keep the total of carrying and ordering cost minimum. The formula to calculate EOQ is square root of 2DS/C. Where, D is demand in units & S is the ordering cost & C is the carrying cost per unit.
- Consider using JIT(Just-In-Time) method to avoid over-stocking of inventories. JIT means ordering inventories only when it's actually needed for production. That avoids unnecessary stocking & thereby reduces carrying cost.
- Prioritize & manage stock using the ABC system of control. The ABC system suggests to classify your inventory into 3 categories: A,B& C. The inventory that's high in value (comprising at least 50% of the total inventory value) falls under A category. The inventory that's moderate in value (35%) falls under B category. And, the rest falls under C category. To reduce carrying cost, you need to have a stricter control on A category items, moderate control on B category items & low control over C category items.
- Classify inventory as per the VED(Vital, essential, desirable) method. While the ABC method advocates costing approach, this method recommends a qualitative way to manage inventory. All vital(critical for production) raw materials should be classified under Vital category. The

moderate ones should fall under Essential category & the least critical ones should fall under Desirable category. The vital category of inventories requires a stricter control followed by essential category & desirable category.

- Regularly inspect the quality of stock to avoid pilferage & damage.
- Follow the FIFO (First In First Out) method of stock movement to avoid shrinkage cost
- Consider renting a smaller or cheaper warehouse instead
- Sub-let the vacant spaces in warehouse, if possible
- Look if you can get rid of the warehouse staff (the production guys can take care of that stuff)
- Set a threshold limit for the amount of money blocked in inventory. Example: Set an inventory carrying cost limit of 10% on sales. If the cost crosses that level, you need to take a few emergency steps to release the blocked funds.

  The idea is to reduce the inventory to such an optimum level that minimizes the carrying cost & at the same time doesn't affect the production schedule or sale.

9.3 Variety Reduction

Variety reduction involves reducing the number of different solutions used to fulfill the same need. When considering developing a procurement strategy for a new category, it is common to find that there is a variety of different standards and solutions employed across an organization to fulfill broadly the same need. Similarly, when looking at the range of items held in stock, it may be that there is more than one line held in stock to meet the same need. Variety reduction involves engaging with stakeholders and identifying whether it is possible to reduce the number of different solutions. If one solution can apply across the organization this would involve standardization.

9.3.1 Need of Variety Reduction

Variety reduction has become an essential part of materials management activities. Various purchases are made often to meet the urgent requirements for specific purposes and a good percentage of these materials thus obtained, very soon become 'slow moving' or even a totally 'dead stock' item within a short period.

Future purchases are not generally linked with stock availability because of the fact that many items are not properly identified and included in the stores catalogue. Economic purchases, storage and control in varieties directly lead to lower inventory cost, and proper usage of

materials make substantial contribution to profit, which in turn could generate additional scope of activities.

Return on capital is generally regarded as an effective measure of efficiency. This is expressed as:

Return on Capital = Profit/Sales x Sales / Capital

'Profit to sales' ratio does not always give a true picture of the results of or industrial enterprise as profit depends on many external factors like, statutory controls, government policies, political and economic influences etc. on which management has little control. 'Sales to capital' is better measure to assess performance or, rather it should be modified as 'sales to working capital' ratio, as little can be done with regard to Fixed Capital.

According to an analysis of capital investment in 29 major industries in India given by central statistical organization, approximately 90% of the working capital is invested in inventories.

Capital which is fixed in the form of land and buildings, plant and machineries etc. is not amenable to reduction. So, almost nothing can be done to reduction. So almost nothing can be done to reduce it. There remains then the working capital, of which a large part is invested in inventories.

Materials in stores, in the process of fabrication and in the form of finished goods are crystalised capital. It is essential, therefore, to keep this form of capital investment at minimum.

9.3.2 Importance of Variety Reduction

Since the numbers of items are reduced due to variety reduction, the increased quantity of an individual item can lead to more economical price, because of larger quantities. It is possible to establish specifications for parts and route wise purchase activities.

The purchasing activity can be made truly competitive by eliminating special lots and brand names. Standardization results in effective communication, which promotes better understanding between different departments, in order to avoid constant disputes and misunderstanding.

9.3.3 Advantages of Variety Reduction

The variety reduction in general offers the following advantages:

- Better after sales service.
- Greater technical productivity.
- Better understanding of technical problems.
- Lesser set up times.
- Higher equipment utilization.
- Reduction in inventory.
- Easier inventory control.
- Better use of storage space.
- Quicker stock checking.
- Reduction in purchasing effort.

Test Your Progress

1. State at least five ways to reduce material cost.

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2. What are the techniques to reduce material cost?

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3. What is the need of variety reduction?

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4. State any two advantages of variety reduction.

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9.4 Cost Reduction And Value Improvement

Cost reduction is the process used by companies to reduce their costs and increase their profits. Depending on a company's services or product, the strategies can vary.

9.4.1 Cost reduction strategies in manufacturing

Following are a few strategies for cost reduction:

1. Cut down material costs

One of the simplest ways to reduce manufacturing overhead costs in by cutting down the material costs. This can be achieved by tweaking product designs and effectively utilizing all the resources

available at hand. It is always beneficial to opt for simpler designs and cost-saving raw materials. The leftover materials including cardboard, metal, and paper can be sent for recycling.

2. Optimize employee performance

Employees in manufacturing companies must be trained to keep pace with the changing consumer expectations. Training and development activities must be carried out to enhance the skills and productivity of employees in manufacturing facilities. Qualified and skilled employees can help businesses minimize their manufacturing overhead costs that occur due to production inefficiencies.

3. Negotiate with suppliers

Another way of significantly reducing the manufacturing overhead costs is to negotiate with the suppliers to reduce prices. To gain a reasonable price reduction from the suppliers, manufacturers can try offering larger deposits and ensuring that all the bills are settled on time.

4. Control inventory storage and purchases

The longer stocks are held, the more is the warehousing costs incurred by manufacturers. To avoid this and reduce the resulting manufacturing overhead costs, manufacturers must have a fair idea of when to resupply so that they do not get stuck with excess or obsolete inventory. Furthermore, adequate care must also be given to avoid inventory shortages. Inventory shortages lead to backorders which require manufacturers to add extra shipping costs and even worse, they can lead to unsatisfied consumers.

5. Value Improvement

Improvement efforts within organizations tend to focus on increasing the value delivered to the customer, or stakeholders, by providing the highest quality product or services in the shortest time and at the lowest cost possible.

Following are a few Value Improvement Approaches:

Through the years various improvement approaches have been developed for this purpose such as: **Total Quality Management (TQM), Kaizen, LEAN, and Six Sigma**. These approaches all share at least one common trait, which is that they all promote Continuous Improvement. According to Wikipedia a continuous improvement is a process of ongoing efforts to improve products, services, or processes.

Let us discuss these approaches in brief here:

a. Total Quality Management :

Total quality management (TQM) consists of organization-wide efforts to instill a culture in which the organization continuously improves its ability to deliver high-quality products and services to customers.

b. Kaizen :

Kaizen is Japanese and stands for “kai” meaning change and “zen” meaning good. It promotes improvements that are based on many small changes rather than a radical change. Six Sigma was originally developed to increase the quality of goods produced by reducing the number of defects per million units produced while Lean aims to improve time and cost by identifying and removing non value adding activities or “wastes”.

c. Lean Movement :

The notion of improving value is often associated to the Lean movement. Activities performed by the organization are evaluated from the perspective of the customer and classified into 3 categories: Value Adding, Value Enabling and Non-Value Adding (or Waste). Value Adding activities are essential to the production and delivery of the product or service to meet the customer’s needs and requirements, where Value Enabling activities are necessary precursors to Value Adding activities. Value Enabling activities may also be activities required by law or regulations to allow the Value Adding activities to be carried out. Non Value Adding activities are considered waste. They do not add value to the customer and do not meet the criteria for Value Adding activities. Waste is basically something that the customer is not willing to pay for.

Various categories of “Muda”, the Japanese word for waste, have been identified by the Lean movement. There are a couple of very well-known and useful mnemonics to help one remember the various types of non-value adding activities, or if you prefer, wastes. The two most popular of these mnemonics are TIMWOOD and DOWNTIME. TIMWOOD capturing a 7 types of wastes categorization, and DOWNTIME capturing an 8 types of wastes categorization.

DOWNTIME stands for:

Defects or the efforts involved in inspecting for and fixing defects

Overproduction of things not demanded by actual customers

Waiting for the previous step in the process to complete

Non-productive or underutilized resources or employees that are not effectively engaged

Transportation or handling of products, goods or services not actually required to perform the processing

Inventory or information that is sitting idle (not being processed)

Motion of people, information or equipment unnecessary due to workspace layout, ergonomic issues or searching for misplaced items

Extra processing in performing any activity that is not necessary to produce a functioning product or service

d. Six Sigma Approach

A central concern of Six Sigma is to understand how well your processes, goods or services meet the specified customer expectations. Yield is a metric often used in assessing the quality of goods or services. Yield is often expressed as a percentage and it represents the proportion of results conforming to requirements or specifications of the customer compared to the number of raw inputs. E.g. we meet the customer expectations or specifications 99.999% of the time.

Efficiency is a central theme of any improvement effort. We are all familiar with the expression of "doing more with less". When it comes to temporal efficiency two basic notions are at play: Lag Time and Processing Time. The Processing Time is the elapsed time from the start of the activity to its completion while the Lag Time is the elapsed time from the completion the preceding activity to the start of the current one.

9.5 Techniques Of Cost Control

Cost control complements sales and keeps the manufacturing business healthy.

9.5.1 Techniques Of Cost Control

So, there are a few techniques of cost control which are as follows:

1. Understanding Costs :

Analyze your company's performance, and you will find that your business costs fall into three categories: materials and labor (also called cost of goods sold), and overhead. Each of these categories has its own opportunity for cost control, and the impact of changes in one area must be considered on the other two. Reducing your sales force may save costs in overhead, for example, though if that reduces product sales, then your material and labor levels are thrown out of balance.

2. Labor Savings :

Direct labor is frequently the single greatest expense in the manufacturing sector. In some regards, it is the most difficult expense to change, because the consequences of change affect people, and their response to change may be unpredictable. Analyze production regularly for redundant tasks, and adjust your work force accordingly, but never lose sight of the motivational changes that may occur coincidentally.

3. Purchasing Savings :

Raw materials provide a variety of ways to reduce and control costs. Watch your suppliers and search for alternate sources for the same quality stock at better prices. Keep annual contract terms with suppliers to allow for changes in market conditions, unless you have a very compelling offer over several years. Investigate payment terms with your suppliers to match the rate of inventory turnover to reduce your working capital needs, reducing costs on money you may borrow.

4. Inventory Management :

Consider the time raw material sits waiting for use. Warehouse space can be freed or eliminated through just-in-time delivery practices, where stock arrives from the supplier and moves directly to the plant floor. Analyze your situation for similar changes. For example, if you have warehousing space you can't divest, try negotiating just-in-time trading with a supplier. In this case, you buy the supplier's inventory when it comes off your shelf, not when it arrives at your plant. Both these strategies reduce the time your operating capital is tied up in raw stock.

5. Take It off The Top :

Overhead expenses are often described as "the cost of doing business" and may be perceived as static. However, a dollar saved on overhead goes straight to the bottom line. Outsource payroll or marketing functions such as direct mail. Routinely review the bills for things such as office supplies, office and cell phones and cleaning services, and be aggressive about finding better deals.

6. Working thePrograms :

Lean manufacturing philosophies such as Kaizen, 5-S and other best-practices programs encompass cost controls in all areas as essential to efficient operation of a manufacturing business. These techniques address corporate culture from the ground up. While there are cost-control benefits, formally instituting a program of this type has costs of its own, so weigh the pros and cons of what such a program has to offer your small business.

Test Your Progress

1. State any three cost reduction strategies.

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2. Explain any three techniques of cost control.

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3. What do you understand by six sigma approach?

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4. What do you understand by Downtime?

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5. What do you understand by Kaizen and lean movement?

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9.6 Standard Costing

Standard costing is the practice of substituting an expected cost for an actual cost in the accounting records. Subsequently, variances are recorded to show the difference between the expected and actual costs. This approach represents a simplified alternative to cost layering systems, such as the FIFO and LIFO methods, where large amounts of historical cost information must be maintained for inventory items held in stock.

Standard costing involves the creation of estimated (i.e., standard) costs for some or all activities within a company. The core reason for using standard costs is that there are a number of applications where it is too time-consuming to collect actual costs, so standard costs are used as a close approximation to actual costs.

Since standard costs are usually slightly different from actual costs, the cost accountant periodically calculates variances that break out differences caused by such factors as labor rate changes and the cost of materials. The cost accountant may periodically change the standard costs to bring them into closer alignment with actual costs.

According to Wheldon, it is a method of ascertaining the costs whereby statistics are prepared to show:

(i) The standard cost;
(ii) The actual cost;
(iii) The difference between these costs which is termed the variance.

9.6.1 Objectives of Standard Costing:

The objectives of Standard Costing for which it is implemented are:

(a) It helps to implement budgetary control system in operation;
(b) It helps to ascertain performance evaluation.
(c) It supplies the ways to utilize properly material, labor and also overhead which will be economic in character.
(d) It also helps to motivate the employees of a firm to improve their performance by setting up a 'standard'.
(e) It also helps the management to supply necessary data relating to cost element to submit quotations or to fix up the selling price of a firm.
(f) It also helps the management to make proper valuations of inventory (viz., Work-in- progress, and finished products).
(g) It acts as a control device to the management.
(h) It also helps the management to take various corrective decisions viz., fixation of price, make-or-buy decisions etc. which will be more beneficial to the firm.

9.6.2 Importance of Standard Costing

Importance of Standard Costing cannot be ignored for the following and that is why the same is well-developed in the present-day world:

(i) Compilation of Historical Cost is very expensive and difficult:

A manufacturing firm making large number of parts requires too much clerical work which is required in order to compile the materials, labour and overhead charges to each and every cost of parts produced for ascertaining the average cost of the product.

(ii) Historical Costs are inadequate:

In order to measure the manufacturing efficiency, historical costs are not practically adequate. It fails to explain the reasons of increased cost or any change in cost structure.

(iii) Historical Costs are too old:

In many firms, costs are determined and selling prices are ascertained even before the production starts—which is not desirable.

(iv) Historical Costs are not typical:

This is due to the wide fluctuation in market for which there is no relation between the selling price per unit and cost price per unit.

9.6.3 Advantages of Standard Costing

Though most companies do not use standard costing in its original application of calculating the cost of ending inventory, it is still useful for a number of other applications. In most cases, users are probably not even aware that they are using standard costing, only that they are using an approximation of actual costs. Here are some potential uses:

- ***Budgeting :***

  A budget is always composed of standard costs, since it would be impossible to include in it the exact actual cost of an item on the day the budget is finalized. Also, since a key application of the budget is to compare it to actual results in subsequent periods, the standards used within it continue to appear in financial reports through the budget period.

- ***Inventory costing :***

  It is extremely easy to print a report showing the period-end inventory balances (if you are using a perpetual inventory system), multiply it by the standard cost of each item, and instantly generate an ending inventory valuation. The result does not exactly match the actual cost of inventory, but it is close. However, it may be necessary to update standard costs frequently, if actual costs are continually changing. It is easiest to update costs for the highest-dollar components of inventory on a frequent basis, and leave lower-value items for occasional cost reviews.

- ***Overhead application:***

  If it takes too long to aggregate actual costs into cost pools for allocation to inventory, then you may use a standard overhead application rate instead, and adjust this rate every few months to keep it close to actual costs.

- ***Price formulation:***

  If a company deals with custom products, then it uses standard costs to compile the projected cost of a customer's requirements, after which it adds a margin. This may be quite a complex system, where the sales department uses a database of component costs that change depending upon the unit quantity that the customer wants to order. This system may

also account for changes in the company's production costs at different volume levels, since this may call for the use of longer production runs that are less expensive.

9.6.4 Problems with Standard Costing

Despite the advantages just noted for some applications of standard costing, there are substantially more situations where it is not a viable costing system. Here are some problem areas:

- ***Cost-plus contracts :***

  If you have a contract with a customer under which the customer pays you for your costs incurred, plus a profit (known as a cost-plus contract), then you must use actual costs, as per the terms of the contract. Standard costing is not allowed.

- ***Drives inappropriate activities :***

  A number of the variances reported under a standard costing system will drive management to take incorrect actions to create favorable variances. For example, they may buy raw materials in larger quantities in order to improve the purchase price variance, even though this increases the investment in inventory. Similarly, management may schedule longer production runs in order to improve the labor efficiency variance, even though it is better to produce in smaller quantities and accept less labor efficiency in exchange.

- ***Fast-paced environment*:**

  A standard costing system assumes that costs do not change much in the near term, so that you can rely on standards for a number of months or even a year, before updating the costs. However, in an environment where product lives are short or continuous improvement is driving down costs, a standard cost may become out-of-date within a month or two.

- ***Slow feedback:***

  A complex system of variance calculations is an integral part of a standard costing system, which the accounting staff completes at the end of each reporting period. If the production department is focused on immediate feedback of problems for instant correction, the reporting of these variances is much too late to be useful.

- ***Unit-level information*:**

  The variance calculations that typically accompany a standard costing report are accumulated in aggregate for a company's entire production department, and so are unable to provide information about discrepancies at a lower level, such as the individual work cell, batch, or unit.

9.6.5 Standard Cost Variances

A variance is the difference between the actual cost incurred and the standard cost against which it is measured. A variance can also be used to measure the difference between actual and expected sales. Thus, variance analysis can be used to review the performance of both revenue and expenses.

There are two basic types of variances from a standard that can arise, which are the rate variance and the volume variance. Here is more information about both types of variances:

- ***Rate variance*:**

  A rate variance (which is also known as a price variance) is the difference between the actual price paid for something and the expected price, multiplied by the actual quantity purchased. The "rate" variance designation is most commonly applied to the labor rate variance, which involves the actual cost of direct labor in comparison to the standard cost of direct labor. The rate variance uses a different designation when applied to the purchase of materials, and may be called the purchase price variance or the material price variance.

- ***Volume variance:***

  A volume variance is the difference between the actual quantity sold or consumed and the budgeted amount, multiplied by the standard price or cost per unit. If the variance relates to the sale of goods, it is called the sales volume variance. If it relates to the use of direct materials, it is called the material yield variance. If the variance relates to the use of direct labor, it is called the labor efficiency variance. Finally, if the variance relates to the application of overhead, it is called the overhead efficiency variance.

Thus, variances are based on either changes in cost from the expected amount, or changes in the quantity from the expected amount. The most common variances that a cost accountant elects to report on are subdivided within the rate and volume variance categories for direct materials, direct labor, and overhead. It is also possible to report these variances for revenue.

It is not always considered practical or even necessary to calculate and report on variances, unless the resulting information can be used by management to improve the operations or lower the costs of a business. When a variance is considered to have a practical application, the cost accountant should research the reason for the variance in detail and present the results to the responsible manager, perhaps also with a suggested course of action.

9.6.6 Creation of a standard cost

Creating a standard cost starts with knowing how to calculate it correctly. Consider the following steps when creating a standard cost:

1. Determine the cost of direct materials, direct labor and overhead :

To determine these costs, you'll need to multiply the rate of each by the quantity (in units or hours).

For example, if the direct materials price is INR 10 and the standard quantity is 20 rupees per unit, you would multiply INR10 by 20 to get INR 200. This would be the standard cost for the direct materials only. Let's say the direct labor rate is INR 15 and the direct labor standard hours per unit is 10 hours. This would mean the standard cost for direct labor is INR 150. Now, let's say the overhead is INR 10 and the number of hours is 5. This would mean the standard cost for the overhead is INR 50 because INR 10 multiplied by 5 is INR 50.

2. Calculate the standard cost :

Once you've determined the standard cost of each of these, add them together to get the overall standard cost.

Following the example above, the standard cost for this production is INR 400 because INR 200 (direct materials standard cost) + INR 150 (direct labor standard cost) + INR 50 (overhead standard cost) = INR 400 (standard cost).

Test Your Progress

1. What are the advantages of standard costing.

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2. What do you understand by Standard costing?

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3. State the importance of standard Costing.

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4. What is standard cost variance?

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5. What do you understand by creation of standard cost?

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9.7 Summary

Cost reduction is to be understood as the achievement of real and permanent reduction in the unit cost of goods manufactured or services rendered without impairing their suitability for the use intended or diminution in the quality of the product.

Variety reduction defined as a form of standardization consisting of the reduction of number of type of products, or materials or parts within a definite range to a lesser number which is adequate to meet prevailing needs at a given time.

Value improvement rigorously identifies tools, management practices, and capabilities that optimize a project's financial value from early concept to front-end engineering design (FEED)

Cost control is the practice of identifying and reducing business expenses to increase profits, and it starts with the budgeting process.

Standard costing is the practice of estimating the expense of a production process. It's a branch of cost accounting that's used by a manufacturer, for example, to plan their costs for the coming year on various expenses such as direct material, direct labor or overhead. These manufacturers will also be able to compare the standard cost to the actual costs.

9.8 Test Your Progress

1. What is material cost reduction?

2. Explain a few techniques of material cost reduction.

3. Explain at least 10 ways to reduce material cost.

4. What do you understand by variety reduction?

5. What is the need and importance of variety reduction?

6. What are the advantages of variety reduction?

7. What do you understand by cost reduction?

8. What is value improvement?

9. What are a few strategies of cost reduction in manufacturing industry?

10. Explain a few techniques of cost control.

11. What is standard costing?

12. What are the objectives of standard costing?

13. Why is standard costing so important?

14. What are the advantages of standard costing?

15. State a few problems associated with standard costing.

16. What do you understand by standard cost variances?

17. How is creation of standard cost done?

9.9 Suggested Readings

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UNIT 10 :COST EFFECTIVENESS

Unit Structure

10.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofCost Effectiveness.
- Completely understandConcept ofCost Analysis For Material Management.
- Get an idea ofMaterial Flow Cost Control.

10.1 Introduction

As a manufacturer, you certainly hope to be able to reduce your manufacturing costs without having to lessen the quantity and quality of your products. However, you should not be reckless while choosing cost-saving ideas, because they may ruin your business instead of grow it.

10.2 Cost Effectiveness

Cost-effectiveness can be best described as a way of analyzing a number of different ways in which cost is calculated and incurred and then comparing it with the outcome which can make clear which one of them is most effective and provides the best outcome. Cost effectiveness analysis is sometimes known as cost benefit analysis.

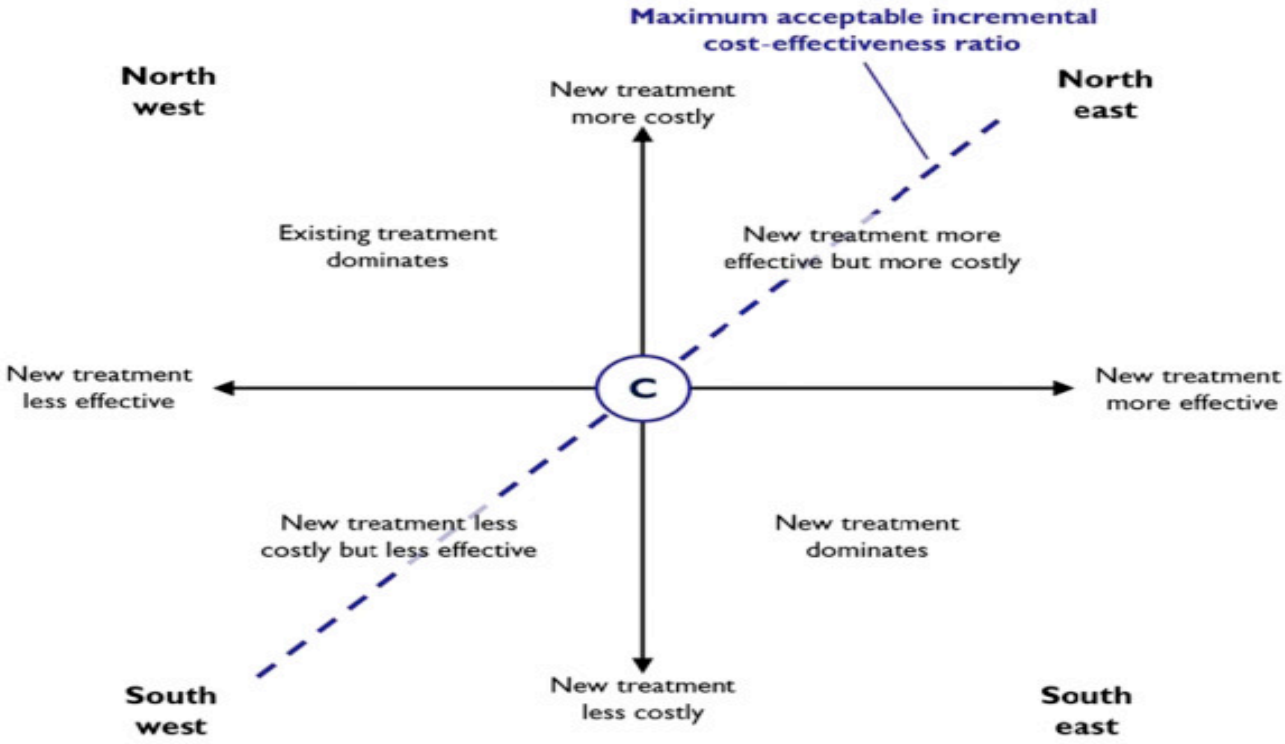

Fig.10.1 : Cost Effectiveness

10.2.1 Importance of cost effectiveness analysis

Organisations have multiple goals, but the fundamental reason they exist is to improve economic conditions of a country. Part of the difference can be explained by variation in non-economic system factors. But part of it can also be explained by the fact that some systems devote resources to expensive interventions with small effects on society, while at the same time low cost interventions with potentially greater benefits are not fully implemented. Cost-effectiveness analysis (CEA) is one tool decision-makers can use to assess and potentially improve the performance of their internal systems. It indicates which interventions provide the highest "value for money" and helps them choose the interventions and programmes which maximize benefits for the available resources.

CEA requires information on:

- The extent to which current and potential interventions improveoverall organizational health, i.e., effectiveness
- The resources required to implement the interventions, i.e., costs

The impact of interventions on organizational health is vital. But it is also important to determine the role of different interventions in contributing to other socially desirable goals, such as reducing material inequalities, and being responsive to the legitimate expectations of the market.

10.2.2Steps of Cost Effectiveness or Benefit Analysis

Step 1: Specify the set of options

Identify a range of genuine, viable, alternative policy options to be analysed. You must consider at least three options, one of which must be non-regulatory. Your agency is responsible for the choice of options. A ‘do nothing’ or ‘business as usual’ option will usually provide the *base case* against which the incremental costs and benefits of each alternative are determined. In some cases, doing nothing may be the best option available. Only costs and benefits that would not have occurred in the base case should be included in the CBA.

Step 2: Decide whose costs and benefits count

For most regulatory proposals, measuring the national costs and benefits is appropriate, rather than measuring any international impacts. That is, as far as is practical, you should count the costs and benefits to all people residing in Australia.

Step 3: Identify the impacts and select measurement indicators

Identify the full range of impacts of each of the options. It is important to identify the incremental costs and benefits for each option, relative to the base case (which will normally be 'what would happen if the current arrangements were to continue?').

Where relevant, the base case should be forward-looking, recognising that the world in which the regulation will be implemented may differ from the current situation (key variables may change in the future, meaning that current or historical parameters may not be the most relevant benchmark). That is, the base case should not simply assume that nothing will change over time—changes that can be reasonably expected should be recognised when identifying impacts of each option.

All the effects of a proposal that are considered desirable by those affected are benefits; all undesirable effects are costs. CBA requires you to identify explicitly the ways in which the proposal makes individuals better or worse off.

The choice of indicators to measure the impacts depends on data availability and ease of monetisation. For example, a regulatory proposal may reduce risks of a hazard. Its positive impact could be measured in terms of a reduced number of accidents. The benefit from accidents avoided could be valued in dollars (see Step 5).

Step 4: Predict the impacts over the life of the proposed regulation

The impacts should be quantified for each time period over the life of the proposed regulation. The total period needs to be long enough to capture all the potential costs and benefits. Because of the uncertainty involved in forecasting costs and benefits over long periods, exercise caution when adopting an evaluation period longer than, say, 20 years (although some environmental regulation may merit the use of a longer time horizon).

Predicting future impacts is difficult. There will always be some uncertainty about the outcome of a proposed regulation. Conducting an assessment of uncertainties should be a standard component of the evaluation of any major proposal. This means that you assess expected values and variability of cost and benefit flows, as well as taking downside risks into account.

A CBA should present the best estimates of expected costs and benefits, along with a description of the major uncertainties and how they were taken into account. You need to set out how costs and benefits are likely to vary with general economic conditions and other influences. For example, would large relative price changes (such as a rise in energy prices or real wages) significantly change the net benefits from the regulatory proposal? If so, what price path might be expected? In general, your CBA should not just assume that the net benefits for one year will be repeated every year.

Although it is difficult to predict what the effects of a proposed regulation might be in 10 or 20 years—or in some cases, even to attach objective probabilities to various scenarios—decisions require some assumptions to be made. A CBA should make those assumptions transparent. When you explicitly consider and justify the assumptions underlying the forecasts, it improves implementation planning and identifies where more effort should be made to improve the analysis. It is a first step towards dealing with the uncertainties that the regulatory proposal may create.

Step 5: Monetize (place dollar values on) impacts

Assigning a net dollar value of the gains and losses of a regulatory initiative for all people affected is one useful way to measure the effects of a proposed change. Measurement of costs and benefits in this way is sometimes referred to as *monetising* costs and benefits. The amount an individual would pay to obtain (or avoid) a change (if that were necessary or possible) is one measure of the value of that change to them. The value could be positive or negative depending on whether the change makes them better or worse off. Summing these values across all affected people gives the community's total willingness to pay for the change. If the sum is positive, the change increases efficiency. The costs and benefits to all people are added without regard to the individuals to whom they accrue: a $1 gain to one person cancels a $1 loss to another.

This 'a dollar is a dollar' assumption enables resource allocation to be separated from distribution effects—or efficiency from equity effects. That does not mean that distributional considerations are unimportant or should be neglected. It means that they should be brought into account as a separate part of the overall analysis of the proposal in question—which may be more important than the resource allocation assessment, but should be distinct from it. Dealing with equity issues is discussed in more detail below in the 'Accounting for equity' section.

Dollar values can be estimated from observed behavior. You can measure the value people place on something by observing how much they actually pay for certain goods or services, and the quantities of those goods and services that are consumed. Market behavior reveals people's valuations (or is at least a guide to them). For example, if a consumer pays $3.50 for a cup of coffee, the value they place on the coffee is at least $3.50 (it will likely be higher).

That said, monetization, or more general quantification, can be difficult because impacts are sometimes uncertain, some are difficult to value in dollar terms, and some are both uncertain and difficult to value. Environmental goods or safety provisions are typical examples of goods that are difficult to place dollar values on, as they are typically not traded in markets. Various methods for estimating the value of nonmarket goods and accounting for uncertainty in CBAs are outlined below in the 'Dealing with costs and benefits that are difficult to value' section.

The fact that some impacts may be very difficult to quantify in dollar terms does not invalidate the CBA approach. In such cases, a detailed qualitative analysis will often be most appropriate in place of dollar values. Your qualitative analysis should be supported by as

much evidence and data as possible to increase the transparency of the report and to assist the decision maker in choosing between alternative options.

Step 6: Discount future costs and benefits to obtain present values

The need to discount future cash flows can be viewed from two main perspectives, both of which focus on the opportunity cost of the cash flows implied by the regulation. The first perspective is the general observation that individuals prefer a dollar today to a dollar in the future. This is most obvious in the fact that banks need to pay interest on deposits to entice individuals to forgo current spending. This general preference for current consumption is known as the 'rate of time preference' and relates to all economic benefits (and costs), not just those that are financial in nature.

Since individuals are not indifferent between cash flows from different periods, those flows cannot be directly compared. For monetised flows to be directly comparable in a CBA, those costs or benefits incurred in the future need to be discounted back to current dollar terms. This reflects society's preferences, which place greater weight on consumption occurring closer to the present.

The second perspective is that flows of costs and benefits resulting from a regulation also have an opportunity cost for investment. When regulations impose costs on individuals or businesses, those costs will need to be funded in some way. This funding imposes costs on the affected party, either through the interest paid for borrowing the money, or the returns forgone when the funds are not used for other purposes.

The regulation will therefore only be beneficial when it provides a return in excess of the cost to society of deferring consumption, or of the return that could have been earned on the best alternative use of the funds. By applying a discount rate to future cash flows, the required rate of return is explicitly taken into account in the net present value calculation.

Either approach demonstrates that the need to discount future cash flows can be viewed in terms of the opportunity cost of the cash flows, whether this is the cost of delaying consumption or the alternative investment opportunities forgone. Since most of the costs and benefits of regulatory proposals are spread out over time, and their value depends on when they are received, discounting is crucial to CBA.

The rate that converts future values into present values is known as the discount rate. If the discount rate were constant at r per cent per year, a benefit of B_t dollars received in t years is worth $B_t/(1+r)^t$ now. Box 1 provides an example of how to calculate net present values. The *Handbook of cost–benefit analysis* provides more guidance.

10.2.3Effective Ways to Reduce Your Manufacturing Costs

1. Cut Your Material Costs

The simplest way you can implement to save your manufacturing costs is to cut the material costs. This can be done by tweaking the design of your products and utilizing all the resources that you have. You may have chosen product components without fully understanding the cost implications.

Opt for a simpler design and cost-saving raw materials. Try not to dispose of leftover cardboard, paper and metal. Instead of sending them to a recycling center, think of ways to sell them all back or reuse them to create another product.

2. Gain Control of Your Inventory & Purchases

The longer you keep your stocks, the more costs you need. Therefore, it is important to know exactly when to resupply and make sure that you're not getting stuck with excess or obsolete inventory. Inventory shortages lead to backorders which require you to add extra shipping costs and even worse, they can lead to unsatisfied consumers. Meanwhile, overstocking can cause decay or contamination (especially if you store perishable food items) and certainly requires more costs such as maintenance or insurance costs.

Investing in an inventory management system or purchasing management system will greatly assist you in saving on manufacturing costs. The former helps you automate your inventory tracking, hence allowing you to maintain your stock levels so easily. The latter helps you manage purchases and procurements more efficiently, thus enabling you to easily communicate with suppliers, create purchase orders, purchase requests and requests for quotations, as well as blanket orders so you can repeatedly order items in bulk over a period of time.

3. Optimize Your Employee Performance

Manufacturing employees must be able to work fast to keep pace with growing consumer expectations. As a business owner, it is a must for you to be able to train your employees so that they can improve their skills and productivity on the production floor. Having qualified employees can help you minimize the turnover which leads to significant labor cost reduction.

4. Automate Your Manual Processes

In the midst of intense competition between manufacturers, you should be able to use technology to improve your manufacturing efficiency and productivity. You may be a little hesitant since the use of technology such as automated solutions requires substantial investment costs. However, implementing an automated solution will actually help you save your operational costs in the

long run.

An ERP solution helps you analyze your workflow, identify bottlenecks in production and automate all the complex processes. From inventory monitoring, employee management, purchasing and procurement controls to budgeting, all can be handled automatically by the system.

5. Negotiate with Your Suppliers

Another way you can apply to save your manufacturing costs is to ask your suppliers to reduce their prices. Before attempting any negotiation, make sure that you have always paid your bills on time (so there will be no hard feelings between you and your suppliers). Also, ask for reasonable price reduction.

To increase your chances of getting the right deal, try to offer larger deposits to your suppliers. Let them know that you are considering some other good deals as well. If they're not willing to give you lower prices, then you should consider sourcing from different suppliers.

10.2.4Key Principles of Effective Product Cost Management

Effective product cost management requires systematic activities, processes throughout the enterprise to find the lowest possible costs.

The benefits of a systematic product cost management (PCM) program are significant, yet many manufacturers struggle to implement these initiatives effectively. This article discusses some key principles to guide and execute an effective PCM program for maximum impact.

Many people and departments within an organization impact product cost:

- An engineering team decides on a specific design, but there are multiple alternatives that meet the same form, fit, and functional requirements. Each dictates a different cost.
- A sourcing team pays to produce a specific design, but there are multiple potential costs for manufacturing the design. Manufacturing costs are often negotiable and depend on plant cost structure, capabilities, and process control.
- A manufacturing team selects one way to produce a specific design and estimates a ballpark cost, but there may be several more cost-effective ways to manufacture the same design.

Traditionally, PCM has been performed by cost engineering experts, or by Value Analysis/Value Engineering (VAVE) team members who specialize in cost reduction and/or support core business functions. These resources typically have strong manufacturing backgrounds and may have worked as a supplier quote estimator. Their expertise is unique and their domain knowledge builds over time, but it is extremely difficult to duplicate and scale across products in a large organization.

Effective PCM requires a set of systematic activities, processes, and tools for use throughout the enterprise to guide the above decisions to the lowest possible costs. This enables manufacturing organizations to attack cost at the point of origin and yield the greatest impact on product cost reduction.

10.2.5Core Cost Management Activities

There are a number of core activities involved in PCM. Some of the most effective include:

- Studying the cost tradeoffs of different concept designs in the R&D stage
- Evaluating multiple design alternatives for lowest cost during NPI
- Evaluating the cost of proposed solutions to an engineering change order
- Evaluating multiple manufacturing and tooling alternatives for lowest cost, including make vs. buy analysis
- Generating a detailed "should cost" to validate supplier quotes and ensure lowest pricing
- Batch analyzing current prices of entire commodity groups to find over-cost outliers
- Evaluating multiple cost-down ideas on current products in real-time to identify the highest potential reduction in the shortest amount of time

10.2.6Cost Management Processes

The core activities above fit into various functions and processes over a product's life cycle and include key Cost Control Points during the overall development process. These are measurable, managed checkpoints that dictate where and when people should perform the activities outlined above. The output and results of these activities build on each other throughout the product development lifecycle. For example, during the introduction of a new product, there are typically design review meetings at regular intervals to ensure the new product is meeting form, fit, and functional requirements. However, rarely is there a conversation about the financial implications of the design alternatives being evaluated. An effective PCM effort should include mandatory cost evaluation as part of key design review milestones.

Another example would be as a design reaches the release to manufacturing (RTM) milestone. At this point in the process, there is often a decision to make or buy that product, or key components within it. A company with a cost control point at that RTM milestone would quickly calculate the financial impact of both options, and make an economically-wise decision in a fraction of the time that it would take to create and manage an RFP response from a supplier.

10.2.7Tools of Cost Management

Effective PCM is also enabled by putting the proper tools in the hands of anyone that impacts product cost. These tools help assess true product costs at a detailed level at any stage and enable people to act on the appropriate opportunities to reduce costs. For example:

- Product cost estimation systems that can quickly and consistently generate and manage accurate estimates without requiring specialized manufacturing or cost knowledge
- Reporting systems for documenting and tracking cost management results and KPI's over time
- Analytics systems to search large volumes of data and identify cost outliers and trends
- BOM cost tracking systems to roll-up costs at any point in a product's life cycle

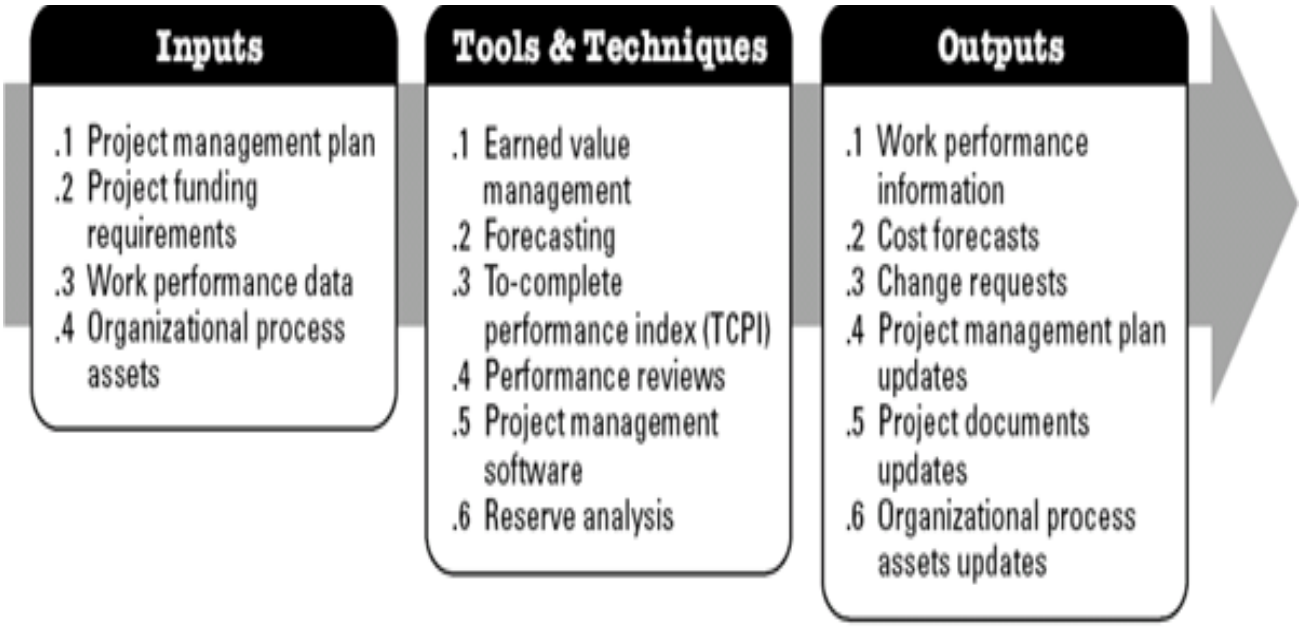

Fig.10.2 :Tools of Cost Management

Without these core activities, processes and tools, PCM remains a highly manual and decentralized function -- of value only to manufacturing or cost engineering experts. It can only be performed one or two times per NPI cycle, severely limiting the windows of opportunity to identify and operationalize product cost savings. It also leads to inconsistent estimation methods with static information that is difficult to update, manage and share.

To drive down COGS by entire percentage points, manufacturers must look to deploy PCM further upstream in the development process and across all departments and levels. Each group must identify its key Cost Control Points and define the activities and processes needed to reduce costs. These groups also need the right tools to analyze cost trade-offs quickly and easily each time they make a decision. The specific recipes for effective PCM will vary for each group, but effort to meet their specific requirements will provide a very high return on investment.

10.2.8Problems arising lack of special care in material management.

Following are the problems arising lack of special care in material management:

- Receiving incorrect material type ϖ Increase materials quantity in storage
- Burglary, theft and vandalism ϖ Destroy material in shipping
- High cost in material transportation
- Unavailable required quantity
- Too early receiving of materials earlier usage
- Incorrect material take-off from drawing and design
- Material Shortage during construction
- Piling of inventory materials
- Poor material selection
- Project delay because of slow delivery materials
- Suddenly alternation price of materials
- Ineffective control of storage

Test Your Progress

1. Why is cost effectiveness analysis important?

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2. State a few core cost management activities.

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3.What do you understand by the tools of cost management?

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4. State a few key principles of effective product cost management.

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10.3 Cost Analysis For Material Management

Cost-benefit analysis is defined as an approach to determine the weaknesses and strengths of action in business. It is a decision making concept employed to understand the cost of a given transaction by comparing it with the derived benefits.

Cost-benefit analysis is a process used by project leaders, business owners, and practitioners to understand the systematic calculating and later comparing costs and benefits of a project. This activity appraisal can be applied on commercial transactions, business or proposed policy, or an impending project.

Cost-benefit Analysis determines the value of costs and benefits in monetary terms and makes a viable comparison to evaluate whether the monetary decision is worthy or not. It is important to express all aspects of the project in the same unit if you are going to make a comparison.

Suppose XYZ Company wants to launch a new product in the market and has shortlisted two items. Both are footwear, and it is expected that they both can be a tremendous success.
The company can handle only one product, so it is a difficult choice to determine the one product that will lead to better profit margins and success. At this point, the analysts prefer to calculate the CBA or Cost-benefit analysis.

This is an easy and convenient way to figure out the costs and benefits from the project so that you can make a viable decision.

10.3.1 10 ideas for cost optimization

Check the current system of cost optimization against these 10 recommended focus areas to exploit information technology to improve business outcomes.

1. Digitalization of business processes:

Moving organizations toward higher levels of appreciation for business processes as essential corporate assets remains a challenge in the digital business landscape. Develop an integrated approach that brings together required competencies and expertise, along with buy-in from the executive leadership team. Establishing process management as a part of the enterprise fabric will ensure change becomes a continuous normal process.

2. Continuous improvement culture:

Enterprises sometimes become trapped by the attitude of "this is what we've always done," which can create waste. CIOs need to work collaboratively with business leaders to identify and remove this waste, which is typically in the form of reworks or delays due to issues further up the line, to focus on lean improvement efforts.

3. Customer self-service:

Today's customers expect answers quickly and on demand. CIOs need to establish a strategy to handle self-service technologies, which must be continuously updated and based on the customer's perspective and experience.

4. Improving business efficiency through analytics:

Don't underestimate the value of analytics beyond conventional business intelligence. Not only can advanced analytics save lives, reduce customer churn and make equipment safer, utilizing

the provided information to gain even single-digit percentage improvements in areas like customer retention or marketing responses can have a big impact on the business.

5. Improving data management:

Use enterprise information management to treat information as a company wide asset. This means people from across the enterprise will have access to data, and will be able to share and use that data to create business value through better and faster decisions.

6. Process automation:

CIOs and business leaders need to go beyond the current use of automation to robotics, and leverage the Internet of Things (IoT) and smart machines to build intelligent business processes.

7. Improving asset management:

Information about assets is a critical asset itself. Utilize the IoT to offer real-time information and performance to allow the enterprise to make better decisions about assets.

8. Supply chain optimization:

Supply chain leaders enjoy 20% to 50% lower supply chain costs than average performers. CIOs need to work collaboratively to look beyond cost reduction to enable increased sales, using a mixture of conventional and unconventional techniques to optimize IT and business costs.

9. Improving inventory management:

Inventory is a challenge for business leaders since it exists paradoxically as both a supply operating lever and balance sheet financial asset. However, since inventory is a working capital asset, reducing inventory will contribute directly to the bottom line.

10. Business process outsourcing:

Managing business process outsourcing (BPO) for companies is challenging, particularly when services are not contracted with a strategic business service or partnership in mind. Focus on business outcomes, such as customer satisfaction, to impact fully manage BPO services.

10.3.2 Advantages of cost-benefit analysis

A cost-benefit analysis is a popular tool with the following advantages-

1. A cost-benefit analysis simplifies the complex decisions in a project.
2. The analysis gives clarity to unpredictable situations. The listing of costs and benefits helps the analyst to identify and later evaluate each cost and benefit.
3. It helps to figure out whether the benefits outweigh the cost and is it financially strong and stable to pursue it
4. It is easy to compare projects of every type in spite of being dissimilar
5. The cost-benefit analysis removes any emotional element and helps to overcome biases
6. It takes into account a broad spectrum of benefits and costs and converts them into currency to simplify matters
7. Suitable for all projects small or large
8. The cost-benefit analysis helps to make a rational decision by looking at the figures expressed in the same units.

10.3.3 Limitations of cost-benefit analysis

A cost-benefit analysis has some limitations of its own like-

1. There are lots of benefits that are hard to quantify and measure items that are considered un-measurable. The chances of inaccuracies are great due to the lack of true estimated value.
2. The project manager relies on data and information from past projects, but the facts are ever-changing in the current scenario.
3. The evaluations are subjective and cannot be considered absolute accurate. Since some of the benefits and costs are non-monetary, it becomes difficult to estimate, quantify, and identify them in monetary terms. This can lead to wrong evaluations

4. Sometimes a cost-benefit analysis turns into a project budget and leads to unrealistic goals and errors.
5. The Cost-benefit analysis estimates the value over some time and can cause serious miscalculations in present value. This leads to inaccurate analysis.
6. The supposed clarity in determining and listing costs and benefits can prove harmful as the actual outcome is dependent on several variables that you can only know with time.

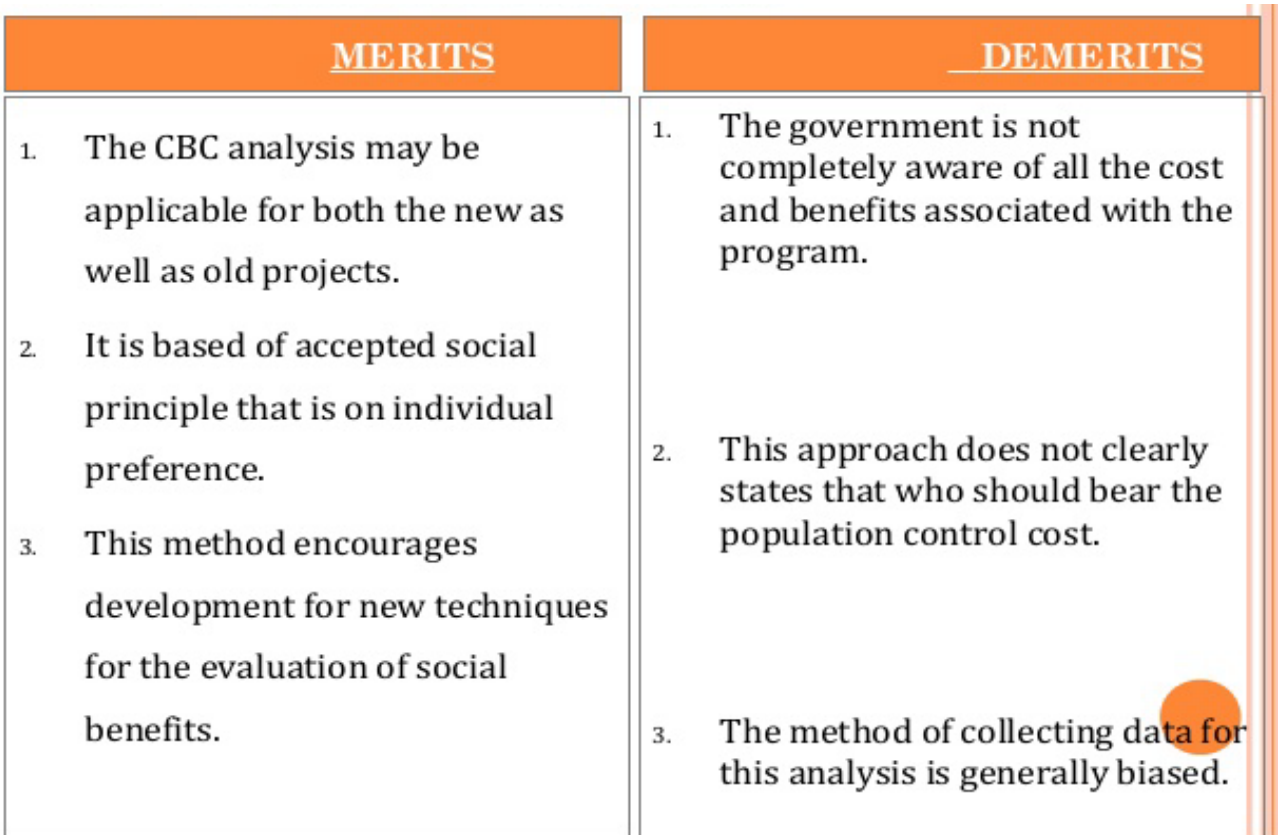

Fig.10.3 : Merits and Demerits of Cost Benefit Analysis

10.3.4 Relevance of the cost-benefit analysis for business

The relevance of the cost-benefit analysis for business are-

1. Evaluates whether the project is worth the capital investment
2. Helps to weigh one marketing initiative against another
3. Appraise the desirability of the proposed policy
4. Determines the feasibility of the project
5. Helps to decide whether hiring new employees will be profitable or not

6. Establishes a benchmark so that it becomes easy to compare projects.

10.4 MaterialFlow Cost Control or Accounting

Material Flow Cost Accounting (MFCA) is one of the Environmental Management Accounting (EMA) tools that has been developed to enable environmentally and economically efficient material usage and thus improve resource efficiency. However, the use of this tool to improve resource efficiency in the South African hotel sector remains unknown. An exploratory study, qualitative in nature, was conducted using a single case study with embedded units approach. A Hotel Management Group that met the selection criteria formed part of this study. In-depth interviews were conducted with 10 participants and additional documents were analysed. The investigated hotels have developed technologies that provide an environmental account in both physical and monetary units which constitute the use of MFCA to improve resource efficiencies.

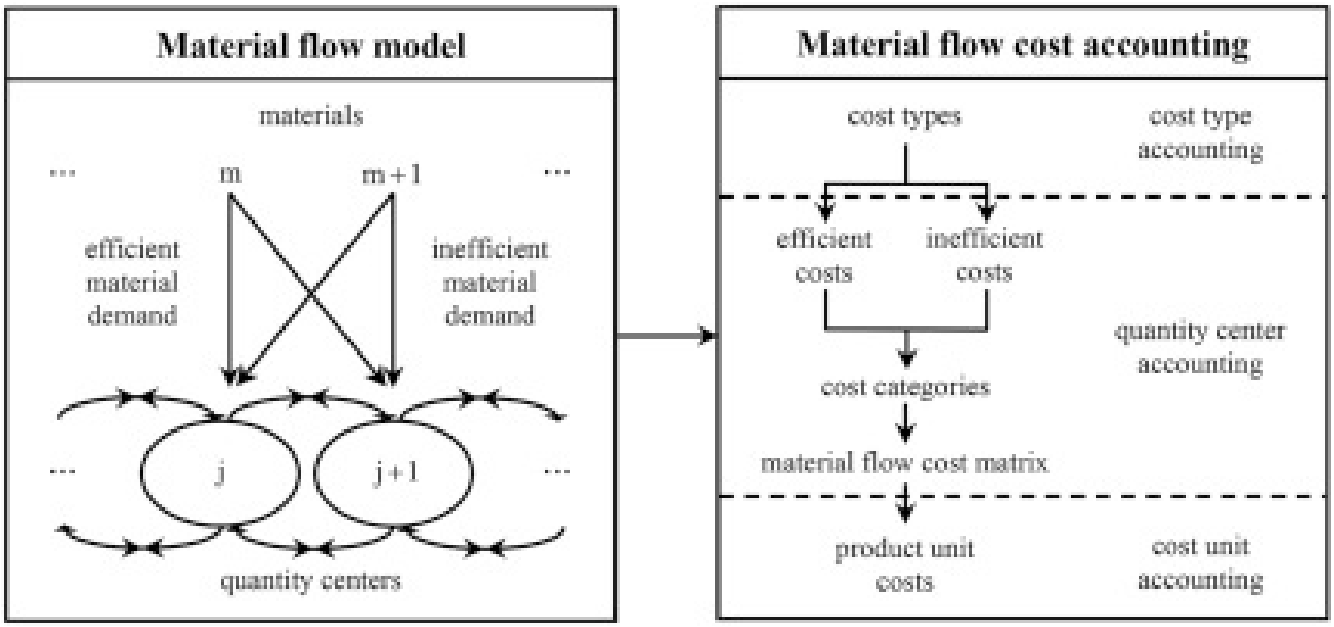

Fig.10.4 : Material Flow Cost Accounting

10.4.1 Objectives of Material Flow Cost Accounting

The aim of MFCA is to enhance both environmental and economic performance through improved material and energy use.[1] Since 2011 a general framework for MFCA has been provided by the ISO 14051 norm. In order to improve material and energy efficiency MFCA aims to:

- Increasing transparency regarding material and energy flows and the respective costs
- Supporting organizational decisions in areas such as process engineering, production planning, quality control, product design and supply chain management
- Improving coordination and communication on material and energy use within organizations.

10.4.2 Importance of material flow cost accounting

MFCA promotes increased transparency of material use practices through the development of a material flow model that traces and quantifies the flows and stocks of materials within an organization in physical and monetary units. This data can be used to seek opportunities to reduce material use and/or material losses, improve efficient uses of material and energy, and reduce adverse environmental impacts and associated costs. This chapter explains detailed steps for MFCA implementation and shows actual case examples. Furthermore, MFCA's impact is not limited to a single entity. MFCA can be applied to the supply chain where material wastage at one organization is occasionally sourced from suppliers.

Test Your Progress

1. Explain any 2 ideas for cost optimization.

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2. What do you understand by cost analysis for material management?

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3.Why is material flow cost accounting important?

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4. What are the objectives of material flow cost accounting? Explain in short.

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10.5 Summary

The definition of **cost effective** is something that is a good value, where the benefits and usage are worth at least what is paid for them.

Cost-effectiveness analysis helps identify ways to redirect resources to achieve more. It demonstrates not only the utility of allocating resources from ineffective to effective interventions, but also the utility of allocating resources from less to more cost-effective interventions.

Steps of cost effectiveness

Step 1: Specify the set of options.

Step 2: Decide whose costs and benefits count.

Step 3: Identify the impacts and select measurement indicators.

Step 4: Predict the impacts over the life of the proposed regulation.

Step 5: Monetize (place dollar values on) impacts.

Step 6: Discount future costs and benefits to obtain present values.

Effective Ways to Reduce Your Manufacturing Costs

1. Cut Your Material Costs.
2. Gain Control of Your Inventory & Purchases.
3. Optimize Your Employee Performance.
4. Automate Your Manual Processes.
5. Negotiate with Your Suppliers.

Core Cost Management Activities

The core activities above fit into various functions and processes over a product's life cycle and include key Cost Control Points during the overall development process. These are measurable, managed checkpoints that dictate where and when people should perform the activities outlined above. The output and results of these activities build on each other throughout the product development lifecycle.

Tools of Cost Management

- Product cost estimation systems that can quickly and consistently generate and manage accurate estimates without requiring specialized manufacturing or cost knowledge
- Reporting systems for documenting and tracking cost management results and KPI's over time
- Analytics systems to search large volumes of data and identify cost outliers and trends
- BOM cost tracking systems to roll-up costs at any point in a product's life cycle

A few problems arising lack of special care in material management.

- Receiving incorrect material type ϖ Increase materials quantity in storage
- Burglary, theft and vandalism ϖ Destroy material in shipping
- High cost in material transportation
- Unavailable required quantity
- Too early receiving of materials earlier usage
- Incorrect material take-off from drawing and design
- Material Shortage during construction

Cost-effectiveness analysis is sometimes called cost-utility analysis. It is different to cost-benefit analysis. In cost-benefit analysis, the outcome is described in monetary terms.

10 ideas for cost optimization

1. Digitalization of business processes.
2. Continuous improvement culture.
3. Customer self-service.

4. Improving business efficiency through analytics.
5. Improving data management.
6. Process automation.
7. Improving asset management.
8. Supply chain optimization.
9. Improving inventory management.
10. Business process outsourcing.

Material flow cost accounting (**MFCA**) is a management tool that assists organizations in better understanding the potential environmental and financial consequences of their material and energy practices and seeks to improve them via changes in those practices.It does so by assessing the physical material flows in a company or a supply chain and assign adequate associated costs to these flows.

Objectives of Material Flow Cost Accounting

- Increasing transparency.
- Supporting organizational decisions.
- Improving coordination and communication.

10.6 Test Your Progress

1. What is cost effectiveness?

2. What is the importance of cost effectiveness analysis?

3. What are the steps involved in cost effectiveness or benefit analysis? Explain in detail.

4. What are the key principles of effective product cost management?

5. What do you understand by core cost management activities?

6. What are the tools of cost management?

7. State a few problems arising lack of special care in material management.

8. How is cost analysis done for material management?

9. State any 7 ideas for cost optimization.

10. What is the concept of material flow cost control or accounting?

11. What are the objectives of material flow cost control?

12. Why is material flow cost control important?

13. What are the advantages and disadvantages of cost benefit analysis?

14.What do you understand by therelevance of the cost-benefit analysis for business?

10.7 Suggested Readings

1. https://www.pmc.gov.au
2. https://www.researchgate.net
3. https://en.wikipedia.org
4. https://researchspace.ukzn.ac.za
5. https://business.utm.my
6. https://www.researchgate.net
7. https://link.springer.com
8. https://onlinelibrary.wiley.com
9. https://www.ipoint-systems.com
10. https://ascelibrary.org
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15. http://www.tools4dev.org
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17. https://www.industryweek.com
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23. https://www.mindtools.com

Block IV Inventory and Surplus Management

In **Block IV**you will learn about inventory management,inventory v/s stores,inventory control. You will also learn aboutinventory build –up, EOQ, various inventory models, inventory models with quantity discount, exchange curve concept, coverage analysis, optimal stocking and issuing policies, inventory management of perishable commodities, and ABC – VED Analysis. Besides this you will also learn about surplus management, information system for inventory management in detail.

In **Unit 11** students will get a thorough knowledge of Inventory Management: Inventory V/S Stores, Types of Inventory, and Inventory Control.

In **Unit 12**you will be able to gather information aboutInventory Build –Up, EOQ, Various Inventory Models, Inventory Models With Quantity Discount, Exchange Curve Concept, Coverage Analysis, Optimal Stocking And Issuing Policies, Inventory Management Of Perishable Commodities, and ABC – VED Analysis.

In **Unit 13** you will be able to analyze Surplus Management, Inventory Management System, and Information System For Inventory Management.

Unit 11 Inventory Management

Unit Structure

11.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofinventory management.
- Completely understandconcept of inventory v/s stores.
- Get an idea of types of inventory.
- Understand inventory control.

11.1 Introduction

Inventory has inventory carrying cost so companies try to maintain inventory at the optimum level. An optimum level of inventory is decided by management. Inventory carrying capacity and inventory turnaround are majorly tracked majors for tracking the optimum level of inventory required for the business. An analyst looks into details of inventory turnover and compares them with a similar industry to understand the efficiency of handling inventory.

11.2 Inventory Management

Inventory management is one of the most critical aspects of any organization. Warehouse managers face many challenges which can benefit from it, including reducing inventory-carrying costs and ensuring that enough inventory is on hand to finish jobs on time. Effective inventory management processes are key to streamlined business operations.

The appropriate inventory management software streamlines warehouse activity. This includes inbound and outbound transfers, label printing and bin tracking. Here are some other benefits:

- **Obsolescence**: Inventory management software monitors stock. It replaces outdated products with the newer versions.
- **Stock-outs:** Keep your customers and your competitive edge by fulfilling orders on time. Inventory management software helps you avoid stock outages that can delay production.
- **Cost**: The carrying costs of excess inventory reduce cash flow. It also limits the capital you have available to invest in your business. If you want to increase your bottom line, cut the cost of inventory and other expenses.

11.2.1 Basic Inventory Management Techniques to Speed up Delivery:

A. Relationship Management:

Strong working relationships with vendors, suppliers and warehouse personnel are important. Inventory management software supports collaboration across the supply chain. Restock the warehouse, troubleshoot manufacturing issues, expand storage space or dispatch orders. Do all this and experience timely delivery of your goods as well as customer satisfaction.

B. Contingency Planning:

Running a business comes with certain risks. However, you can mitigate them with strong inventory management software.

Team members who are responsible for contingency planning can run real-time inventory updates. They can check product availability aligned with delivery deadlines, and see tasks associated with the inventory requirements.

C. Inventory Control:

Inventory control monitors the least level of stock needed to prevent inventory shortages. This ensures that you meet customer demand without disruption or delay. Inventory control also prevents excess stock on hand that ties up capital. Companies use a variety of inventory control methods which are:

- Just in time.
- ABC analysis.
- FIFO method.

D. Regular Audits:

There are three ways to track inventory: physical inventory, spot-checking, and cycle counting.

- Physical inventory - every item in the warehouse is counted once a year.
- Spot-checking - counts the stock to verify it with the quantity that should be there according to the plan.
- Cycle counting - different products or small subsets of inventory are counted in a specific location, on a specified day.

E. Accurate Forecasting:

Accurate forecasting begins with an understanding of past demand. The review of historical data provides insight into future demand. Forecasting indicators include the economy, political trends, past growth rate, orders and promotional activity.

F. Drop-shipping:

Drop shipping is an inventory management method that does not hold inventory in the warehouse. It encourages cost cutting by direct shipment to customers after a product or a part is purchased from third-party vendors.

11.2.2 Inventory Management Strategies

Inefficiencies and inaccuracies in inventory management aren't just harmful for your manufacturing business, but can also affect your entire business process and ultimately lead to customer dissatisfaction.

Manufacturers can avoid those problems by implementing these proven inventory management strategies:

1. Set up Minimum Inventory levels:

Make inventory management easier by setting up "par levels" or the minimum amount of inventory necessary to be on hand at all times. When certain items reach or approach predetermined minimum levels, you know it's time to reorder.

Ideally, you will order items in a sufficient amount to exceed the minimum levels. The minimum inventory levels will vary by product, depending on how quickly the product sells and how long it takes to get the product.

The best way to maintain inventory levels is to take advantage of inventory management software that enables you to set up minimum inventory levels and turn on alerts that notify you whenever your supplies are running low.

2. Conduct Demand Forecasting:

In order to find out the amount of inventory that should be on hand at all times, avoid unnecessary procurement, overstock and stockouts, you need to forecast the demand for your products.

This can be done in several ways by involving internal and external factors such as:

- Market trends
- Sales data of the previous year
- This year's growth rate
- Overall economic conditions
- Upcoming promotions
- Expenditures for planned advertisements

When you use historical sales data, it is important to make sure that the data generated is complete and accurate, so there are no mistakes while performing forecasting. A sophisticated inventory management system has a forecasting feature that allows you to generate forecasts that help you make the right decision for future purchases

3. Use FIFO Method:

First-in, first-out (FIFO) is a critical principle of inventory management. It means that your oldest stock (first-in) must be sold first (first-out), instead of your latest stock. This is especially important for easily damaged goods so you will not end up with unsaleable items.

The FIFO principle can also be implemented on non-perishable products. If the same items are always put at the back, they tend to get obsolete faster. You certainly don't want to sell something that's outdated or not worth selling.

To apply the FIFO principle, you need a well-organized warehouse. This can be realized by adding new products from the back, or making sure your old products stay at the front.

4. Audit & Conduct Regular Inventory Inspections:

Reviewing and conducting regular inventory audits is the best way to find potential problems before they occur. Ideally, this is done every month to cover your entire base.

The easiest way to validate your data is to rely on inventory management software and generate reports to find out how many products you actually have. However, it is important to ensure that the quantities recorded by the system matches the physical count of goods on hand.

11.3 Inventory V/S Stores

Stock is a finished product ready to sell into a marketplace. Stock can also have raw material if the company sells raw material to customers.

A stock is valued at cost of acquisition or market price whichever is less. As stock gets sold it is removed from the balance sheet and recognized as revenue into the profit and loss statement.

11.3.1 Difference between Inventory and Stores

Here are some of the notable differences between stock and inventory according to the various parameters where they are used:

1. The Context:

Inventory is often used for accounting purposes to determine the current raw materials, goods considered to be work in progress and finished products.
On the other hand, stock is used in the business context as it's used to ascertain the bottom line of the business.

2. Valuation:

When valuing inventory, it is determined using the cost incurred by the company using methods such as LIFO, FIFO and Average cost method.
Stock, is valued at the market price which is the selling price at which the finished goods are sold to the customers.

3. Frequency:

Inventory is valued before the end of the financial reporting period. It is valued less frequently compared to stock.
On the other hand, stock is valued frequently at intervals. In most cases, it can be valued on a daily basis since it determines the bottom line of the company.

4. The Revenue:

Inventory takes into account all the assets of a business used to produce the goods it sells. Also, inventory is useful in determining the sale price of stock.
As mentioned, stock is used to determine the total amount of revenue generated by the business.
If there's more stock sold, the business will have higher revenues.

5. Considerations:

As mentioned, inventory is valued at least once every year.
That's because inventory is usually replenished quite often to make sure there is adequate stock for the business to stay afloat.
Furthermore, sale of inventory will create a cash infusion into the business but it is not considered as revenue.
It is only when stock is sold that revenue increases.

Test Your Progress

1. How is inventory different from stores?

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2. State a few benefits of inventory management.

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3. What are a few strategies to avoid problems related to inventory?

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11.4 Types Of Inventory

When it comes to supply and demand, there are different types of inventory that business owners and managers need to know. Understanding these various types of inventory can help you better manage, plan, and budget. You'll then be able to meet demand and thrive in the marketplace.

Types of Inventory are as follows:

1) Raw Materials:

Raw materials are necessary to the life of any business. They're made up of the materials your business uses to produce its own goods.

For example, water, sugar, and lemon would be the raw materials you'd need if you run a lemonade business. Without those raw materials, you can't produce the beverage you market and sell. Lemonade on hand = satisfied (and no longer thirsty) customers.

If your company does not have a system in place to track its supply of raw materials, you can't accurately forecast what you'll produce over the next quarter or year.

2) Work-In-Progress:

Work-in-progress (WIP) is made up of the different parts that are being processed in a system, including all:

- Necessary materials
- Parts (components)
- Assemblies
- Subassemblies

WIP usually includes raw materials that have been released for initial processing. It also covers the entire process of a production. Say, for example, you own an auto repair company. Brake pads would be part of your WIP.

3) Finished Goods:

Like you probably would have guessed, finished goods inventory includes any complete products that are now ready to be marketed and sold. If your restaurant business makes pre-packaged ice cream treats, for instance, the packaged and boxed ice cream cones would be finished goods inventory.

4) Packing Materials:

As the name suggests, packing material is the inventory you use to pack and ship your finished goods. Packing material usually falls into one of three categories:

- Primary packing
- Secondary packing
- Miscellaneous packing

Primary packing material includes the box, bag, or other material that encloses your product while on retail display. If your business manufactures laundry detergent, your primary packing material is the box or bottle that customers pull off the grocery store shelf.
Secondary packing material is the box, bag, or other material you use for convenient storage and transportation of your product. Continuing with the laundry detergent example, the secondary

packing material is the large box that holds four bottles of your product for bulk storage and shipping to retail locations.

Miscellaneous packing material is all of the other items that you use for the storage and transport of your product, including:

- Bubble wrap
- Foam peanuts
- Pallets
- Pallet wrap
- Labels

At first glance, packing materials might not seem like a significant expense. But your business does use a large amount of these supplies every day. If you don't keep tight control of this inventory, the cost will quickly add up.

5) Safety Stock:

With good monitoring, tracking, and control, you can allocate certain types of inventory to protect against supply-and-demand uncertainties, low delivery reliability, and poor-quality components. This type of inventory cushion is called safety stock (or buffer inventory).
Safety stock is the amount of product you keep on hand that exceeds what your business needs to satisfy regular demand.

With safety stock, you can avoid:

- Stock-outs (when an order cannot be filled from existing inventory).
- Backorders.
- Making the customer wait until the next production cycle.
- Causing the customer to go elsewhere to find the product.

When your business doesn't have to contend with these issues, it can provide better customer service—getting the product in the customer's hand when they need it without making them wait—and, ultimately, better customer satisfaction.

Depending on the business you run and the industry in which it operates, a significant amount of safety stock may be a necessary type of inventory. Other businesses can get away with little or no safety stock. It all depends on the market and how quickly you can manufacture a product (with high quality) and deliver it to your customers.

A detailed review of your workflow, workforce, and fulfillment schedule will give you a clear picture of whether or not safety stock is right for your business.

6) Smoothing Inventory:

Smoothing inventory (a.k.a. anticipation inventory) is a type of inventory in which a manufacturer purchases and stores products or supplies in excess of current needs in anticipation of a future event.

Businesses do this because it "smoothes" out the peaks and valleys of seasonal, fluctuating demand and allows them to maintain a constant output. Here's how it works.
A pen manufacturer will build up components, supplies, and completed stock in the months leading up to the start of a new school year (when demand is at its highest). Then, during the rush of back to school time, the manufacturer slowly reduces the excess inventory without having to increase production time.

Storing smoothing inventory allows the manufacturer to save money in other ways, including:

- Keeping workers busy during slow months
- Preventing temporary layoffs
- Stocking up on supplies when prices are lower
- Avoiding hiring, onboarding, training, and other labor costs
- Minimizing overtime hours associated with increased production
- Averting plant shut-down or idling

If your business deals with a seasonal increase in demand, building this type of inventory before the rush comes, can keep your workflow running smoothly and efficiently all year long.

7) Decoupling:

In a manufacturing environment, very rarely does every machine produce at the same rate. One or two pieces of equipment may run several times faster than other pieces of equipment in front of or behind them in the production chain. Sometimes, machines are down for repairs or maintenance.
Despite these differences in activity and production time, manufacturers can maintain the workflow by holding decoupling inventory in stock.
Decoupling inventory are parts, supplies, and finished products that are waiting to be used by the next machine in the chain. Think of it as a type of shock absorber that cushions the manufacturing process against production irregularities caused by a difference in run time, a breakdown, or maintenance of individual machines.
This type of inventory decreases the business's dependence on the sequential nature of the production line and means that Machine B doesn't have to wait for Machine A to finish before they can start. The Machine B operator can pull parts from decoupling stock even if Machine A is down for repairs.

The more decoupling inventory a business holds in the various stages of production and distribution the less it will have to coordinate to keep everything running smoothly.

8) Cycle:

Cycle inventory is a byproduct of economic order quantity theory (EOQ). EOQ attempts to balance inventory costs and machine setup costs.
When your business orders a large number of parts for a single large manufacturing run, inventory costs increase but machine setup costs decrease (because you only have to set up the machine once).
On the other side of the coin, when your business orders a small number of parts for multiple small manufacturing runs, inventory costs decrease, but machine setup costs increase (because you have to alter the machine for each run).
Cycle inventory serves to bring these two costs into alignment and reduce the total cost of the production run. Cycle inventory does this by ordering material in lot sizes rather than on an as-needed basis.

9) MRO Goods:

Maintenance, repair, and operating supplies—or MRO goods—are items put in place to maintain tasks in the production process. These goods are usually a major component of the production process but are not *directly* a part of the finished product.
Examples of MRO goods include gloves, packing materials, tools, etc. Even office supplies like staples, pens and pencils, copier paper, and toner—all of the little parts that keep the wheels turning—are considered MRO goods inventory.

10) Services:

Crucial to business success, service inventory includes the monitoring and management of all other types of inventory in the production process. In a way, it is sort of the "humanized" counterpart to MRO goods.
The comprehensive scheduling system offered by Sling allows you to maintain control of your service inventory by helping you organize your employees' work schedules with ease. That way, scheduling is always simple and convenient!

11) Transportation:

Transit inventories are crucial to businesses that need to transport items or materials from one location to another. Merchandise shipped by truck or rail can sometimes take days (or even weeks) to go from a regional warehouse to your retail facility.
Inventory in transit must be accounted for when it comes to supply and demand, along with the timelines for those demands to be met.

12) Theoretical:

Theoretical inventory attempts to balance (equalize) inflow, processing, and outflow rates into one ideal operation. To do that, theoretical inventory describes the average inventory necessary for a given manufacturing run assuming that no production item (or work-in-progress item) has to wait in a buffer (e.g., decoupling inventory).
In simpler terms, theoretical inventory is the minimum inventory needed for a product to move through the manufacturing system without waiting.
Unless your business runs a single production system (e.g., one machine), theoretical inventory will be an ideal that you may never reach because there will always be some inventory in the system (e.g., transportation, decoupling, MRO, etc.). Nevertheless, you can use this type of inventory to plan production runs and prepare for peak demand.

11.5 Inventory Control

As a manufacturer, if you are targeting a lean manufacturing process, you need to get rid of inventory waste. It is one of the critical elements that act as a barrier to your manufacturing processes of becoming leaner and more ROI driven.
The manufacturing industry loses a lot of money every year due to the overstocking of inventory. At the other end of the spectrum, losses also occur due to understocking and even the unavailability of raw materials (again an outcome of poor inventory control of the raw materials).
And, it is important to think of inventory management as a technique that helps you save money by decreasing overheads. It needs to be an essential element of your business growth strategy. If you go about it in the right manner, it will improve your cash flow, which can then be invested in other revenue generation activities.
Maximizing the potential of your inventory results in improved business profitability – You make better business decisions, which results in improved business outcomes.

11.5.1 Key Aspects of Inventory Control:

A manufacturing plant is relatively complex, and this complexity is based on the domain, whether it is churning out retail goods, food, heavy machinery, automobiles, or something else. If you are a manufacturer or even thinking about getting into manufacturing in a big way, you need to understand the critical aspects of inventory control that will make you make better inventory control decisions.

1. Inventory in Manufacturing Industry:

Manufacturing inventory includes raw materials, which are items that are used to make the finished products. In the case of raw material inventory, these are items that are not yet a part of the production process.

2. Move from Physical Inventory Management to a More Automated Process:

The starting point of any inventory control overhaul is to minimize human intervention throughout the inventory management process. The focus should be on shifting to an automated process that is enabled by the deployment of inventory control software, specifically catering to the needs of the manufacturing industry.

3. Focus on Getting Real-Time Inventory Updates:

When it comes to the raw materials you are using for production and the final products, it will be a massive benefit if you put a system in place that offers you real-time tracking of your inventory items right through the production process.
From the time they reach your manufacturing facility, till the time the final product is delivered to the customer, you need to be able to keep track of every item of your inventory.

4. Disruption Alert:

There are times when, even in a best-case scenario, the inventory management plan can change. There might be a disruption at the raw materials' supplier's end, or there might be an issue with the product line, or the market demand for a product might have increased or decreased.
Such scenarios will disrupt the existing workflow pattern, and it is of critical importance that this change in workflow is taken into consideration in the inventory control process.

The idea is to ensure that all key stakeholders in the inventory control and management process are immediately notified by way of emails, texts, or push notifications when unplanned changes can impact the inventory.

5. Optimizing Production Process:

Meeting the highest standards of inventory control and management is not an end goal in itself. The goal is to ensure optimal inventory to facilitate optimal production. Inventory control plays a huge role in planning the production process from the ground-up.
With proper inventory management controls in place, you have the necessary information to plan your production; this information can include inventory data, the cost of raw materials (not just sourcing, but also warehousing costs), availability of raw materials, and much more. This data helps plan the production process in a more streamlined manner.

6. Forecasting and Planning:
This is yet another highly critical element of inventory management in the manufacturing domain. As a manufacturer, you will need to plan your production budget before the start of every financial year or at times before the beginning of the quarter.
For this to happen, you will need to forecast the demand for your product, which then helps you maintain an adequate supply of raw materials.

7. Smooth and Precise Scheduling – No Scheduling Conflicts or Errors:
Your manufacturing unit might have multiple clients, wherein the product demand varies from one client to another. What's more, in the course of a year, the demand fluctuates, considering changing the buying behavior of consumers, economic pressures, and various other factors.
Also, each client will have different demands when it comes to scheduling product deliveries.

8. Sorting out Warehouse Challenges:
Big manufacturers or even small manufacturers, who are looking to scale their operations, face warehousing challenges. One key challenge is managing warehouse space in the most optimum manner possible.

11.5.2 Inventory Control Ststem:

When it comes to inventory control system for manufacturers, manufacturers keep track of the parts or ingredients that go into making products, in addition to the products themselves.

1. Materials Requirements Planning:

Materials requirements planning, or MRP, builds upon the concepts of inventory control systems by extending the time frame of consideration from keeping track of what you have in the present

to planning what you can manufacture or have available to sell in the future. The MRP sets forth what resources you need to order and when, and what sales orders you can release and when.

Finale is a basic inventory control system for manufacturers without materials requirements planning built in. Small to medium-sized manufacturers may find MRP software overbearing for the complexity of their actual planning needs. The combination of Finale as an inventory control system plus Excel for MRP is the right level of tools for a large class of companies.

2. Lots and Serial Numbers:

Some types of products have expiry dates, or serial numbers, or other properties identified by lot or batch for traceability of the builds. Thus stock may not just be quantities of a particular product, but of a particular lot. For these types of products, the stock item in the block diagram above encompasses the properties of the particular stock item instances that vary from batch to batch or item to item.

3. Stock Control Software:

There is a lot in common between manufacturing software and wholesale and distribution software on the sell side of the inventory management process, so stock control software tends to be the same across these businesses for stock on hand, whether it was purchased from suppliers or manufactured internally.

4. Top Inventory Control Methods:

Manufacturers, grocery stores, clothing retailers, and other large businesses often use a combination of inventory control methods to handle inventory. Therefore, be prepared to blend systems to create the control method you need.

A. ABC Inventory Control:

In this system, you divide your inventory into three different baskets depending on customer demand and usage. For your fast-demand A products, you'll calculate the appropriate number of items to keep in stock. You'll make those same calculations for your medium-demand B products and low-demand C products.
You can easily combine ABC inventory control with other inventory control methods by picking the best inventory control method for each of your three types of products.

B. Fixed Quantity:

In a fixed quantity inventory model, the level of stock is followed continuously. When it reaches a pre-determined level, you place an order for more stock. In most cases, the inventory management system automatically orders more inventory.
Fixed quantity inventory models rely on your ability to monitor your inventory closely. It also assumes that other inventory variables, such as sales and lead time, remain constant.

C. Just in Time:

To implement a just-in-time inventory control method, you order stock a few days in advance of when you anticipate selling it. This type of inventory control method is helpful if you need to decrease your stock for cash-flow purposes.

Of course, the just-in-time system is risky because it doesn't allow for shipping or production delays. If you rely on demand forecasting to order products, you also risk buying too much or too little inventory. Also, any occurrence that causes a delivery lag could result in a lost sale. For this reason, most businesses use the just-in-time control method for high cost or specialty items.

D. Minimum/Maximum Stock Levels:

The concept of the min/max system is simple. You decide an upper and lower inventory limit for each product in your system. When your stock his the lower limit, you buy enough of that product to reach the upper limit.

The min/max method is easy to use, but you do run the risk of running out of products while waiting for them to arrive. It's also possible to set your upper inventory limit too high, which would lead to overstocking. Accurate sales forecasting and sales cycle identification will help you determine exactly how to set your upper and lower limits.

E. Order-Cycling System:

This system requires that you inventory stock every 30, 60, or 90 days (or another predetermined period). You then order products for immediate delivery that are likely to run out before your next inventory.

While this system might work for businesses with limited inventory, larger companies will waste a lot of time conducting inventories. It also requires a very experienced cost accountant to place orders.

F. Two-Bin System:

With this system, you divide each product into two bins. The first bin holds the majority of your stock, and you use that bin to deliver goods to customers. When the first bin is empty, you order more stock, and use the second bin to fulfill orders until the new stock arrives.
The two-bin system requires that you know how much to stock in the second bin to avoid running out entirely. You should also make plans to rotate stock from the second bin to the first bin to prevent spoilage.

G. Vendor-Managed System:

Vendor-managed systems allow you to rely on the supplier to keep track of your inventory and bring additional stock as necessary. If you've ever been shopping at a grocery store while the Frito Lay supplier stocked chips, you've seen this system in action.
If you have a professional vendor who knows how to stock your business correctly, this inventory system can be ideal. However, this type of system requires that you rely on your supplier.

11.5.3 Inventory Control With Software

It can often be hard to track suppliers, manage your accounts receivable and payable, or adhere to a budget when your inventory is in chaos. To improve your efficiency, you must learn how to organize and scale your inventory control methods in manufacturing.

1. Use technology to track real-time inventory:

You can learn how to maintain inventory control by working with partners whose technology provides real-time tracking throughout production. Look for applications that give you precise tracking and streamline or automate various production points.

Using the available technology, you can manage more accurately manage inventory with fewer man-hours, giving you an edge over competitors. Optel's inventory control software for manufacturing companies can help you achieve this.

2. Maintain production with end-to-end traceability:

End-to-end traceability provides you with a start-to-finish view of inventory. You can trace all orders, including all points of origin and destination. Instead of having endless stacks of paper records and manually updated spreadsheets, track this digitally.

Having your component information available in real-time helps to eliminate unknowns in your electronics manufacturing which your clients also value.

3. Take advantage of cloud inventory management:

You need to be able to access inventory details, no matter where you are. Having a cloud inventory management solution is a great way to accurately project your production timelines, meet deadlines and exceed customers' expectations.

Imagine you're in a client meeting and must estimate delivery date for an upcoming order. Having this level of inventory management in the manufacturing industry can help you effectively set client expectations in real-time from anywhere with internet access.

4. Learn how to control inventory in manufacturing by outsourcing:

If you're still determining how to control inventory but are already running lean, then outsourcing this critical task can be a cost-effective option. For more ideas and tips on how to improve inventory management in the electronics industry, have a look at our blog and services.

Test Your Progress

1. How is inventory control done with software?

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2. What are the key aspects of inventory control?

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3. Explain any 3 types of inventory.

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11.6 Summary

Inventory management is the process of keeping track of all the goods your company has in stock. It requires managers to forecast and plan the **inventory** needed to generate sales.

Store management includes setting employee schedules, handling customer issues, and maintaining a clean, safe, shopping environment.

Inventory control monitors the least level of stock needed to prevent inventory shortages. This ensures that you meet customer demand without disruption or delay. Inventory control also prevents excess stock on hand that ties up capital. Companies use a variety of inventory control methods for the same.

11.7 Test Your Progress

1. What do you understand by inventory management? What are its benefits?
2. What are the basic techniques for inventory management to speed up delivery?
3. How is inventory different from stores?
4. What are the inventory management strategies to avoid problems?
5. What are various types of inventories? State any 8 of them.
6. What do you understand by inventory control? What are its key aspects?
7. What do you understand by inventory control system?
8. Explain top inventory control methods in detail.
9. How inventory control be done with software?

11.8 Suggested Readings

1. https://www.manufacturing.net
2. https://www.brahmin-solutions.com
3. https://smallbusiness.chron.com

4. https://www.finaleinventory.com
5. https://www.hashmicro.com
6. https://www.optelco.com
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9. https://www.sortly.com
10. https://www.asp.com.au
11. https://www.educba.com
12. https://www.xero.com
13. https://www.zoho.com
14. https://getsling.com
15. https://www.brahmin-solutions.com
16. https://www.finaleinventory.com

Unit 12 Inventory Build –Up

Unit Structure

12.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge of inventory build –up.
- Understand the concept of EOQ.
- Get an understanding of various inventory models.
- Study inventory models with quantity discount
- Get an insight into exchange curve concept
- Discuss coverage analysis.
- Get an idea of optimal stocking and issuing policies
- Learn inventory management of perishable commodities
- Completely understand concept of abc – ved analysis

- Know about design of inventory distribution systems

12.1 Introduction

Inventory refers to all the items, goods, merchandise, and materials held by a business for selling in the market to earn a profit. Example: If a newspaper vendor uses a vehicle to deliver newspapers to the customers, only the newspaper will be considered inventory. The vehicle will be treated as an asset.

12.2 Inventory Build -Up

The inventory build-up plan is useful when you need extra safety stock, for example due to seasonal variations in demand. ... The inventory build-up plan proposes what items and quantity should be produced and when you must start building the extra safety stock to be able to meet future demand.

12.2.1 Reasons for Inventory Build-Up

Inventory buildup starts because of the reasons, either (i) items get ordered in excess of the requirement or (ii) they do not get used at the same rate at which they are received.

To overcome the first possibility, orders should be placed after consulting the production department. Production and Materials Management departments must together work out the delivery schedules, which must be decided after considering the past schedules, which must be decided after considering the past performances of the suppliers.

Sometimes inventories, get build up because excessive quantities are received at a particular time. For example, receiving the year's requirement spread over 4 quarterly deliveries, is different from receiving in one lot. In the second case the organisation is forced to carry inventory of 12 months at a time. The other danger is that such material deteriorates in storage or pilfered or damaged.

Now coming to the second aspect, store's inventory is consumed by the production department by drawing materials from stores and converting it into finished goods. If the consumption rate falls down, then inventory buildup takes place.

The consumption rate may fall down because of any of the following reasons:

i. Due to change in production plans.

ii. Due to discontinuance of manufacture of a product.
iii. Due to change in design for a particular assembly or set of components.

In such cases rescheduling of the deliveries or reducing the quantities of the pending order must be assorted to. In case the item is not required at all, the further supplies must be stopped and pending orders be cancelled.

12.2.2 Actions to be Taken for Avoiding Inventory Buildup:

(i) Items with no issues and receipts in last one year should be identified in the beginning of the financial year. In consultation with production control and research and designs department all the pending/open purchase orders, if any for all these items should be cancelled.

(ii) In the cases where, items have been received without any issues in the past, matter should be investigated.

These investigations may reveal either of the following:

(a) Items are for new project and utilization is expected to be started in near future.

(b) Items are received for the production planned a few months later.

(c) The item is a replacement for an obsolete item, but will be issued only after existing stock of the obsolete item is exhausted.

(d) The item is for a product whose production has been suspended or delayed due to a temporary slump in the demand.

(e) Item is supplied much ahead of the requirement.

(f) The item is not required.

Business owners build up their inventories as part of a planned cycle of replenishment to cover normal monthly forecast product demands and prevent unnecessary back ordering or customer attrition during crucial sales periods. They also might increase their inventories in preparation of anticipated high foot traffic and sales events such as a new location grand opening or holiday. Having some excess stock isn't bad for business as long as you can move it. However, when inventory builds up for unplanned reasons, you can lose money.

12.2.3 Terms related to Inventory Build-Up:

1. Accumulation Basics:

An inventory accumulation is an excess of inventory that a business owner has difficulty moving after an unplanned event adversely affects sales. For example, a sudden slowdown in the economy results in fewer customers, or road construction or a new competitor redirects foot traffic away from your business. Additionally, anticipated “hot” items might accumulate if consumer interest switches to a similar product or the market becomes saturated with lower priced knock offs.

2. Accumulation Costs:

Business owners that sell products rely on a steady cash flow to run their businesses. When inventory accumulates, you start to lose the money you invested, as well as potential profits. With lower profits, you might have difficulty paying for business expenses such as new advertising, new inventory, employee wages and debts. An excess of inventory also might tempt employees to steal because they think you won’t notice the loss. Additional costs might include higher storage costs or upkeep, insurance premiums or property taxes.

3. Moving Inventory:

A variety of sales strategies can help you to move accumulated inventory. For example, you might offer excess inventory at discounted prices or bundled as free items with large ticket items to attempt to increase impulse purchases. You might also set up an online "clearance" store and shopping cart just for the excess stock and use social media, email subscriber lists and your blog to build product and sale awareness. Additionally, you might break excess products down into smaller components, parts or materials to sell or, if you manufacture your own products, reuse in new products.

4. Additional Solutions:

If attempting to sell excess inventory doesn’t work, other methods exist to use it to the benefit of your business. For example, you might give excess items to trade show and event participants who visit your booth, sign up for your newsletter or make an order to attract them to become customers or buy additional products. You also might give the items to existing customers who send new customers your way. Additionally, you might donate accumulated inventory to non-profit and charitable organizations, churches and schools to build your community reputation and recoup some financial losses through tax breaks.

12.2.4 Negative Effects of Inventory Build – Up

Inventory control is an important part of maintaining your company’s finances. You have a significant amount of money tied up in buying, warehousing and moving inventory. That is why you need to understand the negative effects of building up inventory. Inventory is a

dynamic feature of your business that should be cycled through your warehouse as quickly as possible. If you hold on to inventory for too long, you are causing your company several expensive problems.

1. Obsolescence:

Product obsolescence is an issue with many industries, including technology, auto sales and food distribution. If you allow products to build up rather than making sure they make it to the product shelves or into your next catalog, you run the risk of those products becoming obsolete. The value of the products drop significantly when they are no longer desired by consumers, and you could be looking at a large financial loss if you sell the products. The financial problems get worse if you cannot find a buyer at any price. At that point, you are forced to absorb the entire inventory cost as a loss.

2. Holding Costs:

Warehouse space, personnel, supplies and equipment all cost money. If your inventory requires special attention such as refrigeration, then your holding costs go up. Inventory that is allowed to build up becomes a liability in terms of maintenance costs. Your warehouse crew is forced to attend to the inventory by moving it around to access other inventory, counting it from time to time to satisfy bookkeeping procedures and maintaining the equipment required to move and hold the inventory. The longer inventory is allowed to accumulate in your warehouse without generating revenue, the more of a financial burden it becomes.

3. Interest Rates:

When inventory is allowed to build up without being sold, the company is not able to generate revenue from the inventory to pay bills. To pay operating costs and keep the company going, the business is forced to borrow money. The interest that accumulates on that borrowed money becomes a financial cost that the company would not have to endure if the inventory had been sold.

4. Storage Space:

One misconception about mounting inventory is that it is not harming anything if it is just sitting there. The truth is that inventory that is allowed to build continues to take up warehouse space. The company has less room for new products and either needs to find more warehouse space or create unsafe conditions in the existing warehouse to accommodate more products.

12.3 EOQ

Economic order quantity (EOQ) is the ideal order quantity a company should purchase 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 EOQ is a company's optimal order quantity that minimizes its total costs related to ordering, receiving, and holding inventory.
- The EOQ formula is best applied in situations where demand, ordering, and holding costs remain constant over time.
- One of the important limitations of the economic order quantity is that it assumes the demand for the company's products is constant over time.

12.3.1 Formula of EOQ

- Determine the **demand** in units.
- Determine the **order cost** (incremental cost to process and order).
- Determine the **holding cost** (incremental cost to hold one unit in inventory).
- Multiply the **demand** by 2, then multiply the result by the **order cost**.
- Divide the result by the **holding cost**.
- Calculate the square root of the result to obtain EOQ.

In short: EOQ = square root of (2 x D x S/H) or • (2DS / H)

Where:

- D represents demand, or how many units of product you need to buy.
- S represents setup cost.
- H represents the holding fee or storage cost per unit of product.

12.3.2 Example of calculating EOQ

Meet Matt. Matt runs a men's clothing line. Matt needs to buy 12,000 shirts per year to fulfill demand (D). He incurs a setup cost of $100 (S) and a holding fee (H) of $16 per shirt. He needs to know his EOQ.

Plugging those numbers into the EOQ formula, you get:
EOQ = • (2 x 12,000 x 100/16)
EOQ = • $3,456,000 / $16
EOQ = • 216,000
EOQ = 465 units (rounded up to the nearest whole unit)

The EOQ is usually used to set the reorder point within your inventory management workflows. Together, these metrics tell you when to place an order (reorder point) and how much order to place (EOQ formula). This prevents you from carrying too much deadstock or facing stockouts.

12.3.3 Goal of EOQ

The goal of the EOQ formula is to identify the optimal number of product units to order. If achieved, a company can minimize its costs for buying, delivery, and storing units. The EOQ formula can be modified to determine different production levels or order intervals, and corporations with large supply chains and high variable costs use an algorithm in their computer software to determine EOQ.

EOQ is an important cash flow tool. The formula can help a company control the amount of cash tied up in the inventory balance. For many companies, inventory is its largest asset other than its human resources, and these businesses must carry sufficient inventory to meet the needs of customers. If EOQ can help minimize the level of inventory, the cash savings can be used for some other business purpose or investment.

The EOQ formula determines a company's inventory reorder point. When inventory falls to a certain level, the EOQ formula, if applied to business processes, triggers the need to place an order for more units. By determining a reorder point, the business avoids running out of inventory and can continue to fill customer orders. If the company runs out of inventory, there is a shortage cost, which is the revenue lost because the company has insufficient inventory to fill an order. An inventory shortage may also mean the company loses the customer or the client will order less in the future.

12.3.4 Limitations of Using 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

Test Your Progress

1. What are the limitations of EOQ?

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2. What are the negative effects of inventory build-up?

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12.4 Various Inventory Models

Inventory model is a mathematical model that helps business in determining the optimum level of inventories that should be maintained in a production process, managing frequency of ordering, deciding on quantity of goods or raw materials to be stored, tracking flow of supply of raw materials and goods to provide uninterrupted service to customers without any delay in delivery.

There are two types of Inventory model widely used in business:
1. Fixed Reorder Quantity System
2. Fixed Reorder Period System.

1. Fixed Reorder Quantity System.

Fixed Reorder Quantity System is an Inventory Model, where an alarm is raised immediately when the inventory level drops below a fixed quantity and new orders are raised to replenish the inventory to an optimum level based on the demand. The point at which the inventory is ordered for replenishment is termed as **Reorder Point**.
The inventory quantity at Reorder Point is termed as **Reorder Level** and the quantity of new inventory ordered is referred as **Order Quantity**.

Average Demand (Dav): It is the average number of order requests made per day.
Average Lead Time (TL): The time required to manufacture goods or product.
Average Lead Time Demand (DL): Average number of orders requested during the Lead Time
Average Lead Time Demand (DL) = Average Demand (DAv) X Average Lead Time (TL)

Safety Stock (S): It is the extra stock that is always maintained to mitigate any future risks arising due to stock-outs because of shortfall of raw materials or supply, breakdown in machine or plant, accidents, natural calamity or disaster, labour strike or any other crisis that may the stall the production process.

The quantity of safety stock is often derived by analysing historical data and is set to an optimized level by evaluating carefully the current cost of inventory and losses that may be incurred due to future risk.
Reorder Level (RL): Reorder level is the inventory level, at which an alarm is triggered immediately to replenish that particular inventory stock. Reorder level is defined, keeping into consideration the **Safety Stock** to avoid any stock-out and **Average Lead Time.**

Demand because even after raising the alarm, it would take one complete process cycle **(Lead Time)** till the new inventories arrive to replenish the existing inventory.

Reorder Level (RL) = Safety Stock (S) + Average Lead Time Demand (DL)

Order Quantity (O): Order quantity is the Demand (Order requests) that needs to be delivered to the customer.

Minimum Level: At least Safety Stock has to be always maintained to avoid any future stock-outs as per the standard practices of inventory management.

Minimum Level (LMin) = Safety Stock (S)

Maximum Level: The maximum level that can be kept in stock is safety stock and the demand (the quantity ordered).

Maximum Level (LMax) = Safety Stock (S) + Order Quantity (O)

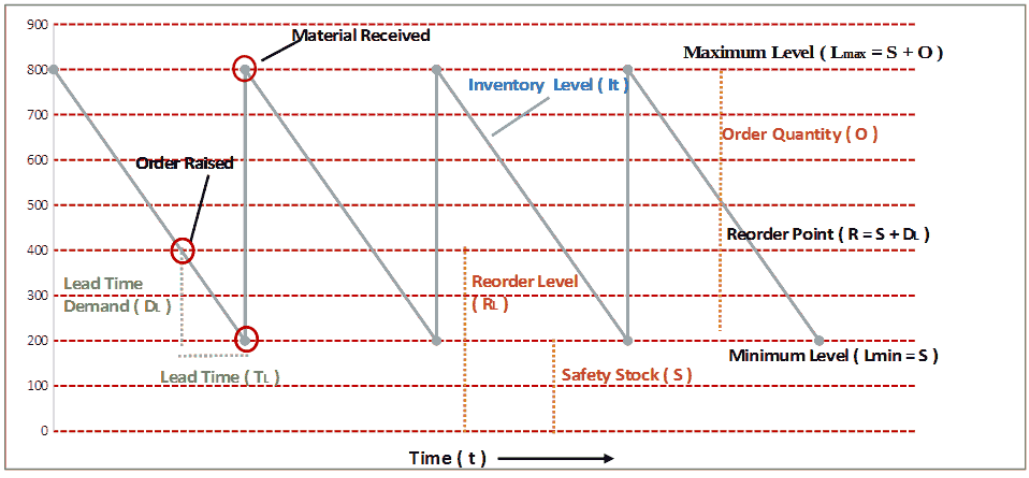

Fig. 12.1: Fixed Reorder Quantity System

Example: The order quantity of an Item is 600 Units. The safety Stock is 200 Units. The Average Lead Time is 5 Days and average consumption per days is 40 units.

Order Quantity (O) = 600 Units
Safety Stock (S) = 200 Units
Average Lead Time (TL) = 5 Days
Average Demand (DAv) = 40 Units
Average Lead Time Demand (DL) = Demand (DAv) X Lead Time (TL) = 200 Units
Reorder Level (RL) = Safety Stock (S) + Average Lead Time Demand (DL) = 400 Units
Minimum Level (LMin) = Safety Stock (S) = 200 Units
Maximum Level (LMax) = Safety Stock (S) + Order Quantity (O) = 800 Units

2. Fixed Reorder Period System:

Fixed Reorder Period System is an Inventory Model of managing inventories, where an alarm is raised after every **fixed period of time** and orders are raised to replenish the inventory to an optimum level based on the demand. In this case replenishment of inventory is a continuous process done after every fixed interval of time.

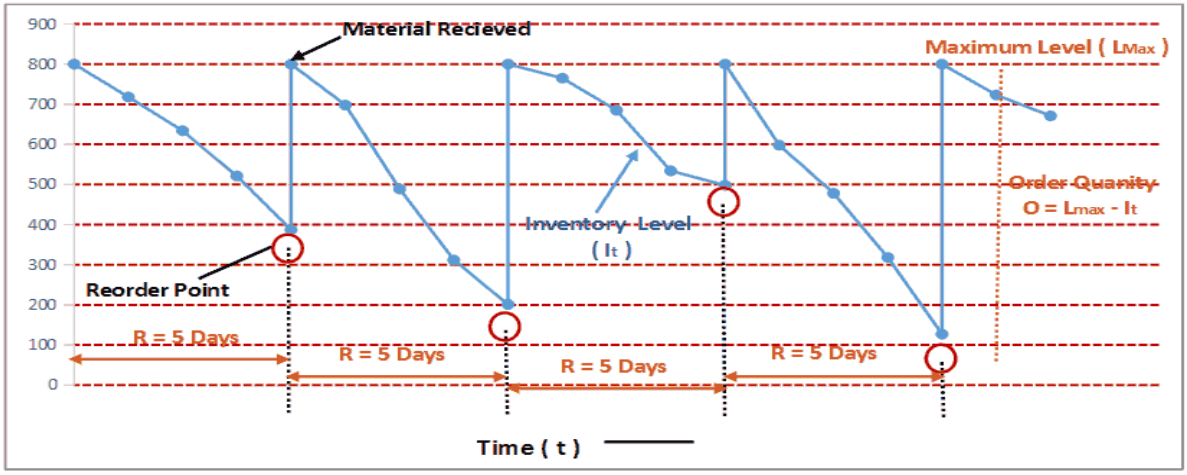

Fig.12.2: Fixed Reorder Period System

Regular Intervals (R): Regular Interval is the fixed time interval at the end of which the inventories would be reviewed and orders would be raised to replenish the inventory.

Inventory on Hand (It): Inventory on hand is the Inventory level measured at any given point of time.

Maximum Level (M): It is the maximum level of inventory allowed as per the production guidelines. The maximum level is derived by analyzing historical data.
Order Quantity: In this system, inventory is reviewed at regular intervals (R), inventory on hand (It) is noted at the time of review and order quantity is placed for a quantity of (M) – (It).
Order Quantity (O) = (M) – (It).

Example: Inventory is replenished at every regular interval of 5 days. The maximum allowable inventory is 800 Units. The inventory reviewed on Day-5, Day-10, Day -15 and Day -20 were 387 Units, 201 Units, 498 Units and 127 Units respectively.

Regular Intervals (R) = 5 Days
Maximum Level (M) = 800 Units
Inventory on Hand: I5 = 387 Units, I10 = 201 Units, I15 = 498 Units and I20 = 127 Units
Order Quantity (O) = (M) – (It).
Order Quantity (O5) = 800 – 387 = 413 Units
Order Quantity (O10) = 800 – 201 = 599 Units
Order Quantity (O15) = 800 – 498 = 302 Units
Order Quantity (O15) = 800 – 127 = 673 Units

12.5 Inventory Models With Quantity Discount

The quantity to order from supplier to replenish inventory in an important decision in material/inventory management. Economic order quantity (EOQ) model computes the amount to order using the assumptions that cost per unit of purchased items remains fixed regardless of the number of units ordered. But, it is common for suppliers to give discounts when order quantities are high. When discounts are considered the economic order quantity may change. The optional order quantity model investigates the total annual inventory costs with and without discounts, and the optional order quantity is one that minimizes total annual inventory costs. The results is that larger than usual economic order quantities may be justified.

Just-in-time manufacturing systems, or Kanban-based manufacturing systems have somewhat altered the promise behind quantity discount models. In these systems, order quantities tend to be much smaller.

Quantity discount is a reduction in price offered by seller on orders of large quantities. Quantity discounts exist in different forms and in certain scenarios they may not be obvious. The well-known *buy-1-get-1-free* sale is actually a 50% quantity discount since you effectively purchase a unit at half the normal price.

12.5.1 Implication for Decision Making

When purchasers following Economic Order Quantity (EOQ) model for ordering inventory have the opportunity to avail a quantity discount on order sizes greaters than their EOQ, they need to base their decision, apart from qualitative factors, on the net effect of the decision on the their income. A typical quantity discount has the following three effects on the income of a purchaser:

a. A saving in the form of reduced price
b. A saving in the form of reduced ordering costs
c. A loss in the form of increased total holding costs of inventory

A decision to avail the quantity discount should be taken only if the net effect of the above components on the income is positive.

The following problem tries to clarify decision making when there is an apportunity to obtain quantity discounts:

Example:

A retail store dealing in computer hardware imports an enterprise model solid-state drive (SSD) at a fixed price of $1000 per unit from the sole distributer of the SSD. On January 1, 2014, the store received an offer of 15% discount on orders of 300 or more units. Provided further that the estimated sales for the year are 600 units, the cost incurred per order is INR 1000 and the average holding cost per unit per annum is estimated to be INR 120 per unit. The full price is likely to remain INR 1000 during the year. Please ignore opening and closing inventories, safety stock etc.

Solution:

$$\frac{\sqrt{2X\ Demand\ XOrder\ Cost}}{\sqrt{Holding\ cost\ per\ unit}}$$

$$\sqrt{\frac{2X600X1000}{120}}$$

= 100 Units.

Economic Order Quantity (EOQ)= 100 units

12.6Exchange Curve Concept

Exchange curve (EC) is also called optimal policy curve which is useful for planning aggregate inventory level in an organization. The total number of orders (TO) per year is plotted against the total investment in inventories (TI) per year.

When TI is given, rational inventory policy tries to minimize TO. The exchange of TI and TO is such that TI.TO = K = Constant.

K•s value is 1/ 2 [£ • Di Vi]2
Where Di = Annual Requirement of ith item, 12 x 6 / 24
Vi = Unit Price for ith item, i = 1… N.
Exchange Curve as seen from the diagram is a rectangular hyperbola. The exchange curve in the diagram is for a situation where the ordering cost is not explicitly known. At any point on the EC, there is an optimal, trade off between TI and TO.

12.6.2 Application of Exchange Curve:

It is a tool to plan aggregate inventory. It assesses quickly the rationality of prevailing inventory policies. EC is plotted first by computing the value of K for selected group of items. TO and TI are determined under prevailing situation. If point C in EC is our prevailing situation, it is irrational. To rationalize it, there are two alternatives – AC or BC such that we reduce inventory to B for the same ordering effort or reduce the number of orders to A for the same inventory. It is a mechanism useful at the macro level.

Inventory Turnover:

It is the figure that indicates the number of times the inventory is rotated in a year, e.g. inventory equal to one month's consumption means a turnover of 12 times and inventory equal to six month's consumption means an inventory turnover of 2 times. The turnover ratio indicates how best the capital tied up in inventory is utilised. Consider the following illustration:

Opening inventory 7 lakhs
Closing inventory 5 lakhs
Average inventory 6 lakhs
Consumption during the year 24 lakhs
Average inventory as the number
of month's consumption 3 months
Inventory turnover rate 4 times a year
Inventory turnover greatly affects the profitability of the company.

Consider the following example.

Company X Company Y Company Z
Cost of sales (Rs) 50 lakhs 50 lakhs 50 lakhs
Gross Profit 15% 7.5 lakhs 7.5 lakhs 7.5lakhs

Material consumed 25 lakhs 25 lakhs 25 lakhs
Inventory held as month's
Consumption 1 month 6 months 12 months
Turnover rate 12 2 1
Value of Inventory held 2.1 lakhs 12.5 lakhs 25 lakhs

Inventory carrying
cost @ 25% 52,500 3.13 lakhs 6.25 lakhs

Net profit (Rs) 6.98 lakhs 4.37 lakhs 1.25lakhs

In XYZ company, there was a sales turnover of 2 crore in 1996. It earned a profit of Rs 20 lakhs. The capital employed was Rs 100 lakhs.

1) Percentage of profit on sales = 20 lakhs x 100 / 200 = 10%
2) Turnover of Investment = 200 lakhs / 100 = 2
3) Percentage of Return on Investment = 10 x 2 = 20%

In 1997, the company reduced its inventories by 20 lacs. The other things i.e. sales turnover and profits, remained the same.

1) Capital employed= 80 lakhs
2) Turnover of Investment= 200 lakhs / 80 lakhs = 2.5

A large part of capital is tied up to inventories, and hence reduction in inventory money improves the returns on assets, though profits on sales remain the same. Consider the following example.

Our earnings are sales revenue minus costs of materials, labor, sales costs, administrative costs etc.
Our capital employed is worth our inventories, cash, fixed assets, plant and equipment etc.
Percentage of profits on sale = Earnings x 10 / Sales Revenue —A
Turnover of investment = Sales Revenue / capital employed –B
A x B = Percentage Return on Investment
Percentage of Profit on sales x Turnover of Investment
Percentage Return on Investment 10 x 2.5 = 25%
It is obvious that a reduction in inventory increases the returns.

Test Your Progress

1. What is the application of exchange curve?

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2. What are the implications of decision making?

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12.7Coverage Analysis

Industry Design Coverage analysis is the procedure used by Nielsen to establish the Industry Design Coverage for product categories. The Market Dynamic Index quantifies the macroeconomic and retail structure factors that impact Industry Design Coverage consistency over time.

12.7.1 Stock Coverage: days cover calculation and other stock

Anyone who manages inventory is familiar with stock coverage.The question is, how do you measure 'days cover calculation' and other useful inventory metrics.

If you're a distribution company, managing stock coverage is essential and having accurate stock measurements at your fingertips is the difference between turning a profit or not. The sooner you move your inventory, ship it at the lowest cost and not get caught with too much dead stock, the better your balance sheet.

Let's look at some of the more common measures involved with analyzing your inventory coverage.

- **Stock on Hand (SOH) -** Stock levels by SKU, by product group, or by warehouse location
- **Sales History -** You're going to want to introduce the actual sales demand for your products to give you the basic supply and demand picture.
- **Average Monthly Unit Sales -** Incomes and sales average for the last 3, 6 & 12 months by product to give you a better understanding of how each product has been performing over time including seasonal influences on product sales (i.e. A pool chemical distributor will want to view demand by season Winter vs Summer, or a giftware company will want to track sales against Valentine's day vs Mother's day vs Christmas, etc.
- **Stock On Order (OO) or Stock In Transit (IT) –** you will need to account for this and add to the stock levels since you will be receipting these goods into your warehouse once they arrive.
- **Sales Back Orders (BO) or Committed Stock (CS) –** these units will need to be added to the equation since this is stock that will be coming out the inventory levels as it is being prepared to ship or waiting for stock to arrive.
- **Min/Max levels –** If you have them and use them, it is good to pull these into the picture for a couple reasons a) you can see whether a product stock levels are within the range or b) see if you need to adjust your stock levels when looking at the sales and monthly averages – sales may be picking up or slowing down, and you need to be aware of this for future planning.
- **Lead Time –** the time it takes to get to your warehouse once an order has been placed on the supplier. Very important when you are comparing your true stock coverage and how long it will take to get your SKU's topped up to optimal stock coverage levels.

It may vary from company to company, however the process will look something like this:

Step 1 – calculate the true stock available (net stock levels)

(SOH + SOO + SIT) – (CS + BO) = Net Stock

Step 2 – calculate your avg. daily run rate using sales history

Total Unit Sales for 12 months/ 365 days = Avg. daily unit sales

Step 3 – calculate your stock coverage (in days)

Net Stock/ Avg. daily unit sales = Stock Coverage in days

So now that you can calculate your stock coverage in days (or months), you may want to compare this to your lead times (the time it takes to be receipted into your inventory). For example, if your stock coverage is 28 days and it takes 84 days (12 weeks) for stock to be delivered, there is a good chance you're going to be Out-of-Stock for 56 days (8 weeks) if unit sales continue on trend for that SKU. And Out-of-stock (OOS) means lost sales, dissatisfied customers and maybe no commissions for a Sales Manager.

12.8Optimal Stocking And Issuing Policies

The general inventory depletion problem can be described as the problem of finding an issue policy which maximizes or minimizes a prescribed function when the inventory itself is changing in quality over time.

The assumption of one demand source withdrawing items from the stockpile is removed and the case of several demand sources is considered.

Next, it is assumed that there is a constant penalty cost, p, each time an item is issued. It can be described as an installation or work stoppage cost.

Finally, the assumption that the field life, $L(S)$, is a concave or convex function is removed. A more general type of function is considered. $L(S)$ is a concave nonincreasing function for $S\mu[0, t]$ and $L(S) = L(t) = c > 0$ for $S \geqq t$. When $L(S)$ has this form, it provides a good approximation to the general decreasing S-shaped curve. In all of the foregoing cases, optimal policies or bounds on the optimal policies are presented.

Test Your Progress

1. What do you understand by coverage analysis?

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2. What do you understand by optimal stocking?

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12.9Inventory Management Of Perishable Commodities

Inventory management is important when it comes to perishable goods. From providing a quick overview of the location of stock to throwing up warnings for impending critical distribution and sell or use-by dates, an effectively managed inventory is often a must for businesses that deal with products that have a finite lifespan. For businesses that are looking to improve their inventory management systems, or even set a new one from scratch, it can be difficult when it comes to deciding on the type of management system to go for. The following solutions should help organisations to manage their perishable goods in a way that both promotes efficiency and saves money.

12.9.1 Inventory management tools for perishable goods

1. Deploy a FIFO Strategy:

First In, First Out, or FIFO, is a simple technique that focuses on stock rotation. By ensuring that the older stock (first in) is sold or distributed first (first out), the stock is naturally sorted by date, thus preventing waste and spoilage. Managing FIFO can be as simple as a date management table on a piece of paper next to the storage area, or as advanced as an electronic data management system that indicates which stock is next in line to leave storage.

2. Set par levels:

Knowing how much stock you need at any one time can be like trying to predict lottery numbers, but good forecasting is the key to minimising waste. Setting a par level can be a method that helps with forecasting; it refers to the amount of perishable stock required on hand at any one time based on sales records. If you are close to being out of stock, then you only need to order back to the set par level, and if you have plenty of stock left, then a light order or no order at all will help prevent overstocking.

3. Contingency planning:

Tying in with forecasting, contingency planning refers to the practice of expecting the worst (and best) case scenarios. For example, meat product sales tend to spike on sunny weekends thanks to the increase in people who would have a barbecue when the sun is out. By having a robust strategy in place, it will enable you to react faster and draw up or offload stock quicker to prevent making a loss.

4. Regular auditing:

Whether you are working with raw ingredients and perishable goods with a short or long lifespan, having regular inventory audits will only help track expiry dates. Audits can be laborious, time-consuming and expensive if you do not have the right tools and strategies in place. But done correctly using a system such as ERP, it can provide the most accurate picture of perishable stock items, the expiry dates and a snapshot of how effective your current stock strategies really are.

12.10ABC – VED Analysis

12.10.1 ABC Analysis

ABC analysis is an inventory management technique that determines the value of inventory items based on their importance to the business. ABC ranks items on demand, cost and risk data, and inventory mangers group items into classes based on those criteria. This helps business leaders understand which products or services are most critical to the financial success of their organization.

Calculation of ABC Inventory Analysis

Conduct ABC inventory analysis by multiplying the annual sales of a certain item by its cost. The results tell you which goods are high priority and which yield a low profit, so you know where to focus human and capital resources.

Formula for ABC inventory analysis:

(Annual number of items sold) x (Cost per item) = **(Annual usage value per product)**

One can use Microsoft Excel to do a basic ABC inventory analysis. List each product or resource in descending order according to its product usage value. Calculate the total of each item in the aggregate amount. Determine the values for the A, B and C categories, then assign a group name to each item. The goods with the highest value then get the manager's closest attention.

12.10.2 VED Analysis

VED analysis is an inventory management technique that classifies inventory based on its functional importance. It categorizes stock under three heads based on its importance and necessity for an organization for production or any of its other activities. VED analysis stands for Vital, Essential, and Desirable.

V-Vital category

As the name suggests, the category "Vital" includes inventory, which is necessary for production or any other process in an organization. The shortage of items under this category can severely hamper or disrupt the proper functioning of operations. Hence, continuous checking, evaluation, and replenishment happen for such stocks. If any of such inventories are unavailable, the entire production chain may stop. Also, a missing essential component may be of need at the time of a breakdown. Therefore, order for such inventory should be before-hand. Proper checks should be put in place by the management to ensure the continuous availability of items under the "vital" category.

E- Essential category

The essential category includes inventory, which is next to being vital. These, too, are very important for any organization because they may lead to a stoppage of production or hamper some other process. But the loss due to their unavailability may be temporary, or it might be possible to repair the stock item or part.

The management should ensure optimum availability and maintenance of inventory under the "Essential" category too. The unavailability of inventory under this category should not cause any stoppage or delays.

D- Desirable category

The desirable category of inventory is the least important among the three, and their unavailability may result in minor stoppages in production or other processes. Moreover, the easy replenishment of such shortages is possible in a short duration of time.

12.10.2.1 Usage of VED Analysis

Small and big organizations both widely use VED analysis. The most important application of this analysis is in maintaining medical inventory in hospitals and their drug stores. Drugs and related supplies comprise a significant portion of a hospital's budget. Moreover, maintaining the right quantity of the right drugs is an extremely challenging task for management. While a shortage of critical medicine can lead to crises and even loss of lives, an abundance of non-important medications can lead to blockage of money and space, both.

VED analysis helps in dividing medicines into the three categories as per their usage and importance. Therefore, medication in the vital group is to be kept in stock compulsorily, as they would be critical for patients. Medicines which are a bit less risky, or which can be obtained from other sources too at short notice, become part of an essential category. Those that are least critical and their shortage will not pose any danger to a patient's health, and lives get its place in the desired class. As a result, the hospital's management can wisely allocate resources on medical inventory as per their respective VED categories.

Test Your Progress

1. What do you understand by inventory management tools for perishable goods?

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2. What is VED Analysis? Explain in brief.

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12.11Summary

Inventory buildup starts because of the reasons, either (i) items get ordered in excess of the requirement or (ii) they do not get used at the same rate at which they are received.

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

ABC analysis strategy is used to classify data into three categories based on the values of the target measured **in** descending order. ... It is based on an assumption that **inventories** of an organization are not of equal value, and can be grouped into three categories (A, B, and C) by their estimated value/importance.

VED analysis is an **inventory management** technique that classifies **inventory** based on its functional importance. It categorizes **stock** under three heads based on its importance and necessity for an organization for **production** or any of its other activities. **VED analysis** stands for Vital, Essential, and Desirable.

12.12Test Your Progress

1. What is inventory build-up?
2. What are the reasons for inventory build-up?
3. What are the actions to be taken for inventory build-up?
4. What are the negative effects of inventory build-up?
5. What is EOQ? What is its formula?

6. What is the goal of EOQ?
7. What are the limitations of EOQ?
8. What are various inventory models? Explain in detail.
9. What is quantity discount?
10. What is exchange curve? What is its application?
11. What do you understand by Optimal Stocking And Issuing Policies
12. What is Stock Coverage? How is days cover calculation and other stock calculation done?
13. What do you understand by inventory management tools for perishable goods
14. What is ABS Analysis? Explain its calculation.
15. What is VED analysis?
16. What is the usage of VED Analysis?
17. Calculate Economic Order Quantity (EOQ) from the following:

Annual consumption	6,000 units
Cost of ordering	Rs. 60
Carrying costs	Rs. 2

18. .From the following particulars, calculate the Economic Order Quantity (EOQ):

Annual requirements	1,600 units
Cost of materials per units	Rs. 40

Cost of placing and receiving one order Rs. 50
Annual carrying cost for inventory value 10%

Answers:
17. 600 units.
18. 200 units

12.13 Suggested Readings

1. https://www.businessmanagementideas.com
2. http://www2.myoops.org
3. https://www.onelook.com
4. https://smallbusiness.chron.com
5. https://www.investopedia.com
6. https://academicjournals.org
7. https://www.researchgate.net
8. https://xplaind.com
9. https://link.springer.com
10. https://www.sciencedirect.com
11. https://www.citeman.com

Unit 13 Surplus Management

Unit Structure

13.0 Objectives

After completing this unit you will be able to:

- Get a deep knowledge ofsurplus management.
- Completely understand concept of Inventory Management System
- UnderstandInformation System For Inventory Management.

13.1 Introduction

Industrial manufacturing and plant operations' professionals all have a common need to find a solution for managing surplus assets so they can focus on their many other responsibilities. Whether that consists of idle assets no longer contributing to daily operations or an entire plant closure due to consolidation of operations that needs to have all assets inventoried, valued, and redeployed or sold; successfully managing surplus assets is an important component of a healthy supply chain. Research suggests that nearly $150 billion worth of underutilized or surplus assets currently exist, and that's a lot of potential value on the table for businesses challenged to find cost reductions or enhance cash flow and streamline operational processes.

13.2 Surplus Management

Surplus or industrial surplus may be defined as those items/goods/materials which are in excess of reasonable operational needs of the enterprise/plant/concern. Surplus is the state of an item when stock is likely to last longer than a reasonable period of time or when it is no longer needed for use.

Surplus stock normally occurs on the following occasions:
(1) When purchases/procurements have been made in larger quantities than the usual needs. However, if inventory control is pursued with steady effort such situation will not arise.

(2) Mostly the materials required for production specially raw materials and components although tools and certain general stored items/goods also become surplus when operations are suddenly reduced.

(3) Sometimes when inadvertently, wrong items have been procured may be on account of some miscalculation or error while at the materials purchasing stage.

(4) Sometimes usual materials are rendered useless or surplus because of change in material specifications.

(5) Whenever, a project is completed, certain quantities of the materials/items, a used for the commissioning of the project are bound to be left unused. This would be surplus.

13.2.1 Primary Sources of Surplus:

The followings are the three primary sources of surplus:

(A) Surplus from Scrap and Waste.

(B) Surplus obsolete or damaged Machines/Equipment.

(C) Surplus, damaged stock or obsolete items.

These sources are examined as follows:

(A) Surplus from Scrap and Waste:
Broken and worn-out tools which are beyond repairs, irreparable parts of machinery, wastage, spoilage empty drums and bugs which are not returnable to suppliers all constitute 'Scrap'.

Wastage:
A residue or pieces cut/chips of raw materials generated during manufacturing process is wastage. Because all the materials infected into production processes are not converted into finished products, surplus/waste from the production process are inevitable and common feature in every enterprise.

Take the example of an enterprise that stamps disks from the copper strip. Normally during the stamping operation, 10 to 15 percent of copper is left out which cannot be used also wherein the production operations. This residue is termed as "Wastage" and must be disposed of as surplus scrap material/item.

For any enterprise, it is impossible to get rid of this type of surplus; however effective and intelligent production planning, handling of materials from stores and control can sizeably contribute to reduce it.

Spoilage:
Inefficient utilization of production equipment/machinery generate surplus, carelessness and poor purchasing are wastage of resources. Products/items spoiled/damaged during the course of production or storage are also spoilage. Spoilage may involve the loss of man as well as machine hours. Special care should be taken particularly during storage of perishable items so that spoilage can be avoided.

(B) Surplus, Obsolete or Damaged Machines/Equipment:

All equipment and machines used for production purposes become surplus sometime in their life due to wear and tear with passage of time or in view of technological developments which leads to invention of better technology machines and make the machine being used technologically obsolete.

In light of this machines/equipment or tools are seldom worn out, they have to be replaced in view of changed circumstances to avail better functioning and efficiency.

In addition to factors mentioned above, the steady improvement has been a greater change particularly for investment programmes. Therefore every manager has been at his wit's end and makes haunting efforts so as to prolong the life of capital assets as long as possible.

But due to reasons of obsolescence, breakdowns, introduction of new products or new methods of manufacture, replacement of major capital assets even buildings become mandatory.

So, in view of the fact that equipment and components get obsolete, the users prefer to dispose them as surplus-even as scrap in certain extreme cases.

(C) Surplus Damaged Stock or Obsolete Items:

Item which have lost physical qualities or have gone out-dated – mostly superseded by a better design and sophisticated technology are called obsolete items. It is rather impossible and unreasonable to expect sales forecasting and production planning to match exactly in reality.

In view of enthusiastic and optimistic sales fore casting and over anticipation, excess materials/ items/products are available in stores.

In addition to this continuous constant, sweeping, successive and rapid changes take place with its sky-rocketing speed in the design and specifications of various materials and components. Hence the slow moving items become surplus in this fast moving society. The net result is that generation of obsolete products and their parts constitute a continuing source of surplus materials.

Besides the difference between production planning and its actual commencement as well as commencement of production and its completion is very vital.

In the manufacturing industry, inventory management can make or break a budget. You need to produce enough units to meet customer demand, otherwise your customers will go elsewhere. If you produce more units than you need, then you have a whole other set of problems. Your customers may be content, but you still have excess units and wasted materials to deal with.

13.2.2 Dealing with a surplus

What can you do with excess inventory? There are a few options, but none of them are great. Here are a few reasons why:

- Storing the units could require you to rent additional warehouse space. Otherwise, the accumulating units could take up too much space on your site and get in the way of your operations.
- Selling it at a discount could come back to bite you. The products could end up in a secondary market, where they could be competing with yours.
- Destroying or dumping the surplus products is a waste of resources. Not only that, but filling up a landfill with your waste can have a negative effect on the environment.
- If you keep trying to sell the products despite reduced interest, your sales team is going to grow frustrated about having to sell an unpopular product while, updated models might be rolling out. The demand was down for a reason, so why would you expect them to suddenly start selling again? Also, soon the products will be out of date.

ERP inventory management software offers many tools to help you plan for customer demand and deal with surplus issues.

13.2.2.1 Working of ERP inventory management software

One of the most important components of a manufacturing enterprise resource planning platform is a robust set of inventory management tools.

- **Demand planning:** An ERP system's inventory management tools provides up-to-date information, so your business can produce exactly what is needed, keeping inventory low while meeting demand.

- **Identifying a surplus immediately:** Sometimes, unexpected events reduce demand with little warning. Whether the surplus occurs because the demand for a particular product drops or because of changes in the market, the ERP software will identify it and notify you right away. This immediate reaction gives you more options than the ones mentioned above, such as contacting the customer right away to offer an additional order.

- **Automated replenishment:** Inventory management software can automate many of the processes around your production and distribution channels, streamlining operations and reducing many costs. As demand grows, ERP software orders the ideal quantities of materials to meet it. This automation reduces the number of transactions you have to make, and helps maintain an efficient turnaround between you, your partners and the end users.

13.2.3 A Strategic Approach to Surplus

Industrial manufacturing and plant operations' professionals all have a common need to find a solution for managing surplus assets so they can focus on their many other responsibilities.

Industrial manufacturing and plant operations' professionals all have a common need to find a solution for managing surplus assets so they can focus on their many other responsibilities. Whether that consists of idle assets no longer contributing to daily operations or an entire plant closure due to consolidation of operations that needs to have all assets inventoried, valued, and redeployed or sold; successfully managing surplus assets is an important component of a healthy supply chain. Research suggests that nearly $150 billion worth of underutilized or surplus assets currently exist, and that's a lot of potential value on the table for businesses challenged to find cost reductions or enhance cash flow and streamline operational processes.

13.2.4 Reduce Costs and Enhance Cash Flow through Asset Recovery

In a recent survey conducted with nearly 200 investment recovery professionals, 81% reported that the management of surplus assets is a strategic part of their business and 28% stated that

recovery and costs are the top factor to success in their role. Oftentimes, the cost of keeping capital assets on the financial books is a significant motivator to selling assets; but the method by which they are sold is critical to maximizing value.

Marketing assets to a larger pool of buyers in a bidding environment is key to realizing full value. In a similar survey of over 1,500 buyers of surplus, 30% stated they look for surplus through online marketplaces. Other methods include direct through manufacturer, online fixed price, private treaty sales, and live auctions, meaning that multiple sales channels are required to reach surplus buyers. Buyers also stated that they expect a high quality of customer service supporting their surplus purchases. Since it's a better investment of an enterprise to put their marketing, customer service, and sales infrastructure into serving their core business; the easiest way to target and serve these surplus buyers is by engaging a trusted provider with established online marketplaces, customer service, and a dedicated base of buyers to effectively sell assets.

13.2.5 Streamline the Reverse Supply Chain

Most leading companies have invested millions in their forward supply chain, ensuring that all aspects – from logistics to fulfillment to shipping and transport – are aligned with best practices. However, the reverse supply chain often lacks the same focus, but can carry great risk. Consider the following situations:

- A factory is being closed due to restructuring and specialized assembly equipment needs to be valued and sold.
- Idle technology assets are sold with personal identifiable data accidentally stored on the item.
- Surplus assets are managed through paper-based systems within the company; each time an employee moves to another department or leaves the company, historical records are lost.

In each of these scenarios, there are proven solutions that can lead to efficiencies like those implemented on the forward supply chain. This includes:

- **Internal Redeployment Program:** A web-based asset management system which allows users from across the globe to manage, track, and redeploy surplus enables companies to fully utilize the value of their existing assets. In addition to providing a uniform, user-friendly process, it takes the guesswork out of what to do with surplus. If there is not a department within the company that requires the asset within an allotted number of days, then the asset can automatically be moved to an online marketplace where it can be sold and return working capital to the company.
- **Leveraging Best Practices from a Trusted Partner:** One of the most innovative companies in the world understood that its expertise was not in managing its reverse supply chain and turned to a vendor to create a process that would align with its internal systems and procedures. Selling specialized assets is difficult for a manufacturer and can test the bandwidth of operational employees forced to market an asset, find a buyer, and then manage the removal, shipping, and collection of payment, not to mention, ensure that it's

compliant with company and state and federal regulations with services such as data wiping and export controls. Through a vendor partnership, the company can provide its goals for the project or surplus program and the vendor can design a solution to deliver that result, provide metrics and reporting that can be easily communicated to management making operations look like a hero to the business.

Test Your Progress

1. What do you understand by primary sources of supply?

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2. What is surplus management? Explain in brief.

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3. What does it require to deal with a surplus?

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13.3 Inventory Management System

An inventory management system helps organizations account for all incoming and outgoing stock to better meet customer demand and avoid the expense of overstock or loss of business with stock outs. The system impacts every essential business function including accounting, production, warehouse management, purchasing, sales and customer service.

13.3.1 Major Specifications of Inventory Management Systems

The key inventory management system specifications involve providing a way to store, organize, manage and analyze inventory data. Systems requirements include:

- An easy-to-use interface that doesn't require advanced training, support or documentation.
- Automation for eliminating manual processes of business functions related to inventory management.

- A reliable, secure database that provides accurate, real-time data.
- Performance that enables fast, actionable inventory monitoring and control.
- The ability for administrators to easily add software modules with minimal configuration so that the system is scalable.
- Software integrations and automated features that minimize manual inventory updates or inputs.

13.3.2 Top Inventory Management System Features by Category

Inventory management systems have features that help manage, control, track and plan inventory. Here's what to expect from those features:

- **Inventory Control:** Inventory control handles products that are already in stock at the warehouse and plays a key role in supply chain management. Inventory control tools can categorize products by type, location and SKU (or serial number), audit data, generate reports in real-time and search, filter and view products. For more on inventory control methods, including expert advice.

- **Inventory Management:** Inventory management features govern the data from other parts of the system, like inventory control. That's not all; inventory management also handles business processes that occur before the stock arrives at a warehouse and how the inventory reaches other destinations. These features include tools for multi-location warehouse management and integrations with other software or enterprise resource planning (ERP) platforms (for example, generating paperless invoices and purchase orders).

- **Inventory Tracking:** To implement inventory controls, you need to track the status of products and materials in the supply chain. Perpetual inventory tracking features help automate manual tasks. For example, the system automatically generates a tracking number when it creates a receipt or invoice. Tracking integrations with third-party logistics (3PL) providers combined with an email solution lets businesses better manage customer relationships by sharing what's in stock or shipping times.

- **Inventory Barcoding:** Barcoding software helps eliminate data entry errors and automate business functions that require communication with other parts of the system. Collecting, storing and organizing digital inventory data makes inventory operations faster and more accurate. Barcoding software can integrate with digital documentation and reporting features (for example, touchscreen signatures and paperless invoicing). Mobile barcode scanning devices improve inventory accuracy, speed up back-office processes and stock replenishment and enable paperless documentation.

- **Inventory Optimization:** Take inventory planning to a higher level with inventory optimization. Add sophistication to a basic inventory plan. Instead of standard ordering formulas and a basic ordering process, you can use tools that provide automated reports, inventory trends and a view of changes across the entire supply chain. This information enables a closer match in supply and demand so you can optimize the inventory on-hand.

- **Inventory Alerts:** Various modules trigger inventory alerts that help reduce waste, optimize inventory financials and manage customer expectations. These features include automated email or SMS messages that alert you to low inventory levels and shipment and supply chain delays. Inventory alerts offer an added level of operational control for sales forecasting, materials planning, shipping logistics and supplier management.

13.3.2.1 Important Features of Inventory Management

Advancements in computing, applications, databases and IT operations created a market for modern inventory management systems. The shift to web services, application-based development and APIs enabled third-party application integrations that weren't possible before. Now, inventory management systems can manage a host of essential, inventory-related business functions.

Consider the following modern inventory management system features, which you can tailor to your business needs and do more than control inventory:

- **Cloud Infrastructure:** Cloud-based software is a scalable, cost-effective solution. Cloud computing means organizations don't need to hire dedicated staff to manage and maintain those systems. Cloud infrastructure also enables automated backups, secure access and real-time collaboration across multiple locations.

- **Internet of Things (IoT) Integrations:** The IoTmovement brought automated inventory controls and reporting, digital labeling, GPS tracking and Bluetooth- and RFID-enabled tracking. The technology has also been used to improve security against theft and loss.

- **Digital Labeling:** The move to digital labeling created features like GPS-enabled RFID tags and digital barcoding. With digital inventory data, organizations can now network handheld devices with databases for real-time tracking and paperless documentation.

- **Mobile Systems:** Mobile applications running on wireless devices communicate with back-office systems and central databases to speed up multi-location inventory processes. Using mobile devices (running iOS or Android) allows for real-time tracking and instant inventory alerts and notifications.

- **Machine Learning and AI:** AI-empowered virtual agents (or chatbots) are changing how businesses share inventory availability to ecommerce customers. They use machine learning algorithms and web-based services to communicate out-of-stock inventory, make recommendations based on an active shopping cart or user history and automate backorder fulfillment. Machine learning can also report sales data trends that are critical to optimizing online customer engagement metrics. Other benefits of machine learning include the ability to improve internal inventory controls and prevent shortages. The technology can also improve forecasting with real-time data analysis and report on inventory trends that are difficult to track and predict manually.

13.3.3Impact of Inventory Management

Implementing proper inventory control procedures can help ensure a business is running at optimal financial levels and that products meet customers' needs and expectations. According to the 2015 "Global State of Multichannel Customer Service Report", 62% of customers have stopped doing business with a brand whose customer service was poor. Of those customer service complaints, frustration over out-of-stock or backordered items is high on the list. In fact, research about convenience stores shows that out-of-stocks could cause a store to lose one in every 100 customers completely. Additionally, 55% of shoppers in any store would not purchase an alternate item when their regular product is out-of-stock. Other areas where businesses incur expenses or lose sales that inventory control practices and methods could address include:

- Spoilage
- Dead stock
- Excess storage costs
- Cost-efficiency
- Decreased sales
- Losing loyal customers
- Excess stock
- Losing track of inventory
- Losing goods in the warehouse

13.3.4 Benefits of Inventory Management Systems

Without an inventory management system, the goods and products that flow through an organization will inevitably be in disarray. An inventory management system enables a company to maintain a centralized record of every asset and item in the control of the organization, providing a single source of truth for the location of every item, vendor and supplier information, specifications, and the total number of a particular item currently in stock. Because inventory often consists of movable assets, inventory management systems are critical for keeping tabs on current stock levels and understanding what items move quickly and which items are more slow-moving, which in turn enables organizations to determine when it's time to reorder with greater accuracy. Overall, a comprehensive inventory management system offers countless benefits to companies including:

- Improved cash flow
- Better reporting and forecasting capabilities
- Reduction in storage costs (overhead)
- Reduced labor costs
- Reduction in dead stock
- Better organization
- Enhanced transparency
- Improved supplier, vendor, and partner relationships

13.3.5 Challenges of Inventory Management Systems

Inventory management systems can have a dramatic effect on productivity and efficiency when implemented properly. Most of the challenges associated with inventory management systems arise from failing to follow best practices or relying on outdated methods, such as manual documentation and inconsistent storage layouts and processes. In these cases, a complete inventory management overhaul may be in order to streamline inventory management and add clarity and consistency to the process company-wide.

A good inventory management system reduces human error by eliminating manual documentation through the use of barcode labels, barcode scanners, and inventory management software, reducing costly mistakes such as:

- Having too much slow-moving inventory in stock, taking up valuable storage space and eating into the company's bottom line.

- Unexpectedly running out of stock of an essential inventory item, which can delay the supply chain due to backorders.

- Inaccurate records (wrong part numbers, incorrect inventory counts) that arise from manual documentation errors.

- Wasted man hours spent tracking down items that are stored in the wrong locations. Inventory storage that's not optimized for efficiency (due to poor warehouse or stock room layouts) can also increase stock picking time, which also increases labor costs.

13.3.6 Best Practices for Inventory Management Systems

Cleary Inventory explains that a good inventory management system can help to enhance productivity, but only if you set it up with some basic essentials including:

- Location names
- Easy-to-read location labels
- Unique item identification numbers
- Units of measure
- A starting count
- A software solution that effectively monitors and tracks activity
- Clear, company-wide policies and processes
- People who know how to support these policies and processes

Implementing a comprehensive inventory management system can be complex. It's not merely a matter of purchasing a good software program; an inventory management system must address the people, processes, and technologies from end-to-end. Following best practices to set up a comprehensive, company-wide inventory management system is an investment that will pay for itself again and again through greater efficiency and a boost to the bottom line.

Test Your Progress

1. What are some of the features of inventory management?

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2. What are the challenges of Inventory Management system?

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3. State a few best practices for Inventory Management system.

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13.4 <u>Information System For Inventory Management</u>

An inventory information system is the combination of inventory management software and inventory management processes & procedures to connect, track and manage the flow of goods, activities, information and resources across a business.

So, an effective inventory management system needs to encompass purchasing, inventory management and warehousing, sales orders, order fulfillment, distribution and customer service management.

Purchasing: it is a very important component of an inventory information system. Too little inventory results in out of stocks. Too much inventory leads to obsolete inventory and limits cash flow. Purchasing includes forecasting, trend analysis, purchasing of goods and/or raw materials, vendor management, special orders and may include other arrangements, such as drop shipping.

Inventory management & warehousing: are at the heart of an inventory information system. Regardless of warehousing setup – one warehouse, multiple locations, warehousing at a 3PL provider, or even if the inventory is drop shipped from a supplier – an inventory system manages the inventory flow throughout the business.

Sales Order: An inventory management system at the center of the sales process produces greater profits and happier customers. Ever place an order for something and get a call back an hour later stating it was out of stock? That is not acceptable in today's competitive business world. From quotes to sales orders, the sales process should be managed with real-time access to availability, pricing and credit management within the inventory management system.

Order fulfillment: is where so many mistakes can occur – if it isn't integrated within the inventory management system. An inventory management system that coordinates picking, packing, shipping & tracking decreases errors, improves speed & accuracy and can have a huge impact on customer satisfaction.

Great customer service: includes handling transactions quickly & accurately regardless of where the transaction occurred – online, offline, by phone, fax, mail order, telephone orders, and/or from a catalog. The inventory management system is once again at the heart of the business supplying consistent, real-time information for all customer-facing personnel.

Acctivate inventory management system: is a powerful, affordable inventory management system that includes all the inventory & business management tools needed including customer relationship management, purchasing, sales order management and decision support tools.

- Inventory management system to manage purchasing, distribution & multiple location warehousing activities.
- Inventory management system with integrated picking, shipping and shipment tracking.

- Inventory management system to handle sales & customer service management with one click quote to sales orders & multi-channel sales management.
- Inventory management system that provides real-time access to the information you need, organized how you want to see it.
- Inventory management system that includes over 100 reports & documents out of the box & the ability to create virtually any report or document with Crystal Reports.
- Inventory management system with an end-to-end, fully-compliant EDI solution created for small and mid-sized businesses.
- Inventory management system that is built to handle substantial volume and growth without major system changes.
- Inventory management system that will transform your entire business.

13.4.1 Inventory Management Module

The modules that make up inventory management systems vary by provider and price. You can start with basic inventory management modules (order management and administration tools) and build systems that include advanced software features and integrations (such as accounting and ecommerce).

The most common inventory control and management modules include the following:

- **Ecommerce Modules:** These modules are useful for selling goods online.
- **Accounting Modules:** These modules automate financial and accounting activities like accounts payable and receivable, procurement and third-party payments, and they categorize revenue.
- **Data Administration Modules:** These admin-like modules provide fast, simple tools for managing inventory system data like connecting users via passwords, updating inventory records and exporting data.
- **Warehouse Management Modules:** Warehouse modules provide must-have inventory management functions like appointment scheduling, order receiving, returns handling, labeling and third-party carrier management.
- **Order Management Modules:** These modules help manage purchase orders, parts requirements and order consolidation.

13.4.2Features of Inventory management software

The software you choose (in addition to any bells and whistles) should offer all the features that are essential for effective inventory management operations.

Here's a quick overview of what to look out for:

- **Barcode scanning:** Easily identify and track your products; inventory management software integrates with barcode scanners for instant product identification and labeling.
- **Inventory optimization:** Maintain just the right amount of inventory for each product, without over- or under-stocking any item. It's especially useful if you deal in products that experience a seasonal rise and fall in demand.
- **Stock notifications:** Receive alerts and notifications when there's over- or under-stocking beyond a defined threshold. This helps you to place orders or offer promotional discounts to clear out extra stock.
- **Report generation:** View sales history in the form of a list of your most popular products. This feature also enables you to manage items in your inventory that have not reached the sales levels you expected, for example, by offering discounts on them.
- **Multilocation management:** Manage multiple warehouses and points-of-sale (POS). All locations can be integrated within a single inventory management system.
- **Stock returns handling:** Manage returns more effectively by reducing time-to-return through automation of the entire process.
- **Material grouping:** Group inventory into predefined categories and ensure you're always updated about quantities of components and specifications that make up your product stock, and manage their reordering schedules as required.
- **Purchase order records:** Create a single view of purchase order records. You can easily identify which products are in demand, both perpetually and seasonally, and prepare to meet your customers' needs.
- **RFID-based in-transit tracking:** This feature is useful if your supplies come from a third-party and you dispatch goods for delivery. This feature leverages RFID technology to provide you with real-time tracking of your inventory in transit.
- **Warehouse management:** This feature is useful if you need to optimize your warehouse stock and maintain an accurate log of each product's location. It'll give you a single view of where all of your products are stored.
- **Demand forecasting:** Through this feature, you can draw on past data to identify future demand. It isn't necessarily offered by all platforms, so if forecasting is important to you, be sure to ask the vendors on your shortlist about this capability.

13.4.3 Functions of Inventory Management Software

Inventory Management Software is built on facilitating lean manufacturing management principles with functions such as:

- Separate inventory master records for each manufacturing individual location (or "EPlant")
- Both eKanban and conventional Kanban control support.
- Complete lot number tracking and traceability including supporting documents
- Serialized inventory control

13.4.3 Software Modules in Inventory Management Systems

The modules that make up inventory management systems vary by provider and price. You can start with basic inventory management modules (order management and administration tools) and build systems that include advanced software features and integrations (such as accounting and ecommerce).

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- **Warehouse Management Modules:** Warehouse modules provide must-have inventory management functions like appointment scheduling, order receiving, returns handling, labeling and third-party carrier management.
- **Order Management Modules:** These modules help manage purchase orders, parts requirements and order consolidation.

Test Your Progress

1. What do you understand by information system for inventory management?

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2. What are the functions of inventory management software? Explain in brief.

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3. State a few software modules in inventory management system.

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13.4 Summary

Surplus or industrial surplus may be defined as those items/goods/materials which are in excess of reasonable operational needs of the enterprise/plant/concern. Surplus is the state of an item when stock is likely to last longer than a reasonable period of time or when it is no longer needed for use.

An inventory management system is a tool that allows you to track goods across your business's supply chain. It optimizes the entire spectrum spanning from order placement with your vendor to order delivery to your customer, mapping the complete journey of a product.

An **inventory management system** (or **inventory system**) is the process by which you track your goods throughout your entire supply chain, from purchasing to production to end sales. It governs how you approach inventory management for your business.

13.5 Test Your Progress

1. What do you understand by surplus?

2. What are the primary sources of supply?

3. What do you understand by strategic approach to supply?

4. How can costs be reduced and cash flow enhancement can be done through asset recovery?

5. How is streamlining of reverse supply chain is done?

6. What is inventory management system?

7. What are the major specifications of inventory management system?

8. What are the important features of inventory management system?

9. What is the impact of inventory management?

10. What are the benefits and challenges of inventory management systems?

11. What are the best practices for inventory management systems?

12. What do you understand by information system for inventory management?

13. What do you understand by inventory management module?

14. What are the features of inventory management software?

15. What are the functions of inventory management software?

16. What are the software modules in inventory management system?

13.6 Suggested Readings

1. https://www.yourarticlelibrary.com/
2. https://www.accenterp.com/inventory-management
3. https://www.impomag.com/
4. https://fonddulac.extension.wisc.edu/
5. https://industrialsupplymagazine.com/
6. https://www.researchgate.net
7. https://www.camcode.com/
8. https://katanamrp.com/
9. https://blog.capterra.com/
10. https://www.iqms.com/
11. https://www.netsuite.com/

Block

5

PRODUCTION AND FORECASTING ISSUES

UNIT 14

Production and Forecasting Issues

14.1 Introduction & Concept of Forecast

Forecasts are a basic input in the decision processes of operations management because they provide information on future demand. The importance of forecasting to operations management cannot be overstated. The primary goal of operations management is to match supply to demand. Having a forecast of demand is essential for determining how much capacity or supply will be needed to meet demand. For instance, operations needs to know what capacity will be needed to make staffing and equipment decisions, budgets must be prepared, purchasing needs information for ordering from suppliers, and supply chain partners need to make their plans.

Two aspects of forecasts are important. One is the expected level of demand; the other is the degree of accuracy that can be assigned to a forecast (i.e., the potential size of forecast error). The expected level of demand can be a function of some structural variation, such as a trend or seasonal variation. Forecast accuracy is a function of the ability of forecasters to correctly model demand, random variation, and sometimes unforeseen events. Forecasts are made with reference to a specific time horizon. The time horizon may be fairly short (e.g., an hour, day, week, or month), or somewhat longer (e.g., the next six months, the next year, the next five years, or the life of a product or service). Short-term forecasts pertain to ongoing operations. Long-range forecasts can be an important strategic planning tool.

Long term forecasts pertain to new products or services, new equipment, new facilities, or something else that will require a somewhat long lead time to develop, construct, or otherwise implement. Forecasts are the basis for budgeting, planning capacity, sales, production and inventory, personnel, purchasing, and more.

Forecasts play an important role in the planning process because they enable managers to anticipate the future so they can plan accordingly. Forecasts affect decisions and activities throughout an organization, in accounting, finance, human resources, marketing, and management information systems (MIS), as well as in operations and other parts of an organization. Following are the areas where forecasting is very useful;

New product / process accounting: New product / process cost estimates, profit projections, cash management.

Finance: Equipment/equipment replacement needs timing and amount of funding / borrowing needs.

Human resources: Hiring activities, including recruitment, interviewing, and training; layoff planning, including outplacement counseling.

Marketing: Pricing and promotion, e-business strategies, global competition strategies.

MIS: New/revised information systems, Internet services.

Operations: Schedules, capacity planning, work assignments and workloads, inventory planning, make-or-buy decisions, outsourcing, project management.

Product/service design: Revision of current features, design of new products or services.

14.1.1 Need of Forecast in Production and Operation Management

In most of these uses of forecasts, decisions in one area have consequences in other areas. Therefore, it is very important for all affected areas to agree on a common forecast

FEATURES COMMON TO ALL FORECASTS

A wide variety of forecasting techniques are in use. In many respects, they are quite different from each other, as you shall soon discover. Nonetheless, certain features are common to all, and it is important to recognize them.

1. Forecasting techniques generally assume that the same underlying causal system that existed in the past will continue to exist in the future.

2. Forecasts are not perfect; actual results usually differ from predicted values; the presence of randomness precludes a perfect forecast. Allowances should be made for forecast errors.

3. Forecasts for groups of items tend to be more accurate than forecasts for individual items because forecasting errors among items in a group usually have a canceling effect. Opportunities for grouping may arise if parts or raw materials are used for multiple products or if a product or service is demanded by a number of independent sources.

4. Forecast accuracy decreases as the time period covered by the forecast—the time horizon — increases. Generally speaking, short-range forecasts must contend with fewer uncertainties than longer-range forecasts, so they tend to be more accurate.

An important consequence of the last point is that flexible business organizations—those that can respond quickly to changes in demand—require a shorter forecasting horizon and, hence, benefit from more accurate short-range forecasts than competitors who are less flexible and who must therefore use longer forecast horizons.

14.1.3 Objective of Demand Forecasting

A properly prepared forecast should fulfil certain requirements:

1. The forecast should be timely. Usually, a certain amount of time is needed to respond to the information contained in a forecast. For example, capacity cannot be expanded overnight, nor can inventory levels be changed immediately. Hence, the forecasting horizon must cover the time necessary to implement possible changes.

2. The forecast should be accurate, and the degree of accuracy should be stated. This will enable users to plan for possible errors and will provide a basis for comparing alternative forecasts.

3. The forecast should be reliable; it should work consistently. A technique that sometimes provides a good forecast and sometimes a poor one will leave users with the uneasy feeling that they may get burned every time a new forecast is issued.

4. The forecast should be expressed in meaningful units. Financial planners need to know how many dollars will be needed, production planners need to know how many units will be needed, and schedulers need to know what machines and skills will be required. The choice of units depends on user needs.

5. The forecast should be in writing. Although this will not guarantee that all concerned are using the same information, it will at least increase the likelihood of it. In addition, a written forecast will permit an objective basis for evaluating the forecast once actual results are in.

6. The forecasting technique should be simple to understand and use. Users often lack confidence in forecasts based on sophisticated techniques; they do not understand either the circumstances in which the techniques are appropriate or the limitations of the techniques. Misuse of techniques is an obvious consequence. Not surprisingly, fairly simple forecasting techniques enjoy widespread popularity because users are more comfortable working with them.

7. The forecast should be cost-effective: The benefits should outweigh the costs.

14.2 Steps in the Forecast Process

There are six basic steps in the forecasting process:

1. Determine the purpose of the forecast. How will it be used and when will it be needed? This step will provide an indication of the level of detail required in the forecast, the amount of resources (personnel, computer time, dollars) that can be justified, and the level of accuracy necessary.

2. Establish a time horizon. The forecast must indicate a time interval, keeping in mind that accuracy decreases as the time horizon increases.

3. Obtain, clean, and analyze appropriate data. Obtaining the data can involve significant effort. Once obtained, the data may need to be "cleaned" to get rid of outliers and obviously incorrect data before analysis.

4. Select a forecasting technique.

5. Make the forecast.

6. Monitor the forecast. A forecast has to be monitored to determine whether it is performing in a satisfactory manner. If it is not, reexamine the method, assumptions, validity of data, and so on; modify as needed; and prepare a revised forecast.

Note too that additional action may be necessary. For example, if demand was much less than the forecast, an action such as a price reduction or a promotion may be needed. Conversely, if demand was much more than predicted, increased output may be advantageous. That may involve working overtime, outsourcing, or taking other measures.

14.3 Importance and Application of Forecast in Production and Operation Management

1. Forecasting plays a pivotal role in the operations of modern management. It is an important and necessary aid to planning and planning is the backbone of effective operations. Many organizations have failed because of lack of forecasting or faulty forecasting on which the planning was based.

2. Production and distribution are two main activities of a business enterprise. Demand forecasts tries to maintain a balance between production and distribution policies of the enterprise.
3. An efficient demand forecast helps the management to take suitable decisions regarding plant capacity, raw material requirements, space and building needs and availability of labour and capital.
4. Demand forecasting is a necessary and effective tool in the hands of the management of an enterprise to have finished goods of right quality and quantity at right time with minimum cost.
5. Forecasting implies the act of making a detailed analysis of the future and planning is impossible without either predicting the future as accurately as possible or making intelligent assumptions about it.
6. Forecasting may be a form of intentional and considered judgement based on feelings, opinions and experiences, and these judgements, at best will be educated guesses. It could also be based upon a rational study and analysis of pertinent data and this process is known as "scientific forecasting". It would depend upon an analysis of past events and current conditions with a view to drawing inferences and conclusions about future events.

14.4 Summary

Demand forecasting is the activity of estimating the quantity of a product or service that consumers will purchase. Demand forecasting involves techniques including both informal methods, such as educated guesses, and quantitative methods, such as the use of historical sales data or current data from test markets. Demand forecasting moving the organization from uncertainty to certainty and it plays immense important role in production and operation management.

14.5 Exercise

1. What is forecasting?
2. Elaborate the concept of forecasting in modern management.
3. "Can you imagine production and operation management without forecasting"? Give rationale behind your answer.
4. Detail down the process of forecasting.
5. Elaborate the importance of forecasting with some real examples from production and operation management.

UNIT 15

Qualitative Methods of Forecasting-I

15.1 Judgmental Forecasting

It is one of the most widely used and influential forecasting techniques where the opinions and intuition of management is utilized. The process brings together in an organized manner, personal judgments about the process being analyzed. Main Reliance is on human judgment.

In this method, the executive uses his own anticipation and what he hears from other. Outside experts are also consulted and the other executive heads are also required to give their opinion in the matter, Salesmen are to provide information about customer's attitude and preferences and the activities of competitors. Thus all the possible information from the opinions of various persons is combined together to change the subjective opinions into quantitative forecast.

Advantages:

1. Simple and Easy to understand.
2. No specialized skill is required
3. Low cost
4. Is based on the information or opinion of the persons who are directly involved in the system.
5. Can be used when satisfactory data is not available.

Disadvantages:

1. Opinions and institution are highly subjective.
2. Personal estimates are likely to be biased.
3. Time required to take the decision may be more.
4. Results can be easily distorted.
5. Lacks scientific validity.
6. It is not based on valid facts.
7. The method is not useful for long term planning.

The method can be more useful for many new products or new service estimators where sufficient past experience is not required.

15.2 Delphi Technique

The Delphi method was originally developed in the early 1950s at the RAND Corporation by Olaf Helmer and Norman Dalkey to systematically solicit the view of experts related to national defense and later in controversial sociopolitical areas of discourse.

The term originates from Greek mythology. Delphi was the site of the Delphic oracle, the most important oracle in the classical Greek world. Thus, the Delphi method may think of as an **expert** brainstorm.

In Delphi decision groups, a series of questionnaires, surveys, etc. are sent to selected respondents (the Delphi group) through a facilitator who oversees responses of their panel of experts. The group does not meet face-to-face. All communication is normally in writing (letters

or email). Members of the groups are selected because they are experts or they have relevant information.

The responses are collected and analyzed to determine conflicting viewpoints on each point. The process continues in order to work towards synthesis and building consensus.

15.2.1 Key Characteristics

The following key characteristics of the Delphi method help the participants to focus on the issues at hand and separate Delphi from other methodologies:

Anonymity of the participants

Usually all participants remain anonymous. Their identity is not revealed, even after the completion of the final report. This prevents the authority, personality, or reputation of some participants from dominating others in the process. Arguably, it also frees participants (to some extent) from their personal biases, minimizes the "bandwagon effect" or "halo effect", allows free expression of opinions, encourages open critique, and facilitates admission of errors when revising earlier judgments.

Structuring of information flow

The initial contributions from the experts are collected in the form of answers to questionnaires and their comments to these answers. The panel director controls the interactions among the participants by processing the information and filtering out irrelevant content. This avoids the negative effects of face-to-face panel discussions and solves the usual problems of group dynamics.

Regular feedback

Participants comment on their own forecasts, the responses of others and on the progress of the panel as a whole. At any moment they can revise their earlier statements. While in regular group meetings participants tend to stick to previously stated opinions and often conform too much to the group leader; the Delphi method prevents it.

Role of the facilitator

The person coordinating the Delphi method is usually known as a *facilitator* or Leader, and facilitates the responses of their *panel of experts*, who are selected for a reason, usually that they hold knowledge on an opinion or view. The facilitator sends out questionnaires, surveys etc. and

if the panel of experts accept, they follow instructions and present their views. Responses are collected and analyzed, then common and conflicting viewpoints are identified. If consensus is not reached, the process continues through thesis and antithesis, to gradually work towards synthesis, and building consensus.

15.2.2 Process of Delphi Method

The process works as follows:

- Members are selected for the Delphi panel due to their expertise.
- They are kept separated and answer through an open-ended questionnaires, surveys, etc. in order to solicit specific information about a subject or content area. Keeping them separated avoids the negative effects of face-to-face discussions and avoids problems associated with group dynamics.
- Members are asked to share their assessment and explanation of a problem or predict a future state of affairs.
- The facilitator (panel director) controls the interactions among the participants by processing the information and filtering out irrelevant content.
- Replies are gathered, summarized, and then fed back to all the group members.
- Members then make another decision based upon the new information.
- The process is repeated until the the responses converge satisfactory, that is, it yields consensus.

The success of this process depends upon the member's expertise and communication skill. Also, each response requires adequate time for reflection and analysis. The major merits of the Delphi process are:

- Elimination of interpersonal problems.
- Efficient use of expert's time.
- Diversity of ideals.
- Accuracy of solutions and predictions.

15.2.3 Applications

Use in forecasting

1. First applications of the Delphi method were in the field of science and technology forecasting. The objective of the method was to combine expert opinions on likelihood and expected development time, of the particular technology, in a single indicator. One of the first such reports, prepared in 1964 by Gordon and Helmer, assessed the direction of long-term trends in science and technology development, covering such topics as scientific breakthroughs, population control, automation, space progress, war prevention and weapon systems.

2. Other forecasts of technology were dealing with vehicle-highway systems, industrial robots, intelligent internet, broadband connections, and technology in education.
3. Later the Delphi method was applied in other areas, especially those related to public policy issues, such as economic trends, health and education. It was also applied successfully and with high accuracy in business forecasting For example, in one case reported by Basu and Schroeder (1977), the Delphi method predicted the sales of a new product during the first two years with inaccuracy of 3–4% compared with actual sales. Quantitative methods produced errors of 10–15%, and traditional unstructured forecast methods had errors of about 20%.

15.2.4 When should the Delphi technique be used?

Linstone and Turoff provide a comprehensive list of situations where it would be best to employ the Delphi technique. These are:

1. The problem does not lend itself to precise analytical techniques but can benefit from subjective judgments on a collective basis.
2. The individuals needed to contribute to the examination of a broad or complex problem have no history of adequate communication and may represent diverse backgrounds with respect to experience or expertise.
3. More individuals are needed than can effectively interact in a face-to-face exchange.
4. Time and cost make frequent group meetings infeasible.
5. The efficiency of face to face meeting can be increased by a supplemental groups communication process.
6. Disagreements among individuals are so severe or politically unpalatable that the communication process must be refereed and/or anonymity assured.
7. The heterogeneity for the participants must be preserved to assure validity of the results ie. Avoidance of domination by quantity or by strength of personality (`bandwagon effect').

15.2.5 Guidelines for selecting the Delphi Panelist

1. Select panel members based on knowledge of the issue and diversity of perspective
2. Provide enough incentive to maintain panelists' motivation to persist to the conclusion of the study
3. Ensure that panelists feel that their contributions are valued
4. Communicate to panelists that they are members of a group with similar expertise to theirs

15.2.6 Advantages of Delphi technique

Following advantages are associated with Delphi method;

1. A formal and structured questionnaire is used.
2. Questionnaire items may be generated by the moderator, the panelists, or both.
3. Either quantitative or qualitative scales may be used.
4. Questionnaires may or may not include open-ended questions.
5. Feedback from each round is in the form of statistical feedback, usually involving some measure of central tendency and some measure of dispersion.
6. Individual responses to items are kept anonymous.
7. Iteration with feedback continues until consensus is reached, as determined by the moderator.
8. Participants do not meet face to face and may be geographically dispersed.

15.2.7 Pitfalls in Delphi technique

1. In Delphi technique there were the time and expense of designing paper and pencil questionnaires, mailing surveys, compiling responses, and following up with non respondents for multiple iterations of the process.
2. Potentially high attrition rate. Because the method requires lengthy responses in the early rounds of the process and the active participation of panelists over several weeks, the potential for a high drop-out rate of panelists exists

15.2.8 Variants of Delphi Method

Traditionally the Delphi method has aimed at a consensus of the most probable future by iteration. Other versions, such as the Policy Delphi, is instead a decision support method aiming at structuring and discussing the diverse views of the preferred future.

In Europe, more recent web-based experiments have used the Delphi method as a communication technique for interactive decision making and e-democracy

The Argument Delphi, was developed by Osmo Kuusi, focuses on ongoing discussion and finding relevant arguments rather than focusing on the output.

The Disaggregative Policy Delphi, developed by Petri Tapio, uses cluster analysis as a systematic tool to construct various scenarios of the future in the latest Delphi round. The respondent's view on the probable and the preferable future are dealt with as separate cases.

15.3 Summary

Qualitative methods tell us about in details regarding forecasting. These methods are not easy to implement as the implementation of these methods require expertise. The output or forecasting through these methods is appropriate where we do not have quantitative information to carry out results.

15.4 Exercise

1. Define “Judgement Forecasting” and explain its advantages and disadvantages.
2. Explain “Delphi Technique” and compare this technique with “Opinion Capture Technique”.
3. Explain the process of Delphi technique with its operational details.
4. Explain decision analysis Delphi.
5. Give a detailed outline of guidelines for conducting a Delphi study.
6. What is ‘argument delphi’?
7. What are various advantages of using Delphi method?

UNIT 16

Qualitative Methods of Forecasting-II

16.1 Forecasting based on cross-impact analysis

Cross-impact analysis is a methodology developed by Theodore Gordon and Olaf Helmer in 1966 to help determine how relationships between events would impact resulting events and reduce uncertainty in the future.

Cross-impact analysis seems to have two schools of thought and ways of approach. The first is the futures forecasting style that originally developed the methodology. The second is a sub-school of intelligence analysts which modified the original methodology to better address their needs. Nevertheless, Cross Impact Analysis is based upon the premise that events and activities do not happen in a vacuum and other events and the surrounding environment can significantly influence the probability of certain events to occur.

Cross-impact analysis attempts to connect relationships between events and variables. These relationships are then categorized as positive or negative to each other, and are used to determine which events or scenarios are most probable or likely to occur within a given time frame.

16.1.1 Cross Impact Matrix

A major part of the intelligence analysis style of cross-impact analysis is the cross-impact matrix. The matrix is a visualization of the cross-impact analysis and allows for modification. It also allows an analyst to find the most influential variables and those variables that are impacted by the most other variables, not just direct, one-to-one relationships.While several traditional Cross Impact Analysis methods suggest the creation of a matrix, the priority still relies in probabilities, one-to-one relationships, and the order of events.

In the intelligence analysis style cross-impact matrix, analysts use pluses and minuses instead of numerical values allowing for non-event variables and allowing the analyst to compare variables directly to all other variables without calculations.

16.1.2 Cross Impact Analysis based on Bayesian rule

In probability theory and statistics, **Bayes' theorem** (alternatively **Bayes' law** or Bayes' rule) describes the probability of an event, based on conditions that might be related to the event. For example, suppose one is interested in whether Addison has cancer, and that she is 65. If cancer is related to age, information about Addison's age can be used to more accurately assess the probability of her having cancer using Bayes' Theorem.

When applied, the probabilities involved in Bayes' theorem may have different probability interpretations. In one of these interpretations, the theorem is used directly as part of a particular approach to statistical inference. With the Bayesian probability interpretation the theorem expresses how a subjective degree of belief should rationally change to account for evidence: this is Bayesian inference, which is fundamental to Bayesian statistics. However, Bayes' theorem has applications in a wide range of calculations involving probabilities, not just in Bayesian inference.

Bayes' theorem is stated mathematically as the following equation;

$$P(A|B) = \frac{P(A)\,P(B|A)}{P(B)},$$

where A and B are events.

- $P(A)$ and $P(B)$ are the probabilities of A and B without regard to each other.
- $P(A \mid B)$, a conditional probability, is the probability of observing event A given that B is true.
- $P(B \mid A)$, is the probability of observing event B given that A is true.

16.1.3 Simulation in Cross Impact Analysis

We assume that decision makers have identified a set of relevant events, together with an estimate of the marginal probability that these events will occur, as well as a causal cross-impact matrix. Our subsequent methodology then involves four computational steps, discussed in the next four subsections respectively:

- computation of revised marginal probabilities,
- computation of consistent occurrence conditional probabilities,
- computation of a likely causal cross-impact matrix or a revised causal cross-impact matrix, and
- ranking of events.

16.2Summary

Cross impact analysis evaluate the relationship between cause and impact. By means of cross impact matrix, we would know about the strength and weaknesses of cause and impact. It is application based concept and having direct impact on our life.

16.2 Exercise

1. Explain cross impact analysis by means of cross impact matrix.
2. What is simulation, how simulation is an integral part of cross impact analysis?
3. Explain Baye's Theorem.
4. Design a cross impact matrix between age andheight.

UNIT 17

Quantitative Methods of Forecasting

17.1 Application of Forecasting

Forecasting has applications in a wide range of fields where estimates of future conditions are useful. Not everything can be forecasted reliably, if the factors that relate to what is being forecast are known and well understood and there is a significant amount of data that can be used very reliable forecasts can often be obtained. If this is not the case or if the actual outcome is affected by the forecasts, the reliability of the forecasts can be significantly lower.

Forecasting has also been used to predict the development of conflict situations. Forecasters perform research that uses empirical results to gauge the effectiveness of certain forecasting models.[15] However research has shown that there is little difference between the accuracy of the forecasts of experts knowledgeable in the conflict situation and those by individuals who knew much less

Similarly, experts in some studies argue that role thinkingdoes not contribute to the accuracy of the forecast. The discipline of demand planning, also sometimes referred to as supply chain forecasting, embraces both statistical forecasting and a consensus process. An important, albeit often ignored aspect of forecasting, is the relationship it holds with planning. Forecasting can be described as predicting what the future will look like, whereas planning predicts what the future should look like. There is no single right forecasting method to use. Selection of a method should be based on your objectives and your conditions (data etc.).Forecasting has application in many situations:

- Supply chain management
- Economic forecasting
- Earthquake prediction
- Egain forecasting
- Land use forecasting
- Player and team performance in sports
- Political forecasting
- Product forecasting
- Sales forecasting
- Technology forecasting
- Telecommunications forecasting
- Transport planning and Transportation forecasting
- Weather forecasting, Flood forecasting and Meteorology

17.2 Specific quantitative forecasting methods

Average approach

In this approach the predictions of all future values are equal to the mean of the past data. This approach can be used with any sort of data where past data is available. In time series notation:

$$\hat{y}_{T+h|T} = \bar{y} = (y_1 + ... + y_T)/T$$ [2]

where $y_1, \cdots, y_T$ is the past data.

Naïve approach

Naïve forecasts are the most cost-effective forecasting model, and provide a benchmark against which more sophisticated models can be compared. In time series data, using naive approach would produce forecasts that are equal to the last observed value. This method works quite well for economic and financial time series, which often have patterns that are difficult to reliably and accurately predict.[2] If the time series is believed to have seasonality, seasonal naive approach may be more appropriate where the forecasts are equal to the value from last season. The naive method may also use a drift, which will take the last observation plus the average change from the first observation to the last observation.[2] In time series notation:

$$\hat{y}_{T+h|T} = y_T$$

Drift method

A variation on the naïve method is to allow the forecasts to increase or decrease over time, where the amount of change over time (called the drift) is set to be the average change seen in the historical data. So the forecast for time $T + h$ is given by

$$\hat{y}_{T+h|T} = y_T + \frac{h}{T-1}\sum_{t=2}^{T}(y_t - y_{t-1}) = y_T + h\left(\frac{y_T - y_1}{T-1}\right).$$ [2]

This is equivalent to drawing a line between the first and last observation, and extrapolating it into the future.

Seasonal naïve approach

The seasonal naïve method accounts for seasonality by setting each prediction to be equal to the last observed value of the same season. For example, the prediction value for all subsequent months of April will be equal to the previous value observed for April. The forecast for time $T + h$ is:[2]

$\hat{y}_{T+h|T} = y_{T+h-km}$ Where m=seasonal period and k is the smallest integer greater than $(h-1)/m$.

The seasonal naïve method is particularly useful for data that has a very high level of seasonality.

17.2.1 Time series forecasting

A time series is a sequence of data points, typically consisting of successive measurements made over a time interval. Examples of time series are ocean tides, counts of sunspots, and the daily closing value of the Dow Jones Industrial Average. Time series are very frequently plotted via line charts. Time series are used in statistics, signal processing, pattern recognition, econometrics,mathematical finance, weather forecasting, intelligent transport and trajectory forecasting, etc

Time series *analysis* comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series *forecasting* is the use of a model to predict future values based on previously observed values. While regression analysis is often employed in such a way as to test theories that the current values of one or more independent time series affect the current value of another time series, this type of analysis of time series is not called "time series analysis", which focuses on comparing values of a single time series or multiple dependent time series at different points in time.

Time series data have a natural temporal ordering. This makes time series analysis distinct from cross-sectional studies, in which there is no natural ordering of the observations (e.g. explaining people's wages by reference to their respective education levels, where the individuals' data could be entered in any order). Time series analysis is also distinct from spatial data analysis where the observations typically relate to geographical locations (e.g. accounting for house prices by the location as well as the intrinsic characteristics of the houses).
A stochastic model for a time series will generally reflect the fact that observations close together in time will be more closely related than observations further apart. In addition, time series models will often make use of the natural one-way ordering of time so that values for a given period will be expressed as deriving in some way from past values, rather than from future values

17.2.2 Causal Model

Some forecasting methods try to identify the underlying factors that might influence the variable that is being forecast. For example, including information about climate patterns might improve the ability of a model to predict umbrella sales. Forecasting models often take account of regular seasonal variations. In addition to climate, such variations can also be due to holidays and customs: for example, one might predict that sales of college football apparel will be higher during the football season than during the off season.

Several informal methods used in causal forecasting do not employ strict algorithms, but instead use the judgment of the forecaster. Some forecasts take account of past relationships between variables: if one variable has, for example, been approximately linearly related to another for a long period of time, it may be appropriate to extrapolate such a relationship into the future, without necessarily understanding the reasons for the relationship.

Causal methods include:

- **Regression analysis** includes a large group of methods for predicting future values of a variable using information about other variables. These methods include both parametric (linear or non-linear) and non-parametric techniques.

- **Autoregressive moving average with exogenous inputs (ARMAX)**

Quantitative forecasting models are often judged against each other by comparing their in-sample or out-of-sample mean square error, although some researchers have advised against this

17.3 Forecasting Error

The forecast error is the difference between the actual value and the forecast value for the corresponding period.

$$E_t = Y_t - F_t$$

Where E is the forecast error at period t, Y is the actual value at period t, and F is the forecast for period t.

17.4 Selection of forecasting model

In virtually every decision they make, executives today consider some kind of forecast. Sound predictions of demands and trends are no longer luxury items, but a necessity, if managers are to cope with seasonality, sudden changes in demand levels, price-cutting manoeuvres of the competition, strikes, and large swings of the economy.

To handle the increasing variety and complexity of managerial forecasting problems, many forecasting techniques have been developed in recent years. Each has its special use, and care must be taken to select the correct technique for a particular application. The manager as well as the forecaster has a role to play in technique selection; and the better they understand the range of forecasting possibilities, the more likely it is that a company's forecasting efforts will bear fruit.

The selection of a method depends on many factors—the context of the forecast, the relevance and availability of historical data, the degree of accuracy desirable, the time period to be forecast, the cost/ benefit (or *value*) of the forecast to the company, and the time available for making the analysis.

These factors must be weighed constantly, and on a variety of levels. In general, for example, the forecaster should choose a technique that makes the best use of available data. If the forecaster can readily apply one technique of acceptable accuracy, he or she should not try to "gold plate" by using a more advanced technique that offers potentially greater accuracy but that requires

nonexistent information or information that is costly to obtain. This kind of trade-off is relatively easy to make, but others, as we shall see, require considerably more thought.

Furthermore, where a company wishes to forecast with reference to a particular product, it must consider *the stage of the product's life cycle for which it is making the forecast*. The availability of data and the possibility of establishing relationships between the factors depend directly on the maturity of a product, and hence the life-cycle stage is a prime determinant of the forecasting method to be used.

Our purpose here is to present an overview of this field by discussing the way a company ought to approach a forecasting problem, describing the methods available, and explaining how to match method to problem. We shall illustrate the use of the various techniques from our experience with them at Corning, and then close with our own forecast for the future of forecasting.

17.5 Summary

Quantitative methods are playing a significant role in any forecasting for business. While selecting a quantitative method, one should understand the limitations of that technique for more accurate and reliable forecasting else there are very high chances of error in the result. For good and more accurate results, we should understand the functionality of the issue.

17.6 Exercise

1. Explain the functional importance of quantitative methods of forecasting.
2. Elaborate the relationship between operations management and forecasting.
3. What are the various types of quantitative methods of forecasting?
4. Explain "Forecasting Error".
5. What are the criteria of selecting best forecasting method?

Block

6

PRODUCTION PLANNING

UNIT-18

FACILITY LOCATION PLANNING

18.0 Introduction;

18.1 Operating Strategies for Multiple Facilities,

18.2 Factors Affecting Facility;

18.3 Location Planning:

18.3.1 Locating Foreign Operations;

18.4 Factors and Location Rating;

18.4.1 Break-even Analysis for Facility Location Planning;

18.4.2 Simple Median Model;

18.4.3 The Centre of Gravity Method;

18.4.4 Transportation Model using MS Excel XP;

18.4.5 Ardalan Heuristics for Location Planning of Service Facilities

18.5 Summary

18.0 INTRODUCTION

Location can be defined as “a place to put something”. Facility location means a place to put the facility. Facility location decisions are strategic, long term, and non-repetitive in nature. Without sound location planning in the beginning, the new facility may pose continuous operating disadvantages for the future operations. Location decisions are affected by many factors, both internal and external, to the organization's operations. Internal factors include the technology used, the capacity, the financial position, and the work force required. External factors include the economic, political, and social conditions in the various localities. Thus, for long term benefits of the facility, a sound and careful location planning is required.

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

18.1 OPERATING STRATEGIES FOR MULTIPLE FACILITIES

When companies have several manufacturing facilities there are several different ways for a company to organize their operations. These ways include: assigning different product lines to different plants, assigning different market areas to different plants, or assigning different processes to different plants. These strategies carry their own cost and managerial implications, but they also carry a certain competitive advantage.

There are four different types of plant strategies:

1. Product Plant Strategy

- Products or product lines are produced in separate plants, and each plant is usually responsible for supplying the entire domestic market.
- It is a decentralized approach as each plant focuses on a narrow set of requirements that includes specialization of labour, materials, and equipment along product lines.
- Specialization involved in this strategy usually results in economies of scale and, compared to multipurpose plants, lower operating costs.
- The plant locations may either be widely scattered or placed relatively close to one another.

2. Market Area Plant Strategy

- Here, plants are designed to serve a particular geographic segment of a market.

- The individual plants can produce either most, or all of the company's products and supply a limited geographical area.
- The operating costs of this strategy are often times higher than those of product plants, but savings on shipping costs for comparable products can be made.
- This strategy is useful when shipping costs are high due to volume, weight, or other factors.
- It can also bring the added benefits of faster delivery and response times to local needs.
- It requires a centralized coordination of decisions to add or delete plants, or to expand or downsize current plants because of changing market conditions.

3. **Process Plant Strategy**

- Here, different plants concentrate on different aspects of a process.
- This strategy is most useful when products have numerous components; separating the production of components results in less confusion than if all the production were done in the same location.
- A major issue with this strategy is the coordination of production throughout the system, and it requires a highly informed, centralized administration in order to be an effective operation.
- It can bring about additional shipping costs, but a key benefit is that individual plants are highly specialized and generate volumes that brings economies of scale.

4. **General-Purpose Plant Strategy**

- Plants are flexible and have the ability to handle a range of products
- It allows for a quick response to products and market changes, but can be less productive than a more focused approach.
- A benefit to this approach is the increase in learning opportunities that happens when similar operations are being done in different plants. Solutions to problems as well as improvements made at one plant can be shared with the other plants.

18.2 FACTORS AFFECTING FACILITY

For a company which operates in a global environment; cost, available infrastructure, labour skill, government policies and environment are very important factors. A right location provides adequate access to customers, skilled labors, transportation, etc. A right location ensures success of the organization in current global competitive environment. A geographic area becomes a focal point for various facility locations based on many factors, parameters and issues. These factors are can be divided into primary factors and secondary factors. A primary factor which leads to industrialization of a particular area for particular manufacturing of products is material,

labour and presence of similar manufacturing facilities. Secondary factors are available of credit FINANCE, communication infrastructure and insurance. The goal of an organization is customer delight for that it needs access to the customers at minimum possible cost. This is achieved by developing location strategy. Location strategy helps the company in determining product offering, market, demand forecast in different markets, best location to access customers and best manufacturing and service location.

If the organization can configure 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:

Customer Proximity: Facility locations are selected closer to the customer as to reduce transportation cost and decrease time in reaching the customer.

Business Area: Presence of other similar manufacturing units around makes business area conducive for facility establishment.

Availability of Skill Labour: Education, experience and skill of available labour are another important, which determines facility location.

Free Trade Zone/Agreement: Free-trade zones promote the establishment of manufacturing facility by providing incentives in custom duties and levies. On another hand free trade agreement is among countries providing an incentive to establish business, in particular, country.

Suppliers: Continuous and quality supply of the raw materials is another critical factor in determining the location of manufacturing facility.

Environmental Policy: In current globalized world pollution, control is very important, therefore understanding of environmental policy for the facility location is another critical factor.

ERRORS IN LOCATION SELECTION

Facility location is critical for business continuity and success of the organization. So it is important to avoid mistakes while making selection for a location. Errors in selection can be divided into two broad categories behavioural and non-behavioural. Behavioural errors are decision made by executives of the company where personal factors are considered before success of location, for example, movement of personal establishment from hometown to new location facility. Non-behavioural errors include lack of proper investigative practice and analysis, ignoring critical factors and characteristics of the industry.

18.3 LOCATION PLANNING

Every firm must use location planning techniques. There are many options for location planning. Corporations choose from expanding an existing location, shutting down one location and moving to another, adding new locations while retaining existing facilities, or doing nothing. There are a variety of methods used to decide the best location or alternatives for the corporation.

Methods such as identifying the country, general region, small number of community alternatives, and site alternatives.

Several factors that influence location positioning include the location of raw materials, proximity to the market, climate, and culture. Models for evaluating whether a location is best for an organization consist of cost-profit analysis for locations, the center of gravity model, the transportation model, and factor rating.

The main factors that affect location decisions include regional factors, community considerations, and site-related factors. Community factors consist of quality of life, services, attitudes, taxes, environmental regulations, utilities, and development support.

18.3.1 LOCATING FOREIGN OPERATIONS

A. Tangible Reasons

The tangible reasons for setting up an operations facility abroad could be as follows:

Reaching the customer: One obvious reason for locating a facility abroad is that of capturing a share of the market expanding worldwide. The phenomenal growth of the GDP of India is a big reason for the multinationals to have their operations facilities in our country. An important reason is that of providing service to the customer promptly and economically which is logistics-dependent. Therefore, cost and case of logistics is a reason for setting up manufacturing facilities abroad. By logistics set of activities closes the gap between production of goods/services and reaching of these intended goods/services to the customer to his satisfaction. Reaching the customer is thus the main objective. The tangible and intangible gains and costs depend upon the company defining for itself as to what that 'reaching' means. The tangible costs could be the logistics related costs; the intangible costs may be the risk of operating is a foreign country. The tangible gains are the immediate gains; the intangible gains are an outcome of what the company defines the concepts of reaching and customer for itself.

The other tangible reasons could be as follows:

(a) The host country may offer substantial tax advantages compared to the home country.

(b) The costs of manufacturing and running operations may be substantially less in that foreign country. This may be due to lower labour costs, lower raw material cost, better availability of the inputs like materials, energy, water, ores, metals, key personnel etc.

(c) The company may overcome the tariff barriers by setting up a manufacturing plant in a foreign country rather than exporting the items to that country.

B. Intangible Reasons

The intangible reasons for considering setting up an operations facility abroad could be as follows:

1. Customer-related Reasons

(*a*) With an operations facility in the foreign country, the firm's customers may feel secure that the firm is more accessible. Accessibility is an important 'service quality' determinant.

(*b*) The firm may be able to give a personal tough.

(*c*) The firm may interact more intimately with its customers and may thus understand their requirements better.

(*d*) It may also discover other potential customers in the foreign location.

2. Organisational Learning-related Reasons

(*a*) The firm can learn advanced technology. For example, it is possible that cutting-edge technologies can be learn by having operations in an technologically more advanced country. The firm can learn from advanced research laboratories/universities in that country. Such learning may help the entire product-line of the company.

(*b*) The firm can learn from its customers abroad. A physical location there may be essential towards this goal.

(*c*) It can also learn from its competitors operating in that country. For this reason, it may have to be physically present where the action is.

(*d*) The firm may also learn from its suppliers abroad. If the firm has a manufacturing plant there, it will have intensive interaction with the suppliers in that country from whom there may be much to learn in terms of modern and appropriate technology, modern management methods, and new trends in business worldwide.

3. Other Strategic Reasons

(*a*) The firm by being physically present in the host country may gain some 'local boy' kind of psychological advantage. The firm is no more a 'foreign' company just sending its products across international borders. This may help the firm in lobbying with the government of that country and with the business associations in that country.

(*b*) The firm may avoid 'political risk' by having operations in multiple countries.

(*c*) By being in the foreign country, the firm can build alternative sources of supply. The firm could, thus, reduce its supply risks.

(*d*) The firm could hunt for human capital in different countries by having operations in those countries. Thus, the firm can gather the best of people from across the globe.

(*e*) Foreign locations in addition to the domestic locations would lower the market risks for the firm. If one market goes slow the other may be doing well, thus lowering the overall risk.

EVALUATING LOCATION ALTERNATIVES- Various models are available which help to identify the ideal location. Some of the popular models are:

18.4 FACTOR RATING METHOD

The process of selecting a new facility location involves a series of following steps:

1. Identify the important location factors.
2. Rate each factor according to its relative importance, i.e., higher the ratings is indicative of prominent factor.
3. Assign each location according to the merits of the location for each factor.
4. Calculate the rating for each location by multiplying factor assigned to each location with basic factors considered.
5. Find the sum of product calculated for each factor and select best location having highest total score.

ILLUSTRATION: *Let us assume that a new medical facility, Health-care, is to be located in Delhi. The location factors, factor rating and scores for two potential sites are shown in the following table. Which is the best location based on factor rating method?*

Sl. No.	*Location factor*	*Factor rating*	*Rating*	
			Location 1	*Location 2*
1.	Facility utilization	8	3	5
2.	Total patient per month	5	4	3
3.	Average time per emergency trip	6	4	5
4.	Land and construction costs	3	1	2
5.	Employee preferences	5	5	3

Solution

Sl. No.	*Location factor*	*Factor rating* (1)	*Location 1*		*Location 2*	
			(Rating) (2)	*Total =* (1) . (2)	*(Rating)* (3)	*Total* = (1) . (3)
1.	Facility utilization	8	3	24	5	40
2.	Total patient per month	5	4	20	3	15
3.	Average time per emergency trip	6	4	24	5	30
4.	Land and construction costs	3	1	3	2	6
5.	Employee preferences	5	5	25	3	15
			Total	96	Total	106

The total score for location 2 is higher than that of location 1. Hence location 2, is the best choice.

Weighted Factor Rating Method

In this method to merge quantitative and qualitative factors, factors are assigned weights based on relative importance and weightage score for each site using a preference matrix is calculated. The site with the highest weighted score is selected as the best choice.

ILLUSTRATION: *Let us assume that a new medical facility, Health-care, is to be located in Delhi. The location factors, weights, and scores (1 = poor, 5 = excellent) for two potential sites are shown in the following table. What is the weighted score for these sites? Which is the best location?*

Sl. No.	*Location factor*	*Weight*	*Scores*	
			Location 1	*Location 2*
1.	Facility utilization	25	3	5
2.	Total patient km per month	25	4	3
3.	Average time per emergency trip	25	3	3
4.	Land and construction costs	15	1	2
5.	Employee preferences	10	5	3

SOLUTION: The weighted score for this particular site is calculated by multiplying each factor's weight by its score and adding the results:

Weighed score location 1 $= 25 \times 3 + 25 \times 4 + 25 \times 3 + 15 \times 1 + 10 \times 5$

$= 75 + 100 + 75 + 15 + 50$

$= 315$

Weighed score location 2 $= 25 \times 5 + 25 \times 3 + 25 \times 3 + 15 \times 2 + 10 \times 3$

$= 125 + 75 + 75 + 30 + 30$

$= 335$

Location 2 is the best site based on total weighted scores.

18.4.1 BREAK EVEN ANALYSIS

Break even analysis implies that at some point in the operations, total revenue equals total cost. Break even analysis is concerned with finding the point at which revenues and costs agree exactly. It is called 'Break-even Point'. The Figure portrays the Break Even Chart: Break-even point is the volume of output at which neither a profit is made nor a loss is incurred.

The Break Even Point (BEP) in units can be calculated by using the relation:

$$\text{BEP} = \frac{\text{Fixed Cost}}{\text{Contribution per unit}} = \frac{\text{Fixed Cost}}{\text{Selling Price} - \text{Variable Cost per unit}} = \frac{F}{S-V} \text{ units}$$

The Break Even Point (BEP) in Rs. can be calculated by using the relation:

$$\text{BEP} = \frac{\text{Fixed Cost}}{\text{PV Ratio}} = \frac{\text{Fixed Cost}}{\left\{\frac{\text{Sales} - \text{Variable Cost}}{\text{Sales}}\right\}} = \frac{F}{\phi} \text{ Rs.}$$

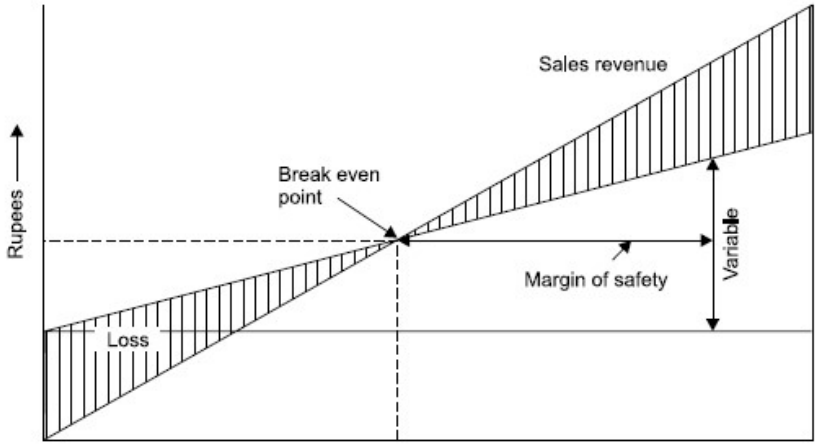


Fig. *Units of output or percentage of capacity*

Plotting the break even chart for each location can make economic comparisons of locations. This will be helpful in identifying the range of production volume over which location can be selected.

ILLUSTRATION: *Potential locations X, Y and Z have the cost structures shown below. The ABC company has a demand of 1,30,000 units of a new product. Three potential locations X, Y and Z having following cost structures shown are available. Select which location is to be selected and also identify the volume ranges where each location is suited?*

	Location X	*Location Y*	*Location Z*
Fixed Costs	Rs. 150,000	Rs. 350,000	Rs. 950,000
Variable Costs	Rs. 10	Rs. 8	Rs. 6

Solution

Solve for the crossover between X and Y:

$$10X + 150{,}000 = 8X + 350{,}000$$

$$2X = 200{,}000$$

$$X = 100{,}000 \text{ units}$$

Solve for the crossover between Y and Z:

$$8X + 350{,}000 = 6X + 950{,}000$$

$$2X = 600{,}000$$

$$X = 300{,}000 \text{ units}$$

Therefore, at a volume of 1,30,000 units, Y is the appropriate strategy.

From the graph we can interpret that location X is suitable up to 100,000 units, location Y is suitable up to between 100,000 to 300,000 units and location Z is suitable if the demand is more than 300,000 units.

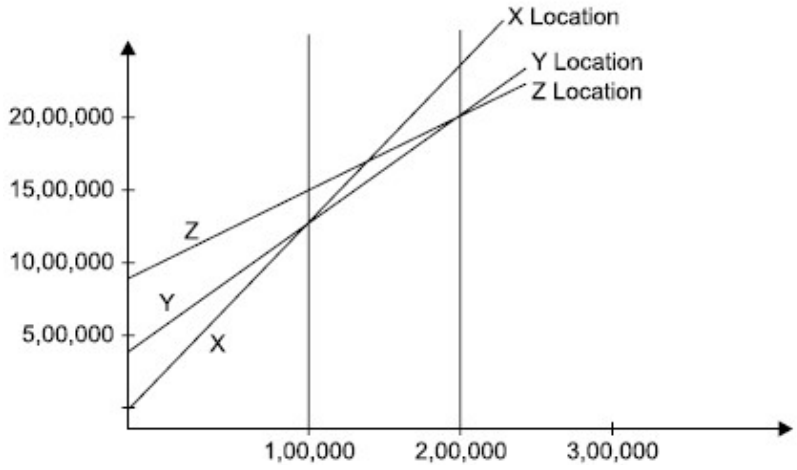


Fig. *BEP chart*

18.4.2 SIMPLE MEDIAN MODEL

Suppose we want to locate a new plant that will annually receive shipments of raw materials from two sources: F1 and F2. The plant will create finished goods that must be shipped to two distribution warehouses, F3 and F4. Given these four facilities where should we locate the new plant to minimize annual transportation costs for this network of facilities?

The Model

The *simple median model* (SMM) can help answer this question. This model considers the volume of loads transported on *rectangular* paths. All movements are made in east-west or north-south directions; diagonal moves are not considered. The SMM provides an optimal solution. This is discussed with the help of Figure and the Table.

Let L*i* = Loads to be shipped annually between each existing facility F*i*, and

C*i* = Cost to move a load one distance unit to or from F*i*.

D*i* = Distance units between facility F*i* and the new plant.

Then, the total transit cost is the sum of the products C*i*L*i*D*i* for all *i*.

$$\text{Total cost of transportation} = \sum_{i=1}^{n} C_i L_i D_i \qquad (2.3)$$

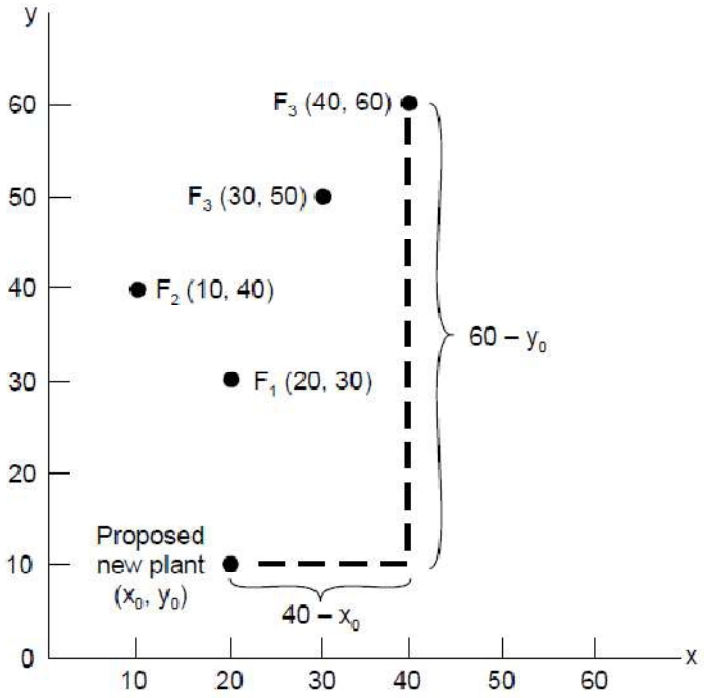


Figure Sources of raw materials and distribution warehouses.

Table - Data related to C_i, L_i and D_i

F_i	L_i	C_i	(X_i, Y_i) of F_i
F_1	755	\$1	(20, 30)
F_2	900	1	(10, 40)
F_3	450	1	(30, 50)
F_4	500	1	(40, 60)
Total	2605		

Since all loads must be on rectangular paths, distance between each existing facility and the new plant will be measured by the difference in the *x*-coordinates and the difference in the *y*-coordinates. If we let (*x*0, *y*0) be the coordinates of a proposed new plant, then

$$Di = | x0 - xi | + | y0 - yi | \qquad (2.2)$$

Notice that we calculate the absolute value of the differences, because distance is always positive.

We could have written Eqn.(2.2) as

$$Di = | xi - x0 | + | yi - y0 | \qquad (2.3)$$

Our goal is to find values for $x0$ and $y0$ for the *new plant* that result in minimum transportation costs.

We follow three steps:

1. Identify the median value of the loads Li moved.

2. Find the *x*-coordinate of the existing facility that sends (or receives) the median load.

3. Find the *y*-coordinate value of the existing facility that sends or receives) the median load

The *x* and *y* coordinates found in steps 2 and 3 define the new plant's best location.

18.4.3 CENTRE OF GRAVITY

Centre of gravity is based primarily on cost considerations. This method can be used to assist managers in balancing cost and service objectives. The centre of gravity method takes into account the locations of plants and markets, the volume of goods moved, and transportation costs in arriving at the best location for a single intermediate warehouse.

The centre of gravity is defined to be the location that minimizes the weighted distance between the warehouse and its supply and distribution points, where the distance is weighted by the number of tones supplied or consumed. The first step in this procedure is to place the locations on a coordinate system. The origin of the coordinate system and scale used are arbitrary, just as long as the relative distances are correctly represented. This can be easily done by placing a grid over an ordinary map.

The centre of gravity is determined by the formula.

$$C_X = \frac{\sum D_{ix} \cdot W_i}{\sum W_i} \qquad C_Y = \frac{\sum D_{iy} \cdot W_i}{\sum W_i}$$

where C_x = *x*-coordinate of the centre of gravity

C_y = *y*-coordinate of the centre of gravity

D_{ix} = *x*-coordinate of location *i*

D_{iy} = *y*-coordinate of location *i*

ILLUSTRATION: *The new Health-care facility is targeted to serve seven census tracts in Delhi. The table given below shows the coordinates for the centre of each census tract, along with the projected populations, measured in thousands. Customers will travel from the seven census tract centres to the new facility when they need healthcare. Two locations being*

considered for the new facility are at (5.5, 4.5) and (7, 2), which are the centres of census tracts C and F. Details of seven census tract centres, coordinate distances along with the population for each centre are given below. Find the target area's centre of gravity for the Health-care medical facility.

Sl. No.	*Census tract*	*(x, y)*	*Population (l)*
1	A	(2.5, 4.5)	2
2	B	(2.5, 2.5)	5
3	C	(5.5, 4.5)	10
4	D	(5, 2)	7
5	E	(8, 5)	10
6	F	(7, 2)	20
7	G	(9, 2.5)	14

SOLUTION: To calculate the centre of gravity, start with the following information, where population is given in thousands.

Sl. No.	*Census tract*	*(x, y)*	*Population (l)*	*Lx*	*Ly*
1	A	(2.5, 4.5)	2	5	9
2	B	(2.5, 2.5)	5	12.5	12.5
3	C	(5.5, 4.5)	10	55	45
4	D	(5, 2)	7	35	14
5	E	(8, 5)	10	80	50
6	F	(7, 2)	20	140	40
7	G	(9, 2.5)	14	126	35
		Total	68	453.50	205.50

Next we find C_x and C_y.

$C_x = 453.5/68 = 6.67$

$C_y = 205.5/68 = 3.02$

The centre of gravity is (6.67, 3.02). Using the centre of gravity as starting point, managers can now search in its vicinity for the optimal location.

18.4.4 TRANSPORTATION MODEL USING MS EXCEL XP

Transportation can be used to solve specific location problems. It could be used to evaluate the cost impact of adding potential location sites to the network of existing facilities. It could also be used to evaluate adding multiple new sites or completely redesigning the network. Transportation modelling finds the least-cost means of shipping supplies from several origins to several destinations. Origin points (or sources) can be factories, warehouses, car rental agencies like Avis, or any other points from which goods are shipped. Destinations are any points that receive goods.

To use the transportation model, we need to know the following:

1. The origin points and the capacity or supply per period at each.

2. The destination points and the demand per period at each.

3. The cost of shipping one unit from each origin to each destination.

The Northwest-Corner Rule

The northwest-corner rule requires that we start in the upper left-hand cell (or northwest corner) of the table and allocate units to shipping routes as follows:

1. Exhaust the supply (factory capacity) of each row (e.g., Des Moines: 100) before moving down to the next row.

2. Exhaust the (warehouse) requirements of each column (e.g., Albuquerque: 300) before moving to the next column on the right.

3. Check to ensure that all supplies and demands are met.

The Intuitive Lowest-Cost Method

The **intuitive method** makes initial allocations based on lowest cost. This straightforward approach uses the following steps:

1. Identify the cell with the lowest cost. Break any ties for the lowest cost arbitrarily.

2. Allocate as many units as possible to that cell without exceeding the supply or demand. Then cross out that row or column (or both) that is exhausted by this assignment.

3. Find the cell with the lowest cost from the remaining (not crossed out) cells.

4. Repeat steps 2 and 3 until all units have been allocated.

THE STEPPING-STONE METHOD

The stepping-stone method will help us move from an initial feasible solution to an optimal solution. It is used to evaluate the cost effectiveness of shipping goods via transportation routes

not currently in the solution. When applying it, we test each unused cell, or square, in the transportation table by asking: What would happen to total shipping costs if one unit of the product (for example, one bathtub) was tentatively shipped on an unused route?

We conduct the test as follows:

1. Select any unused square to evaluate.

2. Beginning at this square, trace a closed path back to the original square via squares that are currently being used (only horizontal and vertical moves are permissible). You may, however, step over either an empty or an occupied square.

3. Beginning with a plus (+) sign at the unused square, place alternating minus signs and plus signs on each corner square of the closed path just traced.

4. Calculate an improvement index by first adding the unit-cost figures found in each square containing a plus sign and then by subtracting the unit costs in each square containing a minus sign.

5. Repeat steps 1 through 4 until you have calculated an improvement index for all unused squares. If all indices computed are *greater than or equal to zero*, you have reached an optimal solution. If not, the current solution can be improved further to decrease total shipping costs.

USING SOFTWARE TO SOLVE TRANSPORTATION PROBLEMS

Excel, Excel OM, and POM for Windows may all be used to solve transportation problems. Excel uses Solver, which requires that you enter your own constraints. Excel OM also uses Solver but is pre-structured so that you need enter only the actual data. POM for Windows similarly requires that only demand data, supply data, and shipping costs be entered.

Excel Transportation module uses Excel's built-in Solver routine to find optimal solutions to transportation problems.

From \ To	Albuquerque	Boston	Cleveland
Des Moines	$5	$4	$3
Evansville	$8	$4	$3
Fort Lauderdale	$9	$7	$5

TABLE-Transportation Costs per Bathtub for Arizona Plumbing

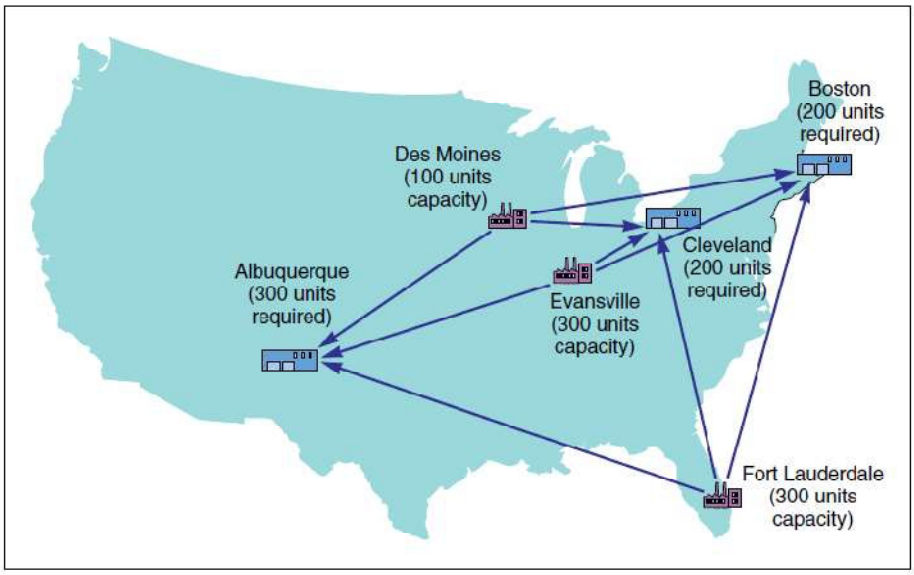


FIGURE - Transportation Problem

From \ To	Albuquerque	Boston	Cleveland	Factory capacity
Des Moines	$5	$4	$3	100
Evansville	$8	$4	$3	300
Fort Lauderdale	$9	$7	$5	300
Warehouse requirement	300	200	200	700

Des Moines capacity constraint

Cell representing a possible source-to-destination shipping assignment (Evansville to Cleveland)

Cost of shipping 1 unit from Fort Lauderdale factory to Boston warehouse

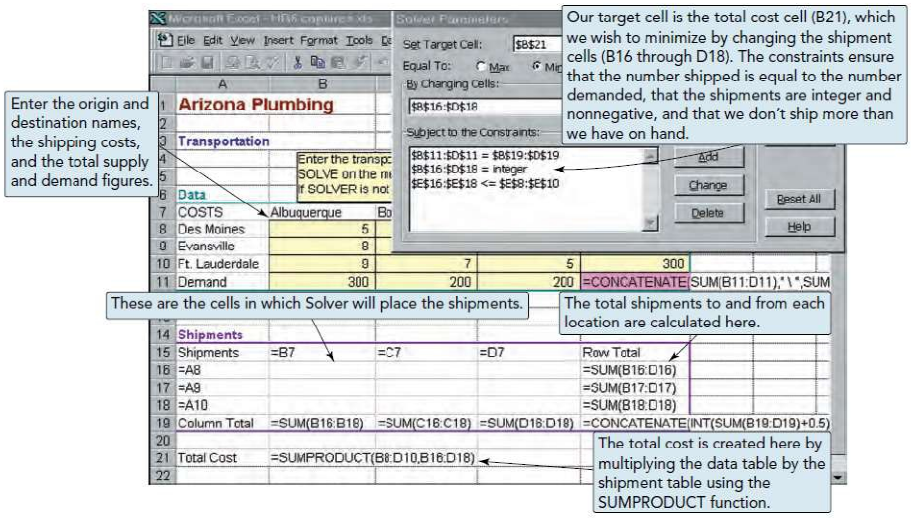
Cleveland warehouse demand

Total demand and total supply

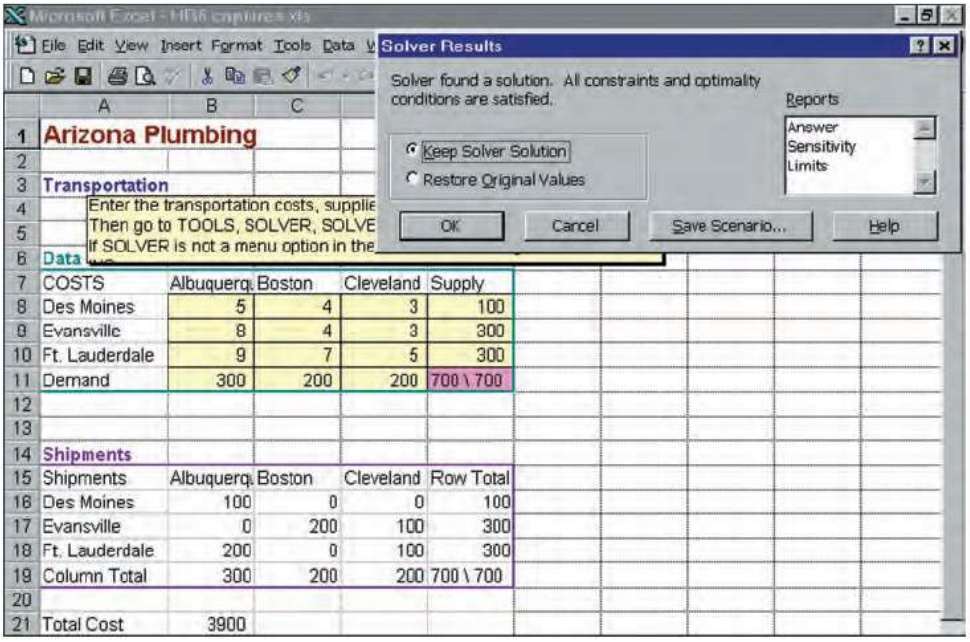
FIGURE-Transportation Matrix for Arizona Plumbing

Program illustrates the input data (from Arizona Plumbing) and total-cost formulas. To reach an optimal solution, we must go to Excel's *Tools* bar, request *Solver*, and then select *Solve*.

The output appears in Program.



Excel OM Input Screen and Formulas, Using Arizona Plumbing Data



Output from Excel OM with Optimal Solution to Arizona Plumbing Problem

18.4.5 ARDALAN HEURISTICS FOR LOCATION PLANNING OF SERVICE FACILITIES

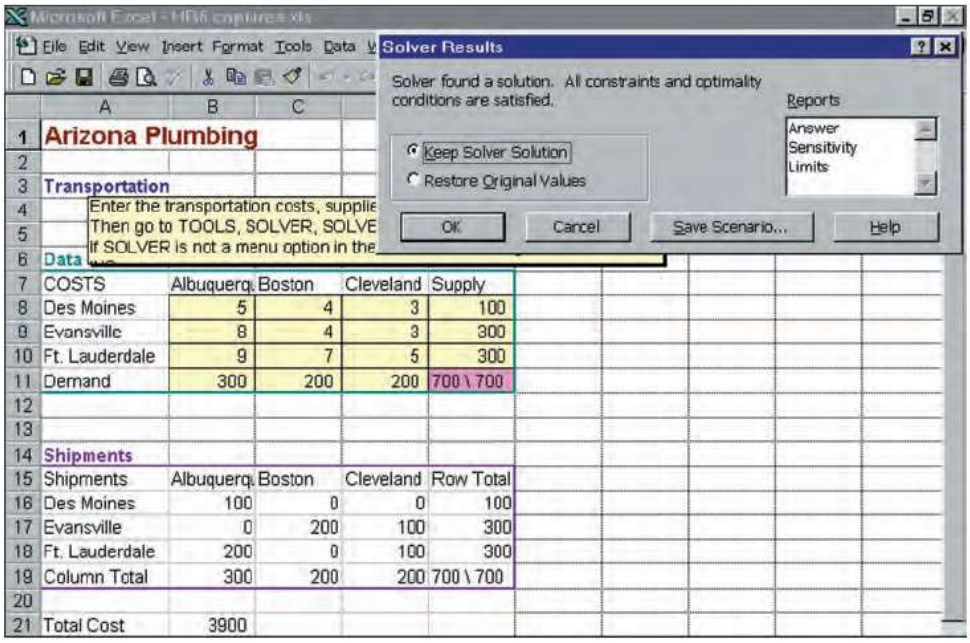
It Need a matrix of distances or costs from each customer location to every other location.

- Demand at each location
- Weight – give higher weight to more important customers – their pain of traveling a longer distance is worth more.
- Only consider locating where customers are
- Identify the one best place to locate at, then the second one to add, then the third, etc.

- Compute cost of satisfying each demand from each possible distribution center location.
- Step 1: Multiply distances * demand

  A to B: 11 * 10 = 110
- Multiply distances times demand, and sum

To	A	B	C	D	*	Dem = A	B	C	D
A	0	11	8	12	*	10	0	110	80	120
B	11	0	10	7	*	8	88	0	80	56
C	8	10	0	9	*	20	160	200	0	180
D	9.5	7	9	0	*	12	114	84	108	0
Total						362	394	268	356	

- 

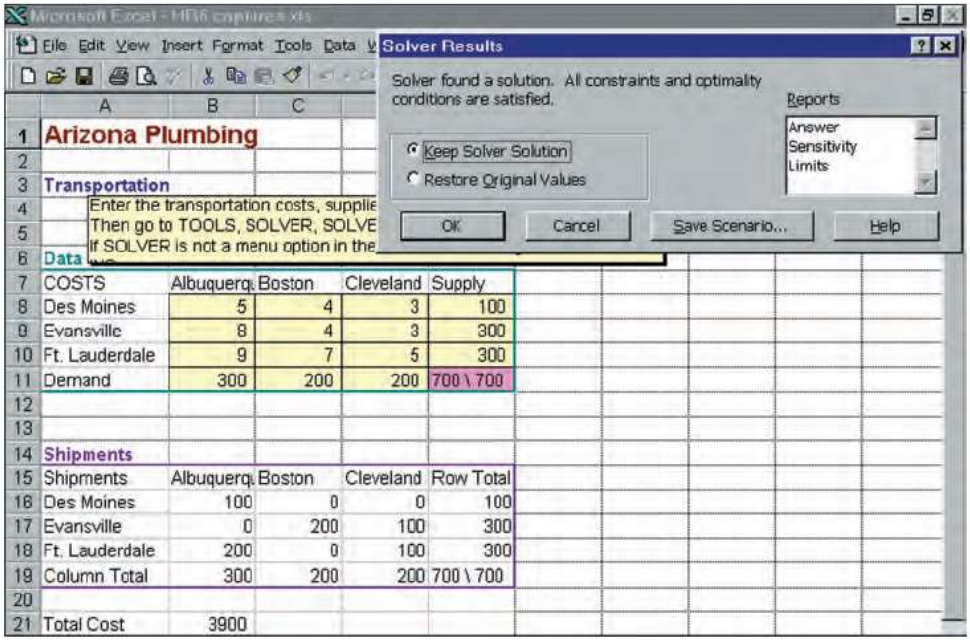
  Choose smallest total as first location

	A	B	C	D
A	0	110	80	120
B	88	0	80	56
C	160	200	0	180
D	114	84	108	0
Total	362	394	268	356

If we only build one facility, we should build it in C, and the total transportation costs will be 268 truckload miles.

Notice that even if we built a facility in B or D, it will continue to be cheaper to serve A from C. In the next step, we will make use of that.

■ Compare each cost in row to the cost in the chosen cost, and switch is lower

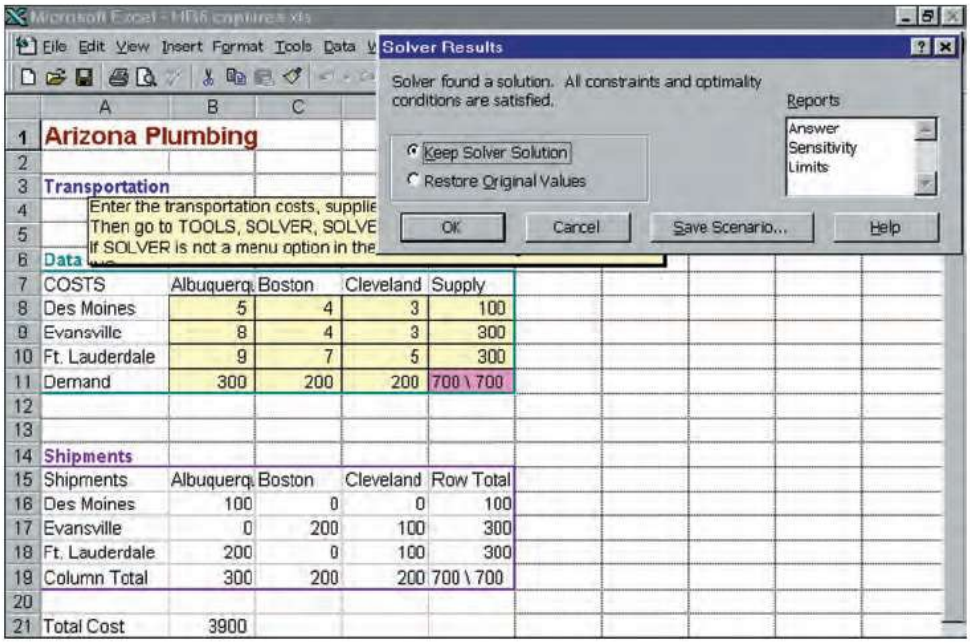


A

	B	C	D	
A	0	80	80	80
B	80	0	80	56

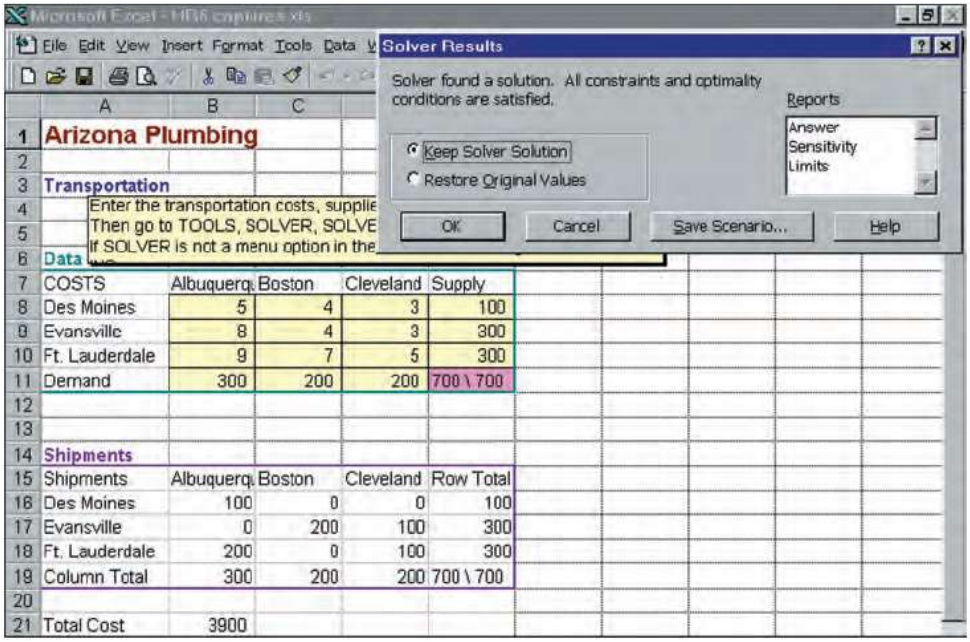
C	0	0	0	0
D	108	84	108	0
Total	188	164	268	136

- Don't need first chosen city any more.

- 

Choose second cheapest city

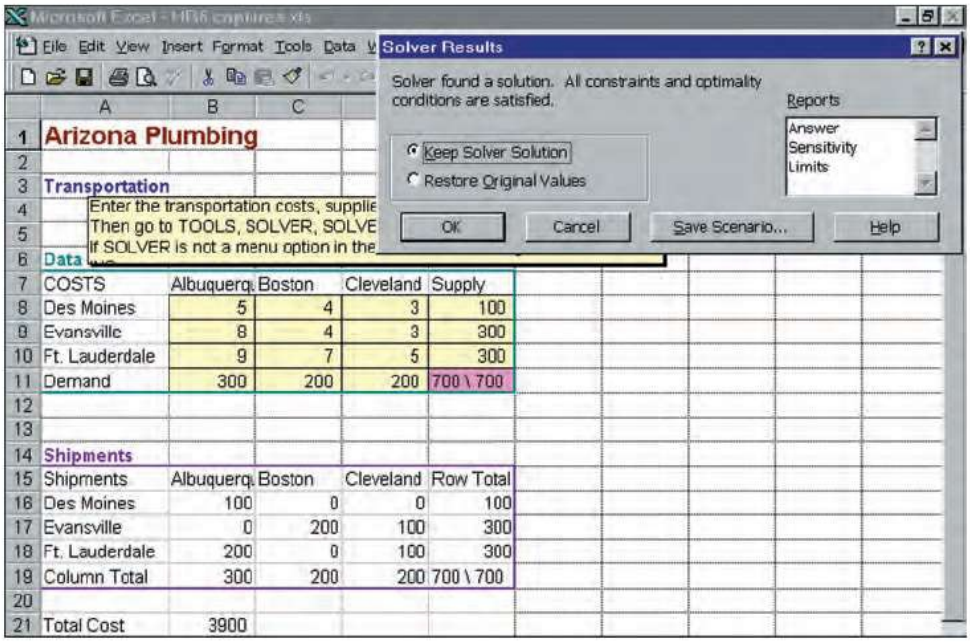
	A	B	D
A	0	80	80
B	80	0	56
C	0	0	0
D	108	84	0
Total	188	164	136

- 

Compare non-chosen cities' costs to cost of chosen, and choose the lower cost

From	A	B	D
A	0	80	80
B	56	0	56
C	0	0	0
D	0	0	0
Total	56	80	136

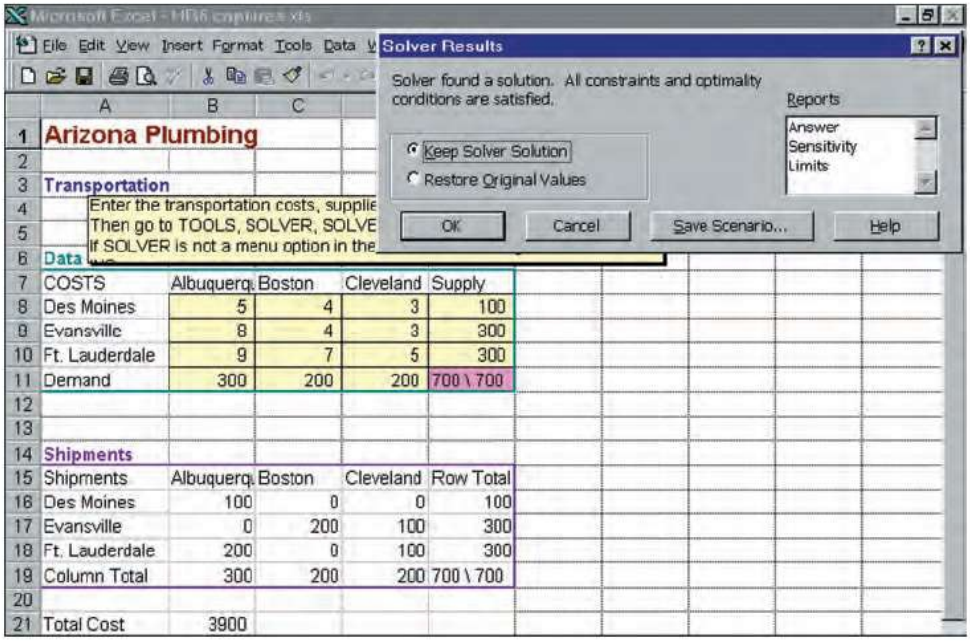
■ Compare non-chosen cities' costs to cost of chosen, and choose the lower cost



From

	A	B
A	0	80
B	56	0
C	0	0
D	0	0
Total	56	80

■ Compare non-chosen cities' costs to cost of chosen, and choose the lower cost



From

	A	B
A	0	0
B	56	0
C	0	0
D	0	0

Total	56	0			
	Total # DCs	Locations	Transp	Transp Total	Savings
	1	C	268		
	2	C,D	136	152	
	3	C,D,A	56	80	
	4	C,D,A,B		0	56

- Assumes that we have to locate in the same city as one of our customers, which is not always the case.
- However, it can be used to find more than one location.
- Center of Gravity does not try to locate in the same city as one of the customers, but can only set one site.
- If we choose the same sites as customers A and X, we obviously don't really have to put the warehouses in those exact cities.

18.5 Summary

Facility location decisions are strategic, long term, and non-repetitive in nature. There are four types of plant strategies: Product Plant Strategy, Market Area Plant Strategy, Process Plant Strategy and General-Purpose Plant Strategy. A right location provides adequate access to customers, skilled labours, transportation, etc. There are several factors that affect facilities: Customer Proximity, Business Area, Availability of Skill Labour, Free Trade Zone/Agreement, Suppliers, and Environmental Policy. There may be some errors in location selection as well. There are several foreign operation. There are factor's rating method, weighted method, break even analysis, simple median model, centre of gravity method, transportation model using various techniques.

UNIT-19
CAPACITY PLANNING

19.0 Introduction

19.1 Aspects of Capacity Planning,

19.2 Determination of Capacity Requirement,

19.3 Capacity Planning for a Single-Stage System,

19.4 Capacity Planning for a Multiple Stage System.

19.5 Evaluation of Alternative Plant Size,

19.6 Traditional Economic Requirements for a Single Production Stage,

19.7 Determination of the Stage Efficiency Stage.

19.8 Summary

19.0 INTRODUCTION

What is Capacity? A dictionary meaning of Capacity is the ability to hold, receive, store, or accommodate. The capacity is also defined as the maximum output of a system in a given period of time under ideal conditions. Management of capacity basically involves capacity planning, balance between various issues against economic advantages and disadvantages and its proper utilization, before discussing the planning and management of capacity let understand the process of measurement of capacity.

Capacity refers to a system's potential for producing goods or delivering services over a specified time interval. Capacity planning involves long-term and short term considerations. Long-term considerations relate to the overall level of capacity; short-term considerations relate to variations in capacity requirements due to seasonal, random, and irregular fluctuations in demand.

Excess capacity arises when actual production is less than what is achievable or optimal for a firm. This often means that the demand in the MARKET for the product is below what the firm could potentially supply to the market. Excess capacity is inefficient and will cause manufacturers to incur extra costs or lose market share. Capacity can be broken down in two categories: Design Capacity and Effective Capacity: refers to the maximum designed service capacity or output rate. Effective capacity is design capacity minus personal and other allowances. Product and service factors effect capacity tremendously.

Capacity is the ability of a systems potential for producing goods or delivering services over a specific time interval. The capacity decisions within a company are very important because they help determine the limit of output and provide a major insight to determining operating costs. Basic decisions about capacity often have long term consequences and this chapter explains the ramifications of those choices. When considering capacity planning within a company, three key inputs should be considered. The three inputs are the kind of capacity to be determined, how much of the products will be needed, and when will the product be needed.

The most important concept of capacity planning is to find a medium between long term supply and capabilities of an organization and the predicted level of long term demand. Organizations also have to plan for actual changes in capacity, changes in consumer wants and demand, technology and even the environment. When evaluating alternatives in capacity planning, managers have to consider qualitative and quantitative aspects of the business. These aspects involve economic factors, public opinions, personal preferences of managers.

The capacity decision is strategic and long-term in nature. Capacity planning is described as matching the capabilities of an organization with the predicted level of future demand. Many organizations become involved with capacity planning due to changes in demand, technology, the environment, etc. Organizations have capacities or limits that their system can handle. Three key inputs to capacity planning:

1. The kind of capacity that will be needed

2. How much capacity will be needed?

3. When will it be needed *Accurate forecasts are critical to the planning process

19.1 Aspects of Capacity Planning Classification

Capacity planning based on the timeline is classified into three main categories long range, medium range and short range.

Long Term Capacity: Long range capacity of an organization is dependent on various other capacities like design capacity, production capacity, sustainable capacity and effective capacity. Design capacity is the maximum output possible as indicated by equipment manufacturer under ideal working condition.

Production capacity is the maximum output possible from equipment under normal working condition or day.

Sustainable capacity is the maximum production level achievable in realistic work condition and considering normal machine breakdown, maintenance, etc.

Effective capacity is the optimum production level under pre-defined job and work-schedules, normal machine breakdown, maintenance, etc.

Medium Term Capacity: The strategic capacity planning undertaken by organization for 2 to 3 years of a time frame is referred to as medium term capacity planning.

Short Term Capacity: The strategic planning undertaken by organization for a daily weekly or quarterly time frame is referred to as short term capacity planning.

Goal of Capacity Planning

The ultimate goal of capacity planning is to meet the current and future level of the requirement at a minimal wastage. The three types of capacity planning based on goal are lead capacity planning, lag strategy planning and match strategy planning.

Factors Affecting Capacity Planning

Effective capacity planning is dependent upon factors like production facility (layout, design, and location), product line or matrix, production technology, human capital (job design, compensation), operational structure (scheduling, quality assurance) and external structure (policy, safety regulations)

Forecasting v/s Capacity Planning

There would be a scenario where capacity planning done on a basis of forecasting may not exactly match. For example, there could be a scenario where demand is more than production capacity; in this situation, a company needs to full fill its requirement by buying from outside. If demand is equal to production capacity; company is in a position to use its production capacity to the fullest. If the demand is less than the production capacity, company can choose to reduce the production or share it output with other manufacturers.

Steps in the Capacity Planning Process

1. Estimate future capacity requirements
2. Evaluate existing capacity and facilities and identify gaps
3. Identify alternatives for meeting requirements
4. Conduct FINANCIAL analyses of each alternative
5. Assess key qualitative issues for each alternative
6. Select the alternative to pursue that will be best in the long term
7. Implement the selected alternative
8. Monitor results

19.2 Determination of Capacity Requirements

- **Facilities:** The size and provision for expansion are key in the design of facilities. Other facility factors include locational factors (transportation costs, distance to market, labour supply, and energy sources). The layout of the work area can determine how smoothly work can be performed.
- **Product and Service Factors:** The more uniform the output, the more opportunities there are for standardization of methods and materials. This leads to greater capacity.
- **Process Factors:** Quantity capability is an important determinant of capacity, but so is output quality. If the quality does not meet standards, then output rate decreases because of need of inspection and rework activities. Process improvements that increase quality and productivity can result in increased capacity. Another process factor to consider is the time it takes to change over equipment settings for different products or services.

- **Human Factors:** the tasks that are needed in certain jobs, the array of activities involved and the training, skill, and experience required to perform a job all affect the potential and actual output. Employee motivation, absenteeism, and labour turnover all affect the output rate as well.
- **Policy Factors:** Management policy can affect capacity by allowing or not allowing capacity options such as overtime or second or third shifts
- **Operational Factors:** Scheduling problems may occur when an organization has differences in equipment capabilities among different pieces of equipment or differences in job requirements. Other areas of impact on effective capacity include inventory stocking decisions, late deliveries, purchasing requirements, acceptability of purchased materials and parts, and quality inspection and control procedures.
- **Supply Chain Factors:** Questions include: What impact will the changes have on suppliers, warehousing, transportation, and distributors? If capacity will be increased,

will these elements of the supply chain be able to handle the increase? If capacity is to be decreased, what impact will the loss of business have on these elements of the supply chain?

- **External Factors:** Minimum quality and performance standards can restrict management's options for increasing and using capacity.
- Inadequate planning can be a major limiting determining of effective capacity.

Importance of Capacity Decisions

1. Impacts ability to meet future demands
2. Affects operating costs
3. Major determinant of initial costs
4. Involves long-term commitment
5. Affects competitiveness
6. Affects ease of management
7. Globalization adds complexity
8. Impacts long range planning

Efficiency: Measure of how well a facility or machine is performing when used

Efficiency= Actual output / Effective Capacity

Utilization: Measure of planned or actual capacity usage of a facility, work center, or machine

Utilization= Actual Output / Design Capacity

Example

Design capacity = 50 trucks/day

Effective capacity = 40 trucks/day

Actual output = 36 units/day

$$\text{Efficiency} = \frac{\text{Actual output}}{\text{Effective capacity}} = \frac{36 \text{ units/day}}{40 \text{ units/ day}} = 90\%$$

$$\text{Utilization} = \frac{\text{Actual output}}{\text{Design capacity}} = \frac{36 \text{ units/day}}{50 \text{ units/ day}} = 72\%$$

Design capacity 50 units/day

19.3 CAPACITY PLANNING FOR A SINGLE-STAGE SYSTEM

The problem addressed is the determination of lot sizes for multiple products to be produced on a single production facility with limited capacity. Demand is assumed to be deterministic and time-varying and must be met without backordering. The objective is to minimize the sum of setup and inventory holding costs. A heuristic solution procedure of the period-by-period type is presented. Moreover, the interaction between lot sizing and smoothing of capacity requirements is investigated in a case study.

Key Decisions in Capacity Planning

1. Amount of capacity needed
2. Timing of changes (frequency of capacity additions)
3. Need to maintain balance
4. Extent of flexibility of facilities
5. External sources of capacity

Steps for Capacity Planning

1. Estimate future capacity requirements
2. Evaluate existing capacity
3. Identify alternatives
4. Conduct financial analysis
5. Assess key qualitative issues
6. Select the best alternative
7. Implement the alternative chosen
8. Monitor results

Input measures of capacity

- Firms operating in low volume, high variety situation find it relevant
  - Refining capacity of BPCL refinery in Mumbai is 260,000 barrels of crude per day

- Television manufacturer often measures its capacity by millions of picture tubes that it produces
- Tool room facility will measure its capacity in terms of machine hours
- A hospital will measure the capacity in terms of number of beds.

Output measures of capacity

- When the volume of production is high and the variety is relatively low output measures are useful
  - Toyota Kirloskar Auto Parts measures it capacity in terms of number of transmission gear boxes it can produce
  - Tata Bearings, a division of Tata Steel, has a capacity of 25 million pieces per annum
  - MICO Bosch has an installed capacity of one lakh distributor pumps at its Jaipur plant
  - An automated car wash facility's capacity can be measured in terms of number of cars serviced per day

Japanese notion of capacity

- Capacity = Work + Waste
- Nine types of waste according to Canon production system:
  - Waste in Operations
  - Waste in Startup
  - Waste in Equipment
  - Waste in Defects
  - Waste in Materials
  - Waste in Indirect Labour
  - Waste in Human Resources
  - Waste in expense

Capacity Augmentation Alternatives

- Waste Elimination

- Multi-tasking of workforce
- Sub-contracting/Outsourcing
- De-bottlenecking
- Addition of new capacity

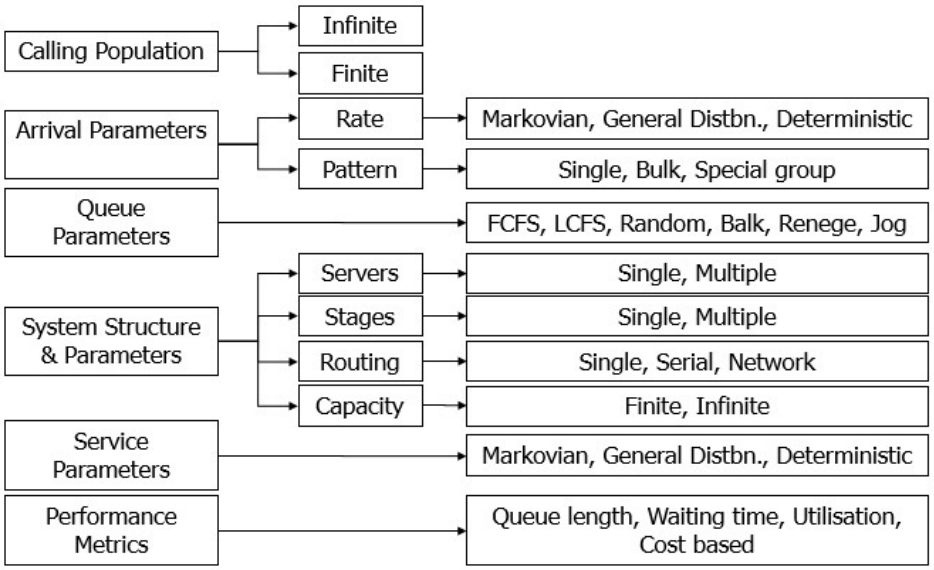
PROBLEM

- A product is manufactured in a shop using a five-stage process. The first step in the process is to cut the sheet metal to required shapes and sizes using a shearing process. After the shearing process, the components are subjected to pressing operations to alter the shape of the flat sheet as per the design. In the third stage of the process welding is done to join the components. The next step in the process is a painting operation. After painting, the components are packed and kept ready for dispatch.
- The time take for each of these operations are 20, 30, 15, 12 and 6 minutes respectively.
- Presently, each stage has only one machine for operation.
- Map the process and analyse the capacity with respect to the following scenarios:
  - If the shop works for an 8-hour shift with an effective available time of 450 minutes, what is the production capacity of the shop?
  - Where is the bottleneck in the system? If we want to add one machine, where should we make the investment?
  - Identify the additional capacity required for a daily production target of 25 units. Compute the utilisation of the machines as per the revised capacity calculations.

Capacity Planning under uncertainty Use of waiting line models

- Often demand placed on resources is uncertain making capacity requirement estimation difficult
- In such cases, waiting line models
  - make use of queueing theory fundamentals
  - to analyse the impact of alternative capacity choices
  - on important operational measures such as queue length, waiting time and utilisation of resources
- In service systems, waiting time is an important operational measure that determines the service quality
  - Computerised passenger reservation facility of Indian Railways
  - Banking system or BSNL's bill payment counters

Components of Queuing Systems



19.4 CAPACITY PLANNING FOR A MULTIPLE STAGE SYSTEM

The four-stage model of the strategic role of operations

Stage 1 Internally Neutral The operations function is internally focused and reactive. They are viewed as a 'necessary evil'. The best that the organization hopes for is that operations 'don't screw up'.

Stage 2 Externally Neutral The operations function tries to be as good as the competition, or to achieve parity with industry norms. Such an organization is likely to benchmark its operations against its competitors, and adopt best practice in its industry so that it does not hold the organization back.

Stage 3 Internally Supportive The operations function seeks to provide credible support for the organization's business strategy. An operations strategy will be developed which will be derived from, and support, the business strategy. The organization's operations are likely to be amongst the best in its industry.

Stage 4 Externally Supportive The operations function provides the basis of competitive advantage for the organization, by setting the standard in their industry. The operations function is likely to aim to be world class by seeking to emulate best practice wherever it is to be found. Operations will be seen as the means of exceeding customer expectations

by delighting the customer. Operations will be managed proactively to drive the business strategy of the organization.

A stage 1 organization finds it impossible to manage its operations strategically, as its operations performance objectives are continually changing between low cost, increased flexibility, improved quality, etc. Because operations managers never have the time to focus on a consistent set of objectives, a stage 1 organization is characterized by a reactive approach to operations management. In such an organization, operations can never provide a source of competitive advantage.

A stage 2 organization manages its operations by seeking to emulate those of its competitors. It is likely to copy the prevailing best practices of its industry, such as JIT (just-in-time), TQM (total quality management), BPO (business process outsourcing) etc. However, as they always adopt these techniques in the wake of industry leaders, they are never likely to have developed the same level of expertise in their application. The best that such an approach can achieve is to match the operations performance of its competitors. Although the combination of operations practices adopted by a stage 2 organization may be considered by some as amounting to an operations strategy in that they are consistent, they will not be overtly linked to business strategy. Indeed, it may be that such an operations strategy is inappropriate for the organization's business strategy. In any event, a stage 2 organization's operations can not provide the basis for competitive advantage.

A stage 3 organization has an operations strategy that is linked to and derived from its business strategy. This means that its operations performance objectives are aligned with, and supportive of, its business objectives, offering the possibility that operations can provide the means of achieving a competitive advantage. The chances of achieving competitive advantage will be considerably increased if the organization has adopted industry best practice in its operations.

A stage 4 organization is radically different to one at any of the other stages. A stage 4 organization uses its operations excellence as the basis for its business strategy – an operations-based strategy. The operations of a stage 4 organization are at the forefront of developments in best practice in that they set industry standards in ways that delight customers. Thus, the organization's operations enable it to retain its existing customers and attract new ones. For an operations-based competitive advantage to be sustainable, the organization must continually develop its operations, as any source of advantage is liable to be imitated by competitors. To remain at stage 4, an organization needs to learn how to make the most of its existing resources and competences to learn how to develop new capabilities. Recent advances in the understanding of organizational performance have emphasized the importance of path dependency

(i.e. how organizations got to their present position), the dynamic nature of the capabilities on which organizational success ultimately depends and the role of organizational learning. (See for example Teece and Pisano, 1994; Cohen and Levinthal, 1990.)

Single-Channel Structures

Single-server, single-stage

Waiting line Server

Single-server, multiple stages

Waiting line Servers

PROBLEM

- The teller facility of a bank has a one-man operation at present. Customers arrive at the bank at the rate of one every 4 minutes to use the teller facility. The service time varies randomly across customers on account of some parameters. However, based on the observations in the past, it has been found that the teller takes on an average 3 minutes to serve an arriving customer. The arrivals follow Poisson distribution and the service times follow exponential distribution.
  - What is the probability that there are at most three customers in front of the teller counter?
  - Assess the various operational performance measures for the teller facility.
  - Of late the bank officials notice that the arrival rate has increased to one every three and a half minutes. What is the impact of this change in the arrival rate? Do you have any observation to make?

Solution to Problem

- Arrival rate at the bank: = 15 per hour
- Service rate at the teller: = 20 per hour
- Utilisation of teller facility: $\rho = \frac{\lambda}{\mu} = \frac{15}{20} = 0.75$
- Probability of at most three customers in the system = $\sum_{n=0}^{n=3} P_n$
- Using equation, we compute P_n for values of n = 0 to 3

  P0 = (1-) = 0.25; P1 = 0.25*0.751 = 0.1875;

  P2 = 0.25*0.752 = 0.1406; P3 = 0.25*0.753 = 0.1055.
- Probability of at most 3 customers =

  0.25 + 0.1875 + 0.1406 + 0.1055 **= 0.6836**

Operational Performance Measures

Avg. No. of customers in the waiting line: $L_q = \frac{\lambda^2}{\mu(\mu-\lambda)}$

Avg. No. of customers in the system: $L_s = L_q + \frac{\lambda}{\mu}$

Avg. time a customer spends waiting in line: $W_q = \frac{L_q}{\lambda}$

Avg. time a customer spends in the system: $W_s = \frac{L_s}{\lambda}$

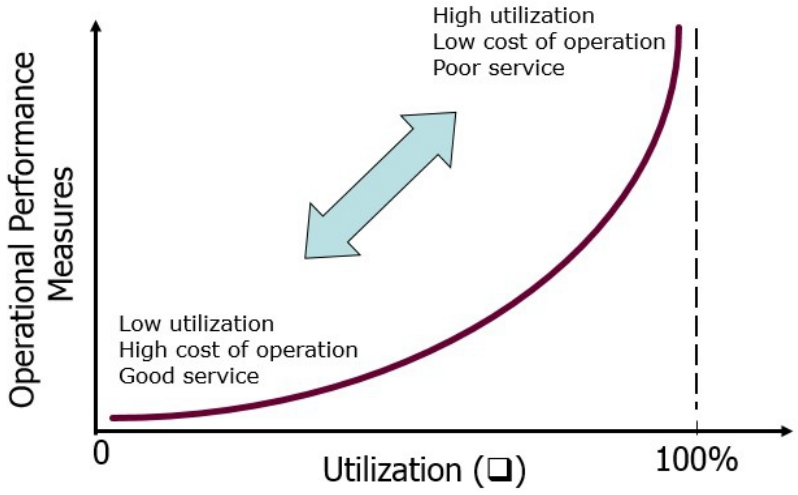
Avg. No. of customers in the waiting line: $L_q = \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{15^2}{20(20-15)} = 2.25$

Avg. No. of customers in the system: $L_s = L_q + \frac{\lambda}{\mu} = 2.25 + \frac{15}{20} = 3.00$

Avg. time a customer spends waiting in line: $W_q = \frac{L_q}{\lambda} = \frac{2.25}{15} = 0.15\,Hr = 9\text{ min}$

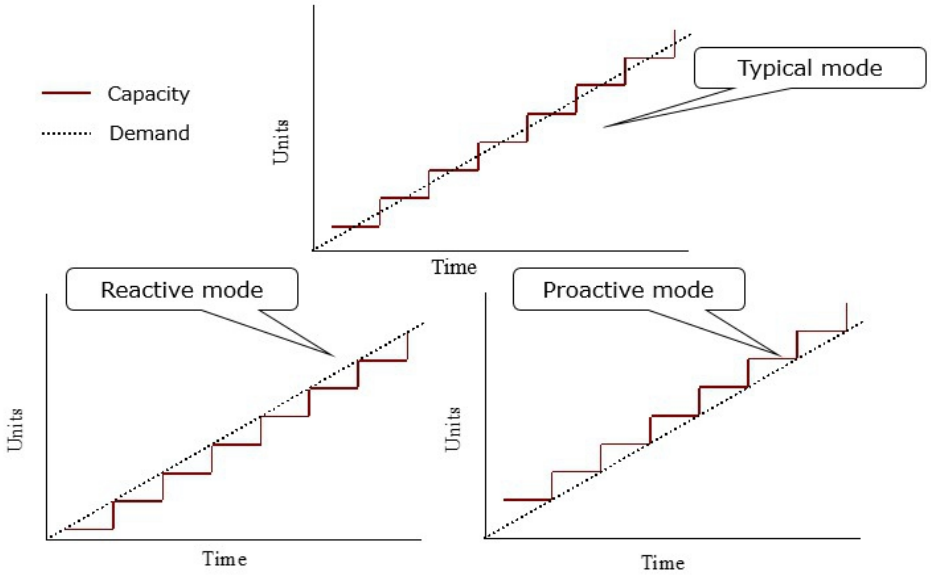
Avg. time a customer spends in the system: $W_s = \frac{L_s}{\lambda} = \frac{3.00}{15} = 0.20\,Hr = 12\text{ min}$

Capacity Design issue **Flexibility/Utilization Trade-off**



19.5 EVALUATION OF ALTERNATIVE PLANT SIZE

Capacity build up (Alternative modes)



Evaluating Alternatives

- Cost-volume analysis: Break-even point
    - One product is involved
    - Everything produced can be sold
    - Variable cost per unit is the same regardless of volume
    - Fixed costs do not change with volume
    - Revenue per unit constant with volume
    - Revenue per unit exceeds variable cost per unit

- Financial analysis
    - Cash Flow - the difference between cash received from sales and other sources, and cash outflow for labor, material, overhead, and taxes.
    - Present Value - the sum, in current value, of all future cash flows of an investment proposal.

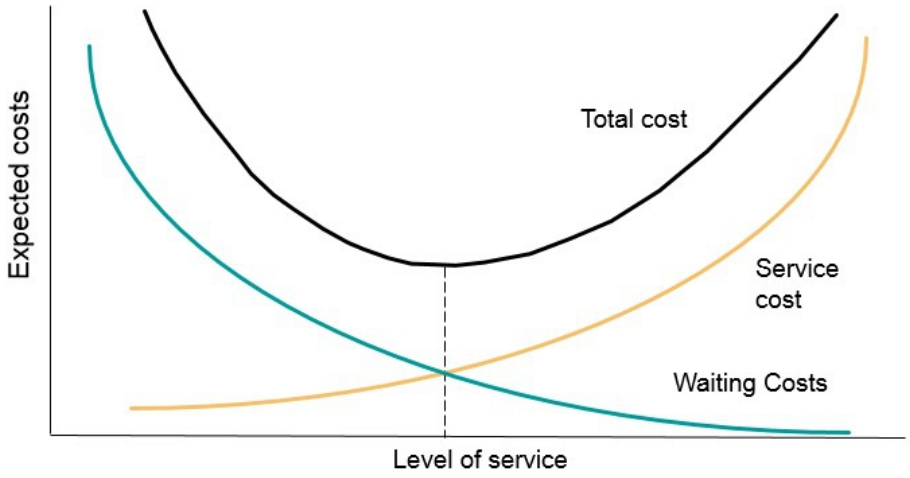
- Decision theory
    - Helpful tool for financial comparison of alternatives under conditions of risk or uncertainty
    - Suited to capacity decisions

- Waiting-line analysis
    - Useful for designing or modifying service systems
    - Waiting-lines occur across a wide variety of service systems
    - Waiting-lines are caused by bottlenecks in the process
    - Helps managers plan capacity level that will be cost-effective by balancing the cost of having customers wait in line with the cost of additional capacity

- Strategy Driven Investment
    - Select investments as part of a coordinated strategic plan
    - Choose investments yielding competitive advantage
    - Consider product life cycles
    - Include a variety of operating factors in the financial return analysis
    - Test investments in light of several revenue projections

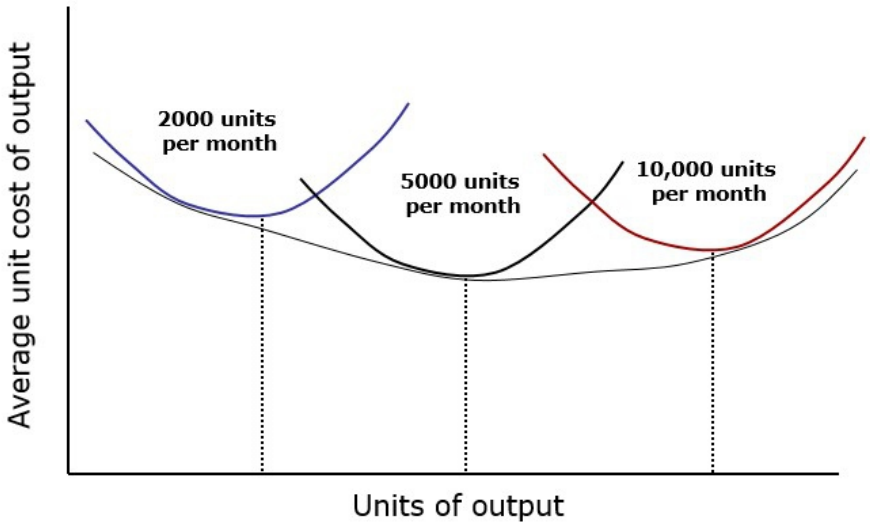
19.6 Traditional Economic Requirements for a Single Production Stage

Cost Relationship in Queuing



- Capacity denotes in general the extent of availability of these resources for use by various processes
- It also denotes the maximum output of products and services one can achieve using these resources
- Capacity planning is a systematic approach to
  - Estimate the amount of capacity required,
  - Evaluation of alternative methods of augmenting capacity
  - Devise methods to use capacity effectively
- Capacity planning is important
  - It has a significant impact on the cost of operation of the system due to large fixed costs associated with capacity
- Economies of scale is an concept in economics related to capacity

Economies of Scale An illustration



19.7 DETERMINATION OF THE STAGE EFFICIENCY STAGE

- Facilities
- Product and Service Factors
- Process Factors
- Human Factors
- Policy Factors
- Operational Factors
- Supply Chain Factors
- External Factors

Strategy in a business organization is essentially about how the organization seeks to survive and prosper within its environment over the long-term. The decisions and actions taken within its operations have a direct impact on the basis on which an organization is able to do this. The way in which an organization secures, deploys and utilizes its resources will determine the extent to which it can successfully pursue specific performance objectives.

Slack et al. (2004) argue that there are five operations performance objectives:

1 Cost: The ability to produce at low cost.

2 Quality: The ability to produce in accordance with specification and without error.

3 Speed: The ability to do things quickly in response to customer demands and thereby offer short lead times between when a customer orders a product or service and when they receive it.

4 Dependability: The ability to deliver products and services in accordance with promises made to customers (e.g. in a quotation or other published information).

5 Flexibility: The ability to change operations. Flexibility can comprise up to four aspects:

i. The ability to change the volume of production.

ii. The ability to change the time taken to produce.

iii. The ability to change the mix of different products or services produced.

iv. The ability to innovate and introduce new products and services.

19.8 Summary

Management of capacity basically involves capacity planning, balance between various issues against economic advantages and disadvantages and its proper utilization, before discussing the planning and management of capacity let understand the process of measurement of capacity. Capacity planning is classified in long term, medium term and short term planning. It is planned with well-defined objectives in step wise step processing. There are several determination of capacity requirement: Facilities, Product and Service Factors, Process Factors, Human Factors, Policy Factors, Operational Factors, Supply Chain Factors, External Factors. Capacity decisions are very important in organizations. Capacity planning may be planned in single stage and multi stage format. Stages may be applied on single-server or on multi-server.

UNIT-20
FACILITY PLANNING

20.0 What Is Facility Planning?

20.1 Need for Facility Planning,

20.2 Facility Planning Objectives,

20.3 Types of Layouts,

20.3.1 Product on Live Layout,

20.3.2 Fixed Position Layout,

20.3.3 Combination Layout, Combination Approach for Developing Process Layout.

20.4 Summary

20.0 WHAT IS FACILITY PLANNING?

Facility layout decisions are based on criteria aimed at creating an effective and efficient workflow and high standard production. Facilities is defined as the workspace and equipment needed to carry out the operations of the organization. This includes offices, factories, computers, and trucks. The location, design, and layout of an organizations' Facility Planning is aka: Master Planning and Facility Design.

There are 5 Phases of Facility Planning

1. Site Selection

- New Construction
- Existing Building Retrofit
- Existing Laundry Renovation/Expansion

2. Preliminary Design

- Project Kick-off
- Define Facility Requirements
- As-built Drawings
- Alternative Preliminary Designs
- Project Cost Estimate

3. Final Design

- Work Out the Details
- Final Design Review / Approval
- Freeze the Design

4. Project Bid

- Building Construction / Modifications
- Process Utility Installation
- Equipment Purchase / Installation
- Design/Build contractor
- Process Utilities – Local vs. Laundry
- Details, Details, Details! The more details the better the price.
- Best Value vs. Lowest Price

5. Project Management

- Building Construction

- Equipment Installation
- Equipment Commissioning
- Project Follow-up

20.1 Need for Facility Planning

There are many factors that can determine where an organization will locate its facilities. For any given situation, some factors become more important than others in how facility location affects an organization's efficiency and effectiveness. There are several reasons why Facility planning is needed is as below:

1. **Proximity to sources of supply:** Firms that process bulk raw materials usually locate close to the source of supply to reduce transportation costs. Paper mills locate close to forests, canneries are built close to farming areas, and fish processing plants are located close to the labours where the fishing vessels dock.
2. **Proximity to customers:** There are several reasons why an organization would locate close to end customers. Service firms need to be close to customers to be convenient, as is the case for grocery stores, gas stations, fast food restaurants, and hospitals. Transportation costs can also require proximity to customers, as in the case of concrete manufacturing. Perishable products often require that they be produced close to the final market, as is the case for bakeries and fresh flowers.
3. **Community factors:** Communities may offer a number of incentives to entice companies, including waiving or reducing taxes, and providing access roads, water and sewer connections, and utilities. Community attitudes can also play a role in an organization's location decision. Some communities may actively discourage companies that might bring more pollution, noise, and traffic to the area. Some communities may not want a prison to be located in their community. Other communities may welcome such firms because of the jobs, tax revenues, and economic diversity they promise.
4. **Labour factors:** Research shows that the majority of location decisions are largely based on labor factors, since labour is a critical variable for many firms. Labour factors include the prevailing wage rate in a community for similar jobs, the supply of qualified workers, and the average education level of the local population (percentage of high school graduates, etc.). Other labour factors can include the degree of union organizing and the general work ethic of a community, as well as other measures of absenteeism, and worker longevity in a job can play a strong role when a firm makes a location decision.
5. **Other factors:** Many other factors can play a role in the location decision, including quality of life (crime rates, good schools, climate, and recreation options), access to major transportation arteries, construction costs, proximity of the competition, and opportunities for future expansion.

As mentioned earlier, the importance of any location factor can vary greatly, depending on the circumstances of the decision.

20.2 FACILITY PLANNING OBJECTIVES

Facilities are central to maximizing the efficiency of the overall operations system. Its objectives is to:

Maximize

- Plant efficiency/output
- Production flexibility
- Quality

Minimize

- Production costs
- Work in process (WIP)
- Project costs

LAYOUT

Plant layout refers to the physical arrangement of production facilities. It is the configuration of departments, work canters and equipment in the conversion process. It is a floor plan of the physical facilities, which are used in production.

According to Moore "*Plant layout is a plan of an optimum arrangement of facilities including personnel, operating equipment, storage space, material handling equipment and all other supporting services along with the design of best structure to contain all these facilities*".

Objectives of Plant Layout

The primary goal of the plant layout is to maximize the profit by arrangement of all the plant facilities to the best advantage of total manufacturing of the product. The objectives of plant layout are:

1. Streamline the flow of materials through the plant.
2. Facilitate the manufacturing process.
3. Maintain high turnover of in-process inventory.
4. Minimize materials handling and cost.
5. Effective utilization of men, equipment and space.
6. Make effective utilization of cubic space.
7. Flexibility of manufacturing operations and arrangements.

8. Provide for employee convenience, safety and comfort.
9. Minimize investment in equipment.
10. Minimize overall production time.
11. Maintain flexibility of arrangement and operation.
12. Facilitate the organizational structure.

Principles of Plant Layout

1. **Principle of integration:** A good layout is one that integrates men, materials, machines and supporting services and others in order to get the optimum utilization of resources and maximum effectiveness.
2. **Principle of minimum distance:** This principle is concerned with the minimum travel (or movement) of man and materials. The facilities should be arranged such that, the total distance travelled by the men and materials should be minimum and as far as possible straight line movement should be preferred.
3. **Principle of cubic space utilization:** The good layout is one that utilize both horizontal and vertical space. It is not only enough if only the floor space is utilized optimally but the third dimension, i.e., the height is also to be utilized effectively.
4. **Principle of flow:** A good layout is one that makes the materials to move in forward direction towards the completion stage, i.e., there should not be any backtracking.
5. **Principle of maximum flexibility**: The good layout is one that can be altered without much cost and time, i.e., future requirements should be taken into account while designing the present layout.
6. **Principle of safety, security and satisfaction: A** good layout is one that gives due consideration to workers safety and satisfaction and safeguards the plant and machinery against fire, theft, etc.
7. **Principle of minimum handling:** A good layout is one that reduces the material handling to the minimum.

20.4 TYPES OF LAYOUTS

Layouts can be classified into the following five categories:

1. Process layout
2. Product layout
3. Combination layout

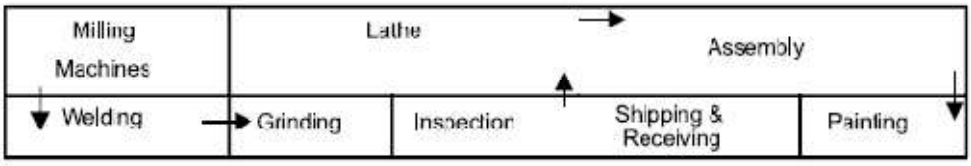
4. Fixed position layout

5. Group layout

Process Layout

Process layout is recommended for batch production. All machines performing similar type of operations are grouped at one location in the process layout *e.g.,* all lathes, milling machines, etc. are grouped in the shop will be clustered in like groups.

Thus, in process layout the arrangement of facilities are grouped together according to their functions. A typical process layout is shown in Fig. The flow paths of material through the facilities from one functional area to another vary from product to product. Usually the paths are long and there will be possibility of backtracking. Process layout is normally used when the production volume is not sufficient to justify a product layout. Typically, job shops employ process layouts due to the variety of products manufactured and their low production volumes.



Advantages

1. In process layout machines are better utilized and fewer machines are required.
2. Flexibility of equipment and personnel is possible in process layout.
3. Lower investment on account of comparatively less number of machines and lower cost of general purpose machines.
4. Higher utilization of production facilities.
5. A high degree of flexibility with regards to work distribution to machineries and workers.
6. The diversity of tasks and variety of job makes the job challenging and interesting.
7. Supervisors will become highly knowledgeable about the functions under their department.

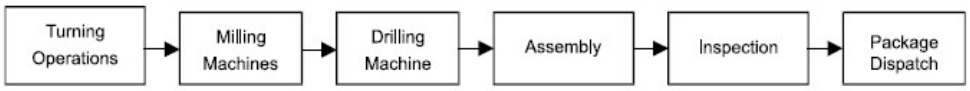
Limitations

1. Backtracking and long movements may occur in the handling of materials thus, reducing material handling efficiency.
2. Material handling cannot be mechanized which adds to cost.
3. Process time is prolonged which reduce the inventory turnover and increases the in process inventory.
4. Lowered productivity due to number of set-ups.
5. Throughput (time gap between in and out in the process) time is longer.

6. Space and capital are tied up by work-in-process.

20.3.1 PRODUCT LAYOUT

In this type of layout, machines and auxiliary services are located according to the processing sequence of the product. If the volume of production of one or more products is large, the facilities can be arranged to achieve efficient flow of materials and lower cost per unit. Special purpose machines are used which perform the required function quickly and reliably. The product layout is selected when the volume of production of a product is high such that a separate production line to manufacture it can be justified. In a strict product layout, machines are not shared by different products. Therefore, the production volume must be sufficient to achieve satisfactory utilization of the equipment. A typical product layout is shown in Fig.



Advantages

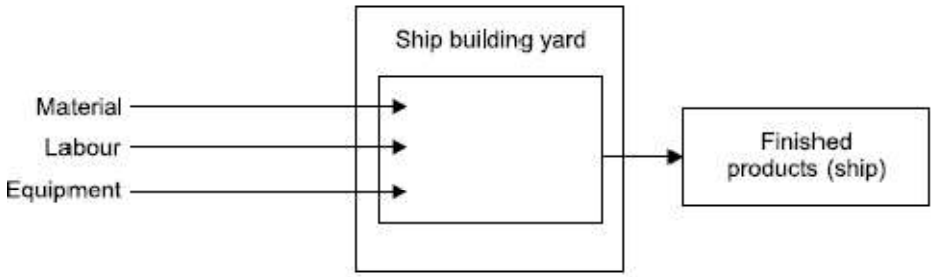
1. The flow of product will be smooth and logical in flow lines.
2. In-process inventory is less.
3. Throughput time is less.
4. Minimum material handling cost.
5. Simplified production, planning and control systems are possible.
6. Less space is occupied by work transit and for temporary storage.
7. Reduced material handling cost due to mechanised handling systems and straight flow.
8. Perfect line balancing which eliminates bottlenecks and idle capacity.
9. Manufacturing cycle is short due to uninterrupted flow of materials.
10. Small amount of work-in-process inventory.
11. Unskilled workers can learn and manage the production.

Limitations

1. A **breakdown** of one machine in a product line may cause stoppages of machines in the downstream of the line.
2. A change in product design may require **major alterations** in the layout.
3. The **line output is decided** by the bottleneck machine.
4. Comparatively **high investment** in equipment is required.
5. **Lack of flexibility.** A change in product may require the facility modification.

20.3.2 FIXED POSITION LAYOUT

This is also called the **project type** of layout. In this type of layout, the material, or major components remain in a fixed location and tools, machinery, men and other materials are brought to this location. This type of layout is suitable when one or a few pieces of identical heavy products are to be manufactured and when the assembly consists of large number of heavy parts, the cost of transportation of these parts is very high.



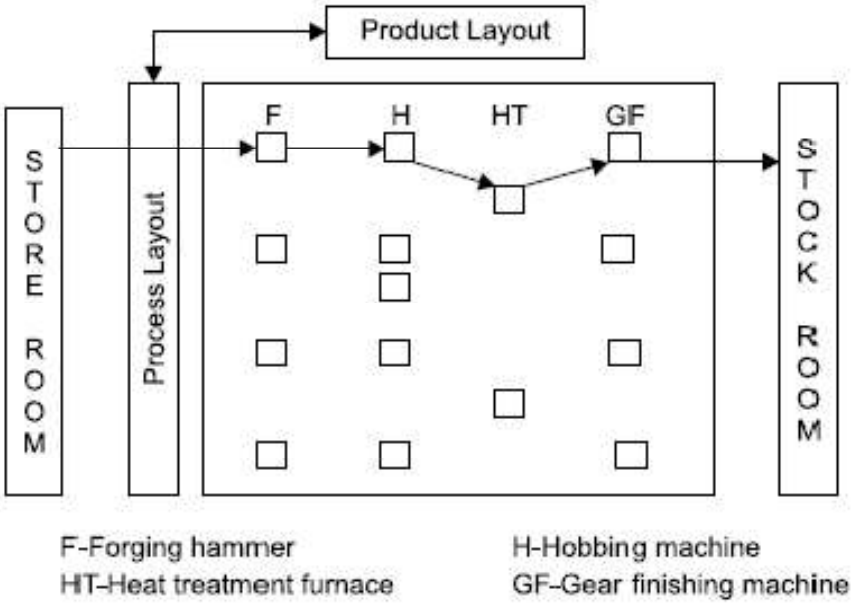
Advantages

The major advantages of this type of layout are:

1. Helps in job enlargement and upgrades the skills of the operators.
2. The workers identify themselves with a product in which they take interest and pride in doing the job.
3. Greater flexibility with this type of layout.
4. Layout capital investment is lower.

20.3.3 Combination Layout

A combination of process and product layouts combines the advantages of both types of layouts. A combination layout is possible where an item is being made in different types and sizes. Here machinery is arranged in a process layout but the process grouping is then arranged in a sequence to manufacture various types and sizes of products. It is to be noted that the sequence of operations remains same with the variety of products and sizes. Figure shows a combination type of layout for manufacturing different sized gears.



Group Layout (or Cellular Layout)

There is a trend now to bring an element of flexibility into manufacturing system as regards to variation in batch sizes and sequence of operations. A grouping of equipment for performing a sequence of operations on family of similar components or products has become all the important.

Group technology (GT) is the analysis and comparisons of items to group them into families with similar characteristics. GT can be used to develop a hybrid between pure process layout and pure flow line (product) layout. This technique is very useful for companies that produce variety of parts in small batches to enable them to take advantage and economics of flow line layout.

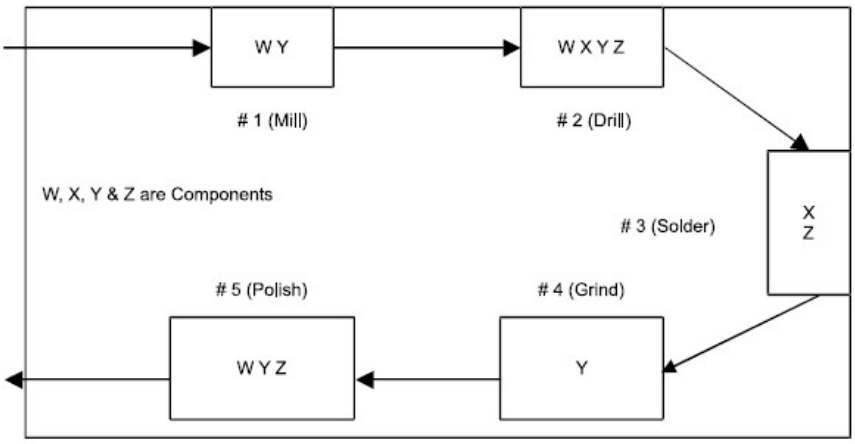
The application of group technology involves two basic steps; first step is to determine component families or groups. The second step in applying group technology is to arrange the plants equipment used to process a particular family of components. This represents small plants within the plants. The group technology reduces production planning time for jobs. It reduces the set-up time.

Thus **group layout** is a combination of the product layout and process layout. It combines the advantages of both layout systems. If there are *m*-machines and *n*-components, in a group layout (Group-Technology Layout), the *m*-machines and *n*-components will be divided into distinct number of machine-component cells (group) such that all the components assigned to a cell are almost processed within that cell itself. Here, the objective is to minimize the intercell movements.

The basic aim of a group technology layout is to identify families of components that require similar of satisfying all the requirements of the machines are grouped into cells. Each cell is capable of satisfying all the requirements of the component family assigned to it.

The layout design process considers mostly a single objective while designing layouts. In process layout, the objective is to minimize the total cost of materials handling. Because of the nature of the layout, the cost of equipments will be the minimum in this type of layout. In product layout, the cost of materials handling will be at the absolute minimum. But the cost of equipments would not be at the minimum if the equipments are not fully utilized.

In-group technology layout, the objective is to minimize the sum of the cost of transportation and the cost of equipments. So, this is called as multi-objective layout. A typical process layout is shown in Fig.



Advantages of Group Technology Layout

Group Technology layout can increase—

1. Component standardization and rationalization.
2. Reliability of estimates.
3. Effective machine operation and productivity.
4. Customer service.

20.4 Summary

Facilities is defined as the workspace and equipment needed to carry out the operations of the organization. There are 5 Phases of Facility Planning: Site Selection, Preliminary Design, Final Design, Project Bid and Project Management. There is huge requirement of facility planning. Facilities are central to maximizing the efficiency of the overall operations system. Plant layout refers to the physical arrangement of production facilities. Layouts can be classified into the following five categories: Process layout, Product layout, Combination layout, fixed position layout and Group layout.

UNIT-21
AGGREGATE PRODUCTION PLANNING

21.0 INTRODUCTION

Production planning and Control is the organization and planning of the manufacturing processes, it coordinates supply and movements of materials and labour; ensures economic and balanced utilization of machines and equipments as well as other activities related with production to achieve the desired manufacturing results in terms of quantity, quality, time and place. Production planning implies formulation, coordination and determination of activities in a manufacturing system necessary for the accomplishment of desired objectives whereas production control is the process of maintaining a balance between various activities evolved during production planning providing most effective and efficient utilization of resources.

Objectives of production planning and control;

- *Determining the nature and magnitude of various inputs factors to manufacture the desired output*
- *To coordinate labour , machines and equipment in the most effective and economic manner,*
- *Establishing targets and checking these against performance.*
- *Ensuring smooth flow of material by eliminating bottlenecks, if any, in production.*
- *Utilization of under employed resources.*
- *To manufacture the desired output of right quality and quantity at right time.*

21.1 LINKAGE BETWEEN LONG TERM AND SHORT TERM PLANNING

Marketing relies on short-term and long-term planning to ensure that company resources are effectively aligned to drive consumer demand at a profit. A short-term plan, sometimes called an operational or tactical marketing plan, is a detailed picture of planned activities, usually over the next 12-month period. Long-term plans, or strategic marketing plans, give the "big picture" of longer-term goals for growth opportunities over five- to 10-year timelines.

Marketing plans are directly related to and evolve out of corporate or company strategic plans. Corporate strategic plans establish broad company goals that are usually expressed in quantifiable terms, such as "to increase operating profit by 5 percent annually over the next five years." These plans look to the future in terms of desired outcomes based on company-wide audits of strengths and weaknesses. In effect, company strategic plans state "where we want to be." In contrast, both tactical and strategic marketing plans are statements of "how to get there." They start with a company's current position and define the pathways to meet the desired outcomes established in the company strategic plan.

Short-Term Plans

Tactical marketing plans are detailed accounts of how the marketing mix — product, distribution, price and promotions — will be managed over the defined period of time, which most commonly is a year, but could be a quarter or even a month, in some cases. If a price increase is required to compensate for increased production costs, the timing of the price increase along with marketing initiatives to mitigate anticipated trade and consumer pushback against the price increase are included in the marketing plan. In effect, tactical plans are "calendars of events" that detail marketing activities on a monthly basis over the next 12 months. They also include supporting monthly sales forecasts and marketing budgets.

Long-Term Plans

Strategic marketing plans establish longer-term marketing strategies against a backdrop of uncertainties relating to future economic, consumer, industry and competitive trends. Many industries need strategic marketing plans because of prolonged lead-times to develop and introduce new products. Such is the case for new product development in the pharmaceutical and defense industries, where products can be in development up to 10 years before market introduction. All companies can benefit from strategic marketing planning because marketing is about creating the future. You need a vision to create the future. Long-term planning opens the window, the vision, into the future.

Integrating Short-Term and Long-Term Planning

Many experienced marketers believe that both tactical and strategic planning responsibilities belong to the marketing department, rather than leaving marketing strategy to corporate

strategists. For instance, Michael Baker, Marketing Professor Emeritus at the University of Strathclyde in Scotland and editor of "The Marketing Book," expressed fear that marketing manager's risk losing the ability to think strategically when removed from the strategic planning process. This can produce narrow-minded, disconnected tactical plans, because they fail to incorporate long-term initiatives that safeguard the future. Short and long-term marketing plans are essential roadmaps that guide the future prosperity of your SMALL BUSINESS. If you are unfamiliar with marketing planning, tap into an abundance of free resources. Visit the Small Business Administration website, or the SCORE website, formerly Service Corp of Retired Executives, for more information on marketing plans.

21.2 AGGREGATE PLANNING

Managing companies for success across a range of time frames - a requisite for achieving both performance and health - is one of the toughest challenges in business. The fact that 10 of the largest 15 bankruptcies in history have occurred since 2001 is playing up its inherent risks. Managements need to build confidence in their ability to realize longer-term strategies and good short-term results. Planning, for any period including aggregate planning, is possible only when management has information available on tap. This is especially true for batch-based manufacturing planning.

Aggregate planning consists of the resource management planning activities that are done after the long-term capacity and capability planning decisions have been made. These planning activities are designed to help the firm achieve its long-term strategic initiatives. The nature of these activities is influenced by the structure of the product delivery systems.

What Is Aggregate Planning?

Firms make the strategic long-term resource commitments that will enable its operations function to achieve its corporate objective. Most of the decisions needed to create these capabilities involve strategic commitments, i.e., where to site and how to site facilities; how to acquire plant and equipment; what type of information systems to be implemented and executed; and how to create an organization with a culture that serves the corporate strategy well.

Aggregate planning is the "big picture" approach to planning for the intermediate term. While strategic planning deals with long range operations of facilities and resources, aggregate planning deals with developing ways to utilize those facilities and resources.

In other words, the aggregate plan links strategic goals and objectives of the organization with the plans for individual products, services and their various components.

Factors Affecting Aggregate Planning

Aggregate planning is an operational activity critical to the organization as it looks to balance long-term strategic planning with short term production success. Following factors are critical before an aggregate planning process can actually start;

- A complete information is required about available production facility and raw materials.
- A solid demand forecast covering the medium-range period
- Financial planning surrounding the production cost which includes raw material, labor, inventory planning, etc.
- Organization policy around labor management, quality management, etc.

For aggregate planning to be a success, following inputs are required;

- An aggregate demand forecast for the relevant period
- Evaluation of all the available means to manage capacity planning like sub-contracting, outsourcing, etc.
- Existing operational status of workforce (number, skill set, etc.), inventory level and production efficiency

21.3 STEPS IN AGGREGATE PLANNING

The process consists of four basic considerations as follows:

- **Concept of Aggregation** starts with a meaningful measure of output. In a single product output organization there is no problem with the output measure. Many organizations have multiple products and it is difficult to find a common factor of measure of output.
  For e.g. steel producer can plan in terms of tons of steel, gallons of paint in case of paint industry. Service organizations such as transport system may use passenger miles as a common measure, health care facilities may use patient visits, and educational institutes may use student to faculty contact ratio in terms of hours as a reasonable measure.
  A group of products or services that have similar demand requirements and common processing, labor and materials requirements is called a Product Family. Therefore a firm can aggregate its products or services into a set of relatively broad families, avoiding too much detail at the planning stage. For example consider the Bicycle manufacture that has aggregated all products into two families: mountain bikes and road bikes. This approach aids production planning for the assembly lines in the plants.

- **Goals for aggregate planning** there are number of goals to be satisfied. It has to provide the overall levels of output, inventory and backlogs dictated by the business plan. Proper utilization of the plant capacity. It should not be under-utilized because it is waste of resources. It is better to operate at a near full capacity. The aggregate plan should be consistent with the company's goals and policies regarding its employees. A firm may like to have employee stability or hire and layoff strategy. Other firms change employees freely as the output level is varied throughout the aggregate planning horizon.

- **Aggregate Demand Forecasts** The benefits of aggregate planning depends on the accurate forecasting. Any suitable forecasting model can be used to forecast demand for product groups as well as individual products.

- **Interrelationships among decisions:** Here the managers must consider the future consequence of current decisions. This is important mainly due to the fact that output plans are developed for a long period of time.

Strategies for Aggregate Planning:

There are three pure strategies that the planner could use for the Aggregate Planning.

Strategy 1. Vary the number of Productive employees in Response to Varying output Requirements (also known as Chase 1 plan). Here, the average productivity per employee is first calculated which determines the number of employees needed to meet the monthly required output demand. The employees are laid off when the output demand falls. As a result there is always Hiring and laying of employees.

Strategy 2. Maintain a Constant Work Force Size but Vary the Utilization of the Work Force (also known as Level # 1).

Suppose, for example, we chose the strategy of employing 70 workers per month throughout the year. On an average, this work force would be capable of producing 700 wagons each day. During the lean months (January, February, March, July, October, November, December), the work force would be scheduled to produce only the amount forecasted, resulting in scheduled to produce only the amount forecasted, resulting in same idle working hours. During high demand months (April, May, June, August, September), overtime operations would be needed to meet demand. The work force would therefore be intensely utilized during some months and underutilized in other months.

Strategy 3. Vary the Size of Inventory in Response to Varying Demand (also known as Chase # 2 plan). Finished goods inventories in make-to-stock companies can be used as a cushion against fluctuating demand. A fixed number of employees, selected to that little or no overtime or idle time is incurred, can be maintained throughout the planning horizon. Producing at a constant rate, output will exceed demand during slack demand periods, and finished goods inventories will accumulate. During peak periods, when demand is greater than capacity, the demand can be supplied from inventory. This planning strategy results in fluctuating inventory levels throughout the planning horizon.

21.5 MANAGERIAL IMPORTANCE OF AGGREGATE PLANNING.

Aggregate planning plays an important part in achieving long-term objectives of the organization. Aggregate planning helps in:

- Achieving financial goals by reducing overall variable cost and improving the bottom line

- Maximum utilization of the available production facility
- Provide customer delight by matching demand and reducing wait time for customers
- Reduce INVESTMENT in inventory stocking
- Able to meet scheduling goals there by creating a happy and satisfied work force
- Laying off/hiring excess/inadequate excess/inadequate excess/inadequate workforce until demand decrease/increase.
- Including overtime as part of scheduling there by creating additional capacity.
- Hiring a temporary workforce for a fix period or outsourcing activity to a sub-contractor.

21.6 Summary

Production planning implies formulation, coordination and determination of activities in a manufacturing system necessary for the accomplishment of desired objectives whereas production control is the process of maintaining a balance between various activities evolved during production planning providing most effective and efficient utilization of resources. Marketing plans are directly related to and evolve out of corporate or company strategic plans. Plans may be short term or long term. Aggregate planning activities are designed to help the firm achieve its long-term strategic initiatives. Aggregate planning process consists of four basic considerations: Concept of Aggregation, Goals for aggregate planning, Aggregate Demand Forecasts, Interrelationships among decisions. There are three pure strategies that the planner could use for the Aggregate Planning. There is very much managerial planning.

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