

## Cost Analysis

- ❖ An engineering design is not complete until we have a good idea of the cost required to build the design or manufacture the product.
- ❖ Generally, among functionally equivalent alternatives, the lowest-cost design will be successful in a free marketplace.
- ❖ The fact that we have placed this chapter on cost evaluation toward the end of the text does not reflect the importance of the subject.
- ❖ Understanding the elements that make up cost is vital because competition between companies and between nations is fiercer than ever.
- ❖ The world is becoming a single gigantic marketplace in which newly developing countries with very low labour costs are acquiring technology and competing successfully with the well-established industrialized nations.
- ❖ Maintaining markets requires a detailed knowledge of costs and an understanding of how new technology can lower costs.

Cost estimates are used in the following ways:

1. To provide information to establish the selling price of a product or a quotation for a good or service.
2. To determine the most economical method, process, or material for manufacturing a product.
3. To become a basis for a cost-reduction program.
4. To determine standards of production performance that may be used to control costs.
5. To provide input concerning the profitability of a new product

## **Categories of cost:**

- ❖ We can divide all costs into two broad categories: product costs and period costs.
- ❖ Product costs are those costs that vary with each unit of product made.
- ❖ Material cost and labor cost are good examples.
- ❖ Period costs derive their name from the fact that they occur over a period of time regardless of the amount (volume) of product that is made or sold.
- ❖ An example would be the insurance on the factory equipment or the expenses associated with selling the product.
- ❖ Another name for a product cost is variable cost, because the cost varies with the volume of product made.
- ❖ Another name for period cost is fixed cost, because the costs remain the same regardless of the volume of product made.
- ❖ Fixed costs cannot be readily allocated to any particular product or service that is produced.

- ❖ Yet another way of categorizing costs is by direct cost and indirect cost.
- ❖ A direct cost is one that can be directly associated with a particular unit of product that is manufactured.
- ❖ In most cases, a direct cost is also a variable cost, like materials cost.
- ❖ Advertising for a product would be a direct cost when it is assignable to a specific product or product line, but it is not a variable cost because the cost does not vary with the quantity produced.
- ❖ An indirect cost cannot be identified with any particular product.
- ❖ Examples are rent on the factory building, cost of utilities, or wages of the shop floor supervisors.
- ❖ Often the line between direct costs and indirect costs is fuzzy.
- ❖ For example, equipment maintenance would be considered a direct cost if the machines are used exclusively for a single product line, but if many products were manufactured with the equipment, their maintenance would be considered an indirect cost.



- Returning to the cost classifications of fixed and variable costs, examples are:

**Fixed costs:**

1. Indirect plant cost

(a) Investment costs

- Depreciation on capital investment
- Interest on capital investment and inventory
- Property taxes
- Insurance

(b) Overhead costs (burden)

- Technical services (engineering)
- Product design and development
- Nontechnical services (office personnel, security, etc.)
- General supplies
- Rental of equipment

2. Management and administrative expenses

(a) Share of cost of corporate executive staff

(b) Legal staff

(c) Share of corporate research and development staff

(d) Marketing staff

3. Selling expenses

(a) Sales force

(b) Delivery and warehouse costs

(c) Technical service staff

**Variable costs:**

1. Materials

2. Direct labour (including fringe benefits)

3. Direct production supervision

4. Maintenance costs

5. Power and utilities

6. Quality-control staff

7. Royalty payments

8. Packaging and storage costs

9. Scrap losses and spoilage

- Another important cost category is working capital, the funds that must be provided in addition to fixed capital and land investment to get a project started and provide for subsequent obligations as they come due.
- It consists of raw material on hand, semi-finished product in the process of manufacture, finished product in inventory, accounts receivable, and cash needed for day-to-day operation.
- The working capital is tied up during the life of the plant, but it is considered to be fully recoverable at the end of the life of the project.

## **Cost analysis helps to:**

- ❖ To determine actual cost of a product or the process.
- ❖ To compare the actual cost with the estimated cost.
- ❖ To provide the management with actual cost figures so that it can frame practical sales policies and cost structure etc.
- ❖ To ascertain departmental efficiency on the basis of an actual cost it incurs for production.
- ❖ To determine profitability of products.



## **Engineering the Design: From Prototype to Product**

- Conceptual design is often a cognitive process in which a designer formulate his/her ideas through critical thinking process.
- After too many iterative design steps a designer stepped to materialize those ideas.
- On the beginning of embodiment design, designer starts to check the viability of design through prototype testing.
- The final goal of any design will be manufacturing the product and commercially introduce that product in to market.
- Hence the post design work flow starts from the designer to end user through different manufacturing processes, a designer should aware about these post design procedure in order to reduce issues during these process.
- Certain design considerations can reduce cost of post design procedures effectively.

## **Planning**

- Planning (also called forethought) is the process of thinking about and organizing the activities required to achieve a desired goal.
- It involves the creation and maintenance of a plan, such as psychological aspects that require conceptual skills.
- There are even a couple of tests to measure someone's capability of planning well.
- As such planning is a functional property of intelligent behaviour.

## **Planning for Manufacturing:**

- ❖ A great deal of detailed planning must be done to provide for the production of the design.
  - ❖ A method of manufacture must be established for each component in the system.
  - ❖ As a usual first step, a process sheet is created; it contains a sequential list of all manufacturing operations that must be performed on the component.
  - ❖ Also, it specifies the form and condition of the material and the tooling and production machines that will be used.
  - Specifying the production plant that will be used (or designing a new plant) and laying out the production lines
  - Planning the work schedules and inventory controls (production control)
  - Planning the quality assurance system
  - Establishing the standard time and labor costs for each operation
  - Establishing the system of information flow necessary to control the manufacturing operation
- All of these tasks are generally considered to fall within industrial or manufacturing engineering.

## **Planning for Distribution:**

- Important technical and business decisions must be made to provide for the effective distribution to the consumer of the products that have been produced.
- In the strict realm of design, the shipping package may be critical. Concepts such as the shelf life of the product may also be critical and may need to be addressed in the earlier stages of the design process.
- A system of warehouses for distributing the product may have to be designed if none exists.
- The economic success of the design often depends on the skill exercised in marketing the product.
- If it is a consumer product, the sales effort is concentrated on advertising in print and video media, but highly technical products may require that the marketing step be a technical activity supported by specialized sales brochures, performance test data, and technically trained sales engineers.

## **Planning for Use:**

- The use of the product by the consumer is all-important, and considerations of how the consumer will react to the product pervade all steps of the design process.
- The following specific topics can be identified as being important user-oriented concerns in the design process:
  - ease of maintenance
  - durability
  - reliability
  - product safety
  - convenience in use (human factors engineering)
  - aesthetic appeal
  - economy of operation
- Obviously, these consumer-oriented issues must be considered in the design process at its very beginning.
- They are not issues to be treated as afterthoughts.

## **Planning for the Retirement of the product:**

- The final step in the design process is the disposal of the product when it has reached the end of its useful life.
- Useful life may be determined by actual deterioration and wear to the point at which the design can no longer function, or it may be determined by technological obsolescence, in which a competing design performs the product's functions either better or cheaper.
- In consumer products, it may come about through changes in fashion or taste.
- In the past, little attention has been given in the design process to product retirement.
- This is rapidly changing, as people the world over are becoming concerned about environmental issues.
- There is concern with depletion of mineral and energy resources, and with pollution of the air, water, and land as a result of manufacturing and technology advancement.

## **Benefits of planning**

- ✓ Planning reduces uncertainty, risk and confusion in operation
- ✓ Planning guides decision making by managers
- ✓ Planning helps in achieving coordination and control
- ✓ Planning is an element of flexibility makes an organization capable of coping with changing environment challenges
- ✓ Planning leads to economy and efficiency in operations

# Scheduling

- Scheduling is the process of arranging, controlling and optimizing work and workloads in a production process or manufacturing process.
- Scheduling is used to allocate plant and machinery resources, plan human resources, plan production processes and purchase materials.
- It is an important tool for manufacturing and engineering, where it can have a major impact on the productivity of a process.
- In manufacturing, the purpose of scheduling is to minimize the production time and costs, by telling a production facility when to make, with which staff, and on which equipment.
- Production scheduling aims to maximize the efficiency of the operation and reduce costs.



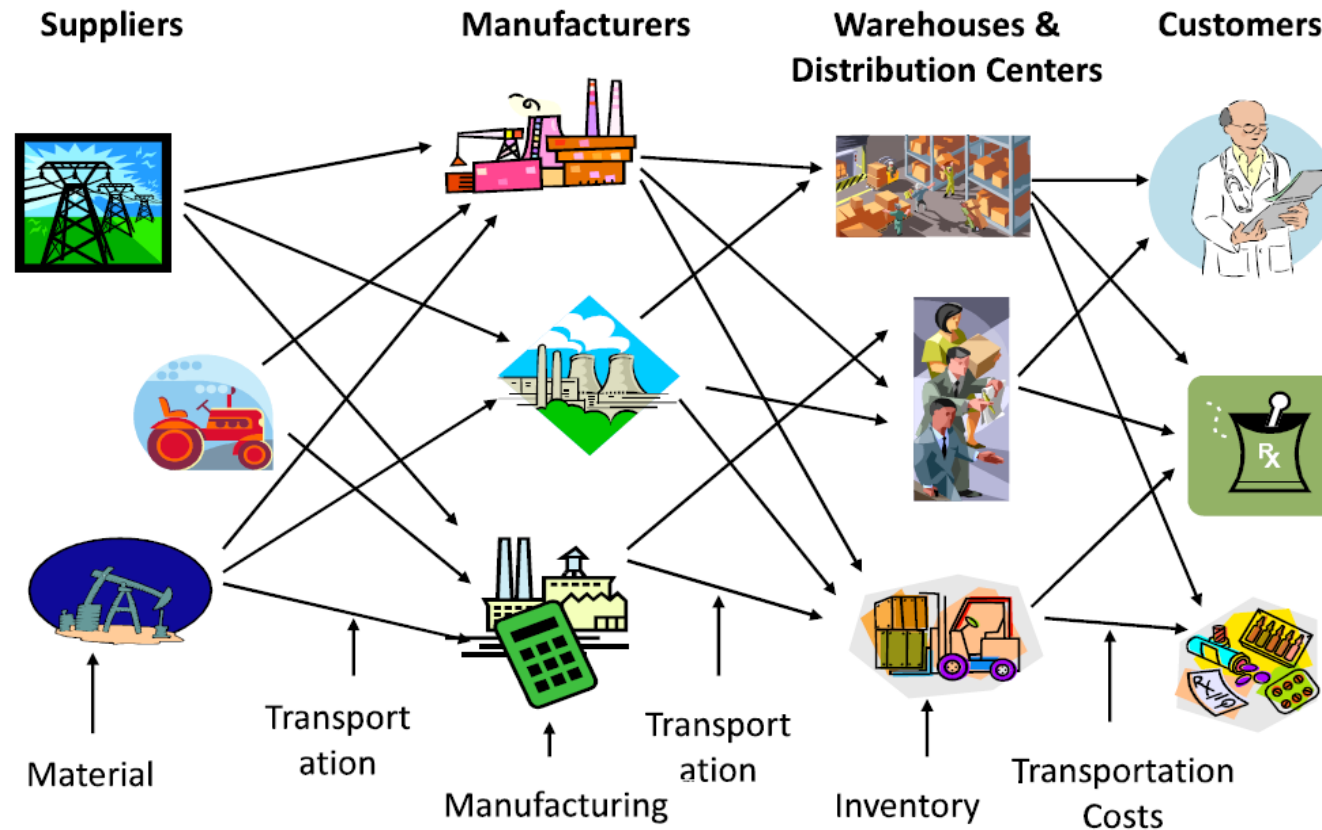
- ✓ The schedule must portray the activities required to support the project plan.
  - ✓ Provides time-scaled network schedules that define when work tasks are to be performed.
  - ✓ Produces reports that provide the Project Manager, the information necessary to monitor schedule status and to initiate corrective action if required.
  - ✓ Provides assistance in implementation of corrective action when required.
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- Before we can do any real scheduling, we have to know what we have to do every single day that takes up time.
  - We already know we have client work that eats up significant chunks of our time, but there are other things we do as well: email, general admin work, answering phone calls, meetings, sending invoices, estimating projects, self-education, etc.
  - We have to come to terms with how much time we spend doing these things on the daily basis and how much time we have left for client work.

- Batch production scheduling is the practice of planning and scheduling of batch manufacturing processes.
- Although scheduling may apply to traditionally continuous processes such as refining, it is especially important for batch processes such as those for pharmaceutical active ingredients, biotechnology processes and many specialty chemical processes.
- Batch production scheduling shares some concepts and techniques with finite capacity scheduling which has been applied to many manufacturing problems.

## **Supply Chain Management**

- ❑ Supply chain management (SCM) is the management of the flow of goods and services.
- ❑ It includes the movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption.
- ❑ Interconnected or interlinked networks, channels and node businesses are involved in the provision of products and services required by end customers in a supply chain.
- ❑ Supply chain management has been defined as the "design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally.

- ❑ Supply chain management is the management of network of interconnected businesses involved in the ultimate provision of goods and services required by the end customer.
- ❑ Supply chain management spans all movement and storage of raw materials, work-in-process inventory and finished goods from point-of-origin to point-of-consumption.



- Organizations increasingly find that they must rely on effective supply chains, or networks, to compete in the global market and networked economy.
- Successful SCM requires a change from managing individual functions to integrating activities into key supply chain processes.
- In an example scenario, a purchasing department places orders as its requirements become known.
- The marketing department, responding to customer demand, communicates with several distributors and retailers as it attempts to determine ways to satisfy this demand.
- Information shared between supply chain partners can only be fully leveraged through process integration.

## **Inventory Management**

- Inventory management is a science primarily about specifying the shape and percentage of stocked goods.
- It is required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials.
- The scope of inventory management concerns the fine lines between replenishment lead time, carrying costs of inventory, asset management, inventory forecasting, inventory valuation, inventory visibility, future inventory price forecasting, physical inventory, available physical space for inventory, quality management, replenishment, returns and defective goods, and demand forecasting.
- Balancing these competing requirements leads to optimal inventory levels, which is an ongoing process as the business needs shift and react to the wider environment.

- Successful inventory management involves creating a purchasing plan that will ensure that items are available when they are needed (but that neither too much nor too little is purchased) and keeping track of existing inventory and its use.
- Two common inventory-management strategies are the just-in-time method, where companies plan to receive items as they are needed rather than maintaining high inventory levels, and materials requirement planning, which schedules material deliveries based on sales forecasts.
- Inventory management involves a retailer seeking to acquire and maintain a proper merchandise assortment while ordering, shipping, handling, and related costs are kept in check.
- It also involves systems and processes that identify inventory requirements, set targets, provide replenishment techniques, report actual and projected inventory status and handle all functions related to the tracking and management of material.
- This would include the monitoring of material moved into and out of stockroom locations and the reconciling of the inventory balances.

## Why Inventory?

- 1. Time:** The time lags present in the supply chain, from supplier to user at every stage, requires that you maintain certain amounts of inventory to use in this lead time. However, in practice, inventory is to be maintained for consumption during 'variations in lead time'. Lead time itself can be addressed by ordering that many days in advance.
- 2. Seasonal Demand:** demands varies periodically, but producer's capacity is fixed. This can lead to stock accumulation, consider for example how goods consumed only in holidays can lead to accumulation of large stocks on the anticipation of future consumption.
- 3. Uncertainty:** Inventories are maintained as buffers to meet uncertainties in demand, supply and movements of goods.
- 4. Economies of scale:** Ideal condition of "one unit at a time at a place where a user needs it, when he needs it" principle tends to incur lots of costs in terms of logistics. So bulk buying, movement and storing brings in economies of scale, thus inventory.
- 5. Appreciation in Value:** In some situations, some stock gains the required value when it is kept for some time to allow it reach the desired standard for consumption, or for production. For example; beer in the brewing industry