CHAPTER SIX

Cost Estimation

Chapter Outline

- Cost accounting
- Classification of cost
- Elements of cost
- Types of estimation
- Methods of estimation
- Data requirement and sources
- Collection cost
- Allowance in estimation
- Costing methods
- Costing of job process and operation (Refer Chapter Three)
- Uniform costing

Cost Accounting

- **Costing and Cost Concepts**
- **Cost accounting** is recently used in every sphere of modern day business.
- Of course it has its origin from the ancient time.
- The farmers and the craftsmen were using the technique to ascertain the cost of their product.
- But its real development has begun during the eighteenth and ninetieth century.
- Cost accounting is accounting for cost.

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- The cost accounting consists of two words: Cost and Accounting.
- **Cost** means the resources sacrificed for the production of a commodity and **accounting** refers to the financial information system.
- **Cost accounting system** can be described as measurement and reporting of resources used in monetary terms.
- **Cost accounting** is the branch of accounting dealing with the classification, recording, allocation, summarization and reporting of current and prospective cost.

Costing and Cost Accounting

- We use costing and cost accounting interchangeably. But they should not be.
- We should know, what are the differences.
- **Costing** refers to the technique and process of ascertaining cost.
- The technique consists of the **principles** and **rules** for the determining the costs of products and services.
- **Cost accounting** on the other hand, is defined as the process of accounting for cost from the point at which expenditure is incurred or committed.
- It is a **specialized branch** of accounting which involves classification, accumulation, allocation, absorption and control of costs.

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- **The concept of cost accounting** is some bit wider than costing and cost accounting.
- It includes several subjects like **costing, cost accounting, cost control, budgetary control,** and **cost audit**.
- Is the **application** of costing and cost accounting principles, methods and techniques to the science, art and practice of cost control.
- It includes the **presentation of information** derived those from for the purpose of managerial decision making.

Functions of Cost Accounting

a. **Cost ascertainment:** it has been the chief function of cost accounting. This purpose is some times referred to as product costing or cost accumulation.

b. **Cost Analysis:** is one of the important function of cost accounting.

c. **Cost control:** To control the cost, is the chief motive of every management. Cost information shows the performance of the organization.

- There are **two types** of cost control **Standard Costing** and **Budgetary Control**.

Objectives Of Cost Accounting

- It helps in ascertaining the **cost of production** of every units, job, operation process, department and service.
- It indicates to management any **inefficiency** and the extent of **various forms of waste**, whether as material, time, expense or in the use of machine, equipment and tools.
- It discloses **profitable** and **unprofitable** activities.
- It provides **actual figures** of cost for comparison with estimates and to assist the management in their price fixing policy.

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- It present **comparative cost data** for different periods and different volumes of production and those by assist the management in budgetary control.
- It records and report to the concerned manager how **actual costs compare with standard cost** and possible causes of differences between them.
- It indicates the **exact cause** of increase or decrease in profit or loss shown by the financial accounts.
- It also provides **data** for comparison cost within the firm and also between similar firms.

Cost Classification

- Proper classification of cost is necessary for the clear understanding of the cost.
- The cost can be classified according to their **common characteristics**.
  - The classification may be:
    1. Behavioral classification
    2. Direct and indirect cost
    3. Product cost and period cost
    4. Relevant and irrelevant cost
    5. Real cost
    6. Opportunity cost

1. Behavioral Classification

- **Fixed, Variable, Marginal, and Average Costs**
- **Fixed costs** are constant or unchanging regardless of the level of output or activity.
- In contrast, **variable costs** depend on the level of output or activity.
- **A marginal cost** is the variable cost for one more unit.
- **Average cost** is the total cost divided by the number of units.

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- **For instance**, in a production environment **fixed costs**, such as those for factory floor space and equipment, remain the same even though production quantity, number of employees, and level of work-in-process may vary.
- **Labor costs** are classified as a variable cost because they depend on the number of employees in the factory.
- Thus **fixed costs** are level or constant regardless of output or activity, and **variable costs** are changing and related to the level of output or activity.

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- **As another example**, many universities charge full-time students a **fixed cost** for 12 to18 hours and a cost per credit hour for each credit hour over 18. Thus for full-time students who are taking an overload (> 18 hours), there is a **variable cost** that depends on the level of activity.
- This example can also be used to distinguish between **marginal** and **average costs**. A **marginal cost** is the cost of **one more unit**. This will depend on how many credit hours the student is taking. If currently enrolled for 12 to 17 hours, adding one more is free. The marginal cost of an additional credit hour is $0. However, if the student is taking 18 or more hours, then the marginal cost equals the **variable cost** of one more hour.

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•To illustrate **average costs**, the **fixed** and **variable costs** need to be specified. Suppose the cost of 12 to 18 hours is $1800 per term and overload credits are $120/ hour. If a student takes 12 hours, the **average cost** is $1800/12 = $150 per credit hour. If the student were to take 18 hours, the average cost decreases to $1800/18 = $100 per credit hour. If the student takes 21 hours, the average cost is $102.86 per credit hour [$1800 + (3 x $120) /21].

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- **Average cost** is thus calculated by dividing the total cost for all units by the total number of units. Decision makers use average cost to attain an overall cost picture of the investment on a **per unit basis**.
- **Marginal cost** is used to decide whether the **additional unit** should be made, purchased, or enrolled in. For the full-time student at our example university, the marginal cost of another credit is $0 or $120 depending on how many credits the student has already signed up for.

Example 1

- An entrepreneur named DK was considering the money-making potential of chartering a bus to take people from his hometown to an event in a larger city. DK planned to provide transportation, tickets to the event, and refreshments on the bus for his customers. He gathered data and categorized the predicted expenses as either fixed or variable.

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DK's Fixed Costs		DK's Variable Costs	
Bus rental	$80	Event ticket	$12.50 per person
Gas expense	75	Refreshments	7.50 per person
Other fuels	20		
Bus driver	50		

- Develop an expression of DK's total fixed and total variable costs for chartering this trip.

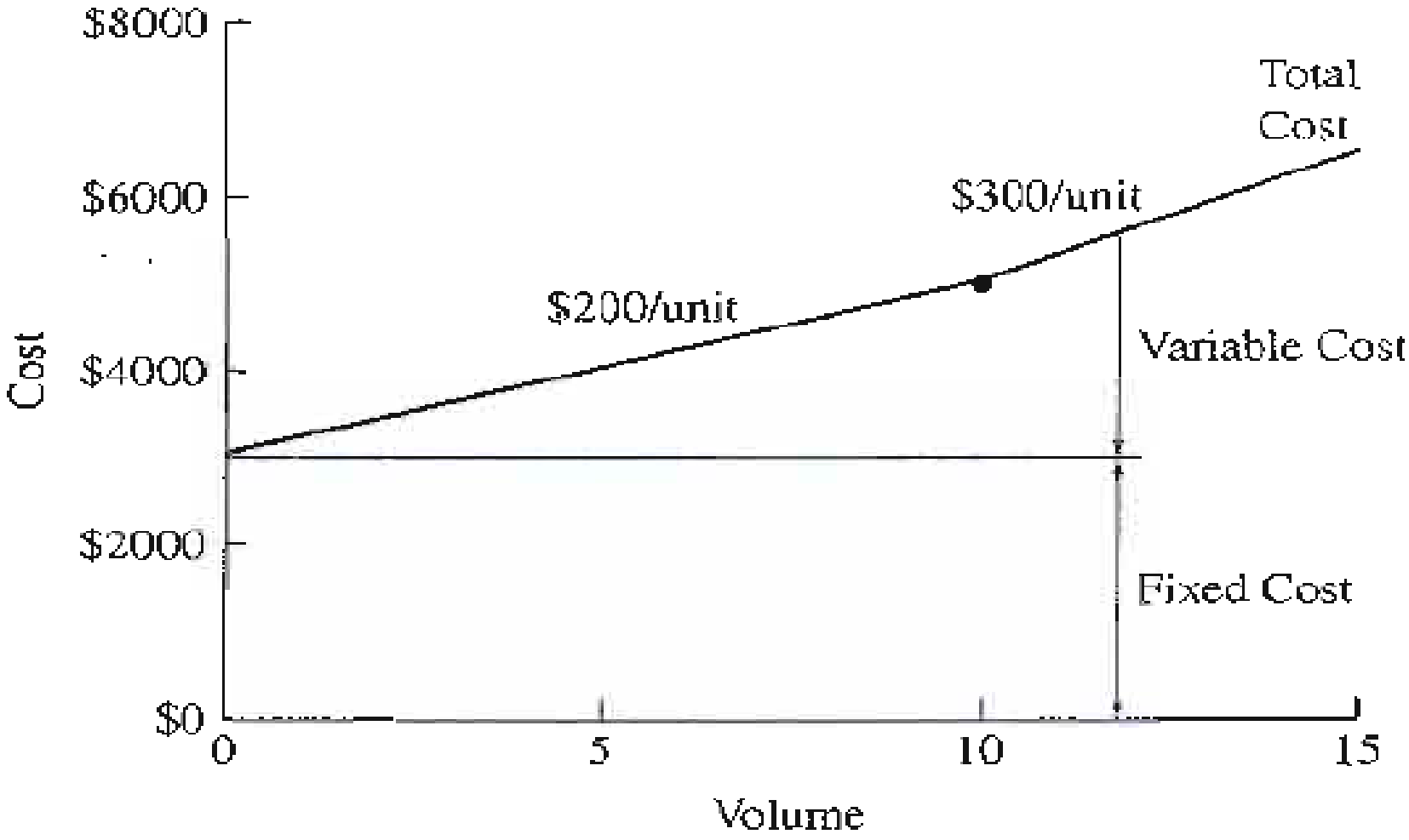
Solution

- DK's fixed costs will be incurred regardless of how many people sign up for the trip (even if only one person signs up!). These costs include bus rental, gas and fuel expense, and the cost to hire a driver:
- **Total fixed costs = 80 + 75 + 20 + 50 = $225**
- DK's variable costs depend on how many people sign up for the charter, which is the level of activity. Thus for event tickets and refreshments, we would write
- **Total variable cost=12.50+7.50=$20 per person**
- **Total cost =Total fixed cost + Total variable cost**

Relationship Between Total, Fixed and Variable Costs

- The relationship between **total cost** and **fixed** and **variable costs** are shown in **Figure 1**.
- The fixed-cost portion of $3000 is the same across the entire range of the output variable x.
- Often, the variable costs are linear (y equals a constant times x); however, the fixed costs can be nonlinear.
- For example, employees are often paid at 150% of their hourly rate for overtime hours, so that production levels requiring overtime have higher variable costs.

Figure 1: Fixed, variable and total costs



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- **Total cost** in Figure 1 is a fixed cost of $3000 plus a variable cost of $200 per unit for straight-time production of up to 10 units and $300 per unit for overtime production of up to 5 more units.
- Figure 1 can also be used to illustrate **marginal** and **average costs**. At a volume of 5 units the marginal cost is $200 per unit, while at a volume of 12units the marginal cost is $300 per unit. The respective average costs are $800 per unit, or (3000 + 200 x 5)/5, and $467 per unit, or (3000 + 200 x 10 + 300 x 2)/12.

Example 2

- In Example 1, DK developed an overall total cost equation for his business expenses. Now he wants to evaluate the potential to make money from this chartered bus trip.

Solution

- DK's total cost equation:

Total cost= total fixed cost +total variable cost

= $225 + ($20)(number of people on the trip)

where number of people on the trip =*X*. *Thus*,

- Total cost = 225 + *20x*
- Using this relationship, DK can calculate the total cost for any number of people up to the capacity of the bus.

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- DK's total revenue from this trip can be expressed as:
- **Total revenue=(Charter ticket price)(Number of people on the trip) = (Ticket price) (x)**
- DK believes that he could attract 30 people at a charter ticket price of $35. Thus
- Total profit = (Total revenue) - (Total costs) = (35x) - (225 + 20x) = 15x - 225
- At x=30,
- Total profit = 35 x 30 - (225 + 20 x 30) = $225
- So, if **30 people** take the charter, DK will net a profit of $225. This is somewhat simplistic analysis ignores the value of DK's time-he would have to "pay himself" out of his $225 profit.

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- In Examples 1 and 2 DK developed total cost and total revenue equations to describe the **charter bus proposal**. These equations can be used to create what is called **a profit-loss breakeven chart** (see **Figure 2**). Both the costs and revenues associated with various levels of output (activity) are placed on the same set of x-y axes. This allows one to illustrate a **breakeven point** (in terms of costs and revenue) and **regions** of **profit** and **loss** for some business activity. These terms can be defined as follows.

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- **Breakeven point:** The level of business activity at which the total costs to provide the product, good, or service are equal to the revenue (or savings) generated by providing the service. This is the level at which one "just breaks even."
- **Profit region:** The output level of the variable x greater than the breakeven point, where total revenue is greater than total costs.
- **Loss region:** The output level of the variable x less than the breakeven point, where total costs are greater than total revenue.

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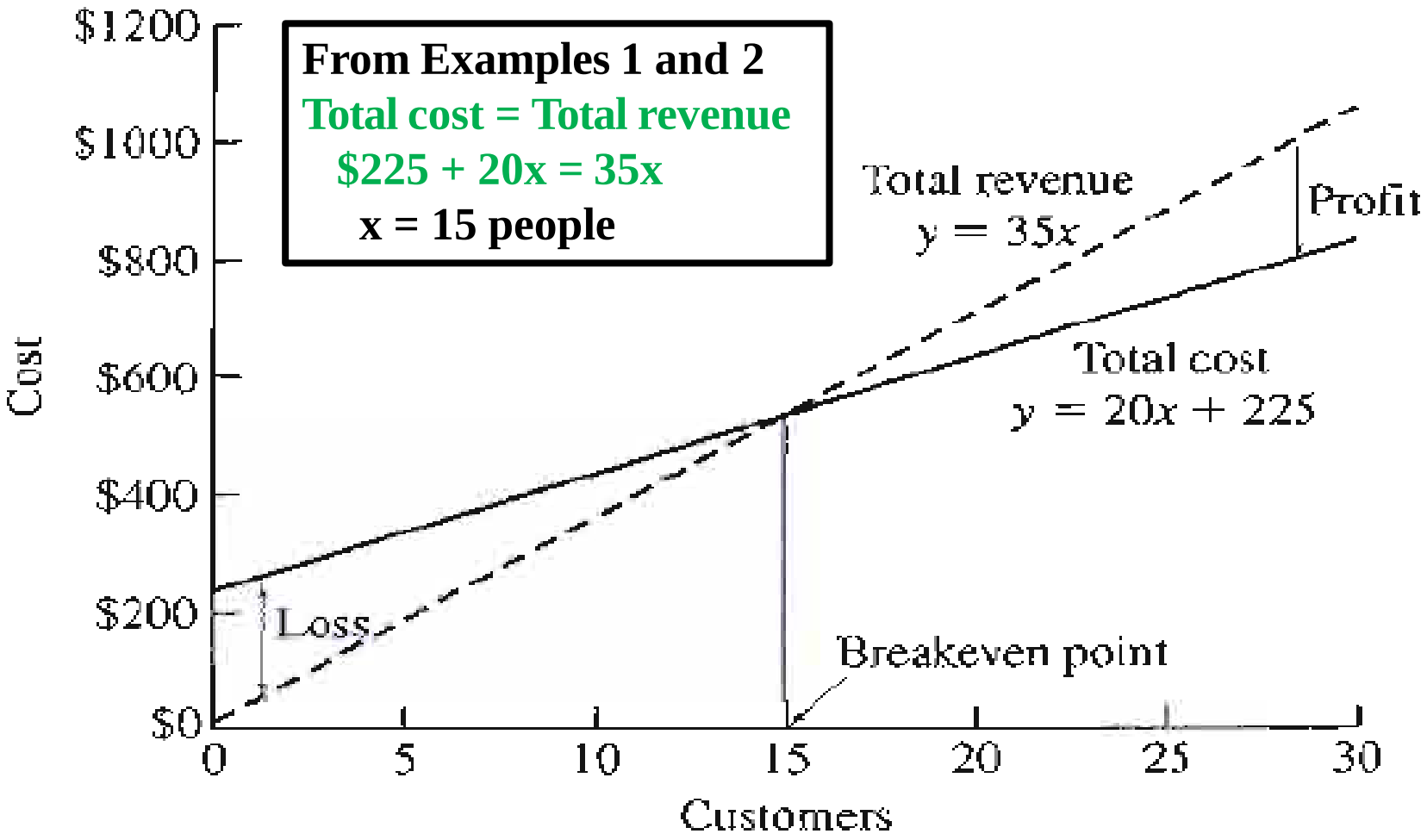
- Notice in **Figure 2** that the breakeven point for the number of persons on the charter trip is 15 people.
- For more than 15people, DK will make a **profit**. If fewer than 15 sign up there will be a **net loss**.
- At the breakeven level the total cost to provide the charter equals the revenue received from the 15 passengers.
- We can **solve for the breakeven** point by setting the total costs and total revenue expressions equal to each other and solving for the unknown value of x.

Figure 2: Profit-loss breakeven chart for Examples 1and 2.



2. Direct And Indirect Cost

- **Direct costs -**The expenses incurred on material and labor which are **economically** and **easily traceable** for a product, service or jobs.
- In the process of manufacturing of production of articles, materials are purchased, laborers are employed and the wages are paid to them.
- Certain other expenses are also incurred directly.
- All of these take an **active** and **direct part** in the manufacture of a particular commodity and hence are called direct costs.

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- **Indirect costs** - The expenses incurred on those items which are **not directly chargeable** to production are known as indirect costs.
- For example **salaries of timekeepers**, **storekeepers** and **foremen**.
- Also certain expenses incurred for running the administration or factory **manager's salary**, **factory rent**, **depreciation of machinery** are the indirect costs.
- All of these cannot be conveniently allocated to production and hence are called indirect costs.

3. Product Cost And Period Cost

- The costs which are a **part of the cost of a product** rather than an expense of the period in which they are incurred are called as **“product costs.”**
- They are included in **inventory values**.
- In financial statements, such costs are treated as assets until the goods they are assigned to be sold.
- They become an **expense at that time**.
- These costs **may be fixed as well as variable**, e.g., cost of raw materials and direct wages, depreciation on plant and equipment etc.

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- The costs which are not associated with production are called **period costs**.
- They are treated as an **expense of the period** in which they are incurred.
- They may also be **fixed as well as variable**.
- Such costs include **general administration costs**, **salaries salesmen** and **commission**, **depreciation** on office facilities etc..
- They are charged against the **revenue** of the relevant period.
- Differences between **opinions** exist regarding whether certain costs should be considered as product or period costs.

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- Some accountants feel that **fixed manufacturing costs** are more closely related to the passage of **time** than to the manufacturing of a **product**.
- Thus, according to them **variable** manufacturing costs are **product costs** whereas fixed manufacturing and other costs are **period costs**.
- However, their view does not seem to have been yet widely accepted.

4. Relevant And Irrelevant Cost

- **Relevant costs** are those which change by managerial decision.
- **Irrelevant costs** are those which do not get affected by the decision.
- For example, if a manufacturer is planning to close down an **unprofitable retail sales shop**, this will affect the wages payable to the workers of a shop.
- This is relevant in this connection since **they will disappear** on closing down of a shop.
- But **prepaid rent of a shop** or **unrecovered costs** of any equipment which will have to be scrapped are irrelevant costs which should be ignored.

5. Real Cost

- The **real cost** of production is the sacrifices borne by the society to produce a particular commodity.
- Marshall defines real costs as "The exertions of all the different kinds of laborers that are directly or indirectly involved in making it, together with the abstinence or rather the waiting's required for raising the capital used in making it, all these efforts and sacrifices together will be called **the costs of production of the commodity**".

6. Opportunity Cost

- **Opportunity cost** refers to an advantage in measurable terms that have foregone on account of not using the **facilities** in the manner originally planned.
- For example, if a building is proposed to be utilized for **housing a new project plant**, the likely **revenue** which the building could fetch, if **rented out**, is the **opportunity cost** which should be taken into account while evaluating the profitability of the project foregone.

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- Suppose, a manufacturer is confronted with the **problem of selecting** anyone of the following alternatives:
  a) Selling a **semi-finished product** at $. 2 per unit
  b) Introducing it into a **further process** to make it more refined and valuable
- Alternative (b) will prove to be remunerative only when after paying the cost of further processing, the amount realized by the sale of the product is more than $. 2 per unit.
- Also, the revenue of $. 2 per unit is foregone in case alternative (b) is adopted.
- The term "**opportunity cost**" refers to this **alternative revenue.**

Elements Of Cost

1. Material

- The substance from which a product is made. It may be in a raw or a manufactured state. It can be direct or indirect.
  - **Direct Material**
  - The material which becomes an **integral part** of a finished product
  - All material or components specifically purchased, produced or requisitioned from stores.
  - Primary **packing** material (e.g. carton, wrapping, cardboard, boxes etc.)
  - Purchased or partly produced components.
  - Direct material is also described as process material, prime cost material, production material, stores material, constructional material etc.

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- **Indirect Material**

  - The material which is used for purposes **ancillary** to the business and which cannot be conveniently assigned to specific physical units is termed as indirect material.
  - Consumable stores, oil and waste, printing and stationery material etc
  - Indirect material may be used in the **factory**, **office** or the **selling** and **distribution** divisions.

2. Labor

- Human **effort** for the conversion of materials into finished goods.
  - **Direct Labor**
    - The labor which actively and directly takes part in the production of a particular item.
    - described as process labor, productive labor, operating labor, etc.
  - **Indirect Labor**
    - The labor employed for the purpose of carrying out tasks incidental to goods produced or services provide.
    - Wages of storekeepers, foremen, timekeepers, directors' fees, salaries of salesmen etc
    - the office or the selling and distribution divisions.

3. Expenses

➢ Direct Expenses

- These are the expenses that can be directly, conveniently and wholly allocated to **specific cost centers** or **cost units**
  - Hire of some **special machinery** required for a particular contract
  - Cost of **defective work** incurred in connection with a particular job or contract etc.
  - Chargeable expenses.

➢ Indirect Expenses

  - Cannot be directly, conveniently and wholly allocated to cost centers or cost units
  - Rent, lighting, insurance charges etc.

4. Overhead

- **Overhead :** The term overhead includes indirect material, indirect labor and indirect expenses.
  - **Factory or works**, where production is done
  - **Office and administration**, where routine as well as policy matters are decided
  - **Selling and distribution**, where products are sold and finally dispatched to customers

- **For all cases**
  - Indirect material
  - Indirect labor
  - Indirect expenses

Components of Total Cost

- ✓ **Prime Cost**
  - **Prime cost** consists of costs of direct materials, direct labors and direct expenses. It is also known as **basic**, **first** or **flat** cost.
- ✓ **Factory Cost**
  - prime cost and, works or factory overheads that include costs of indirect materials, indirect labors and indirect expenses incurred in a factory
  - known as **works** cost, **production** or **manufacturing** cost.
- ✓ **Office Cost**
  - sum of office and administration overheads and factory cost
  - as **administration cost** or the **total cost of production**.
- ✓ **Total Cost**
    - Selling and distribution overheads are added to the total cost of production to get **total cost** or the **cost of sales**.

Components of total cost	
Direct material Direct labor Direct expenses	**Prime cost** or direct cost or first cost
Prime cost plus works overheads	**Works cost** or factory cost or production cost or manufacturing cost
Works cost plus office and administration overheads	**Office cost** or total cost of production
Office cost plus selling and distribution overheads	Cost of sales or **total cost**

Cost Sheet

- It is a document that provides for the **assembly of an estimated detailed cost** in respect of cost centers and cost units.
- It analyzes and classifies in a tabular form the **expenses** on different items for a **particular period**.
- It shows the cost of a **particular unit** pertaining to each item of expenditure and the total per unit cost.
- May be prepared on the basis of **actual data** (historical cost sheet) or **estimated data** (estimated cost sheet), depending on the technique employed and the purpose to be achieved.

Example

An information that has been obtained from the records of a company named **left center corporation** for the period from June 1 to June 30, 1998 is given in the table below. Prepare statement of the cost.

Cost of raw materials on June 1,1998	30,000
Purchase of raw materials during the month	450,000
Wages paid	230,000
Factory overheads	92,000
Cost of work in progress on June 1, 1998	12,000
Cost of raw materials on June 30, 1998	15,000
Cost of stock of finished goods on June 1, 1998	60,000
Cost of stock of finished goods on June 30, 1998	55,000
Selling and distribution overheads	20,000
Sales	900,000
Administration overheads	30,000

Cost statement

Components of Total cost	Amount	Cost components
Opening stock of raw materials	30,000	30,000
Add-- purchase	480,000	30,000+450,000
Less-- closing stock of raw material	465,000	480,000-15,000
Value of raw materials consumed	465,000	**Direct material cost**
Wages	230,000	given
Prime Cost	**695,000**	**230,000+465,000**
Factory overheads	787,000	695,000+92,000
Add-- opening stock of work in progress	799,000	787,000+12,000
Less-- closing stock of work in progress	799,000	799,000-000
Factory Cost	**799,000**	
Add-- Administration overhead	829,000	799,000+30,000
Add--opening stock of finished goods	889,000	829,000+60,000
Less-- closing stock of finished goods	834,000	889,000-55,000
Cost of production	**834,000**	
Add-- selling and distribution overheads	854,000	834,000+20,000
Total Cost	**854,000**	
Sales	900,000	
Profit	**46,000**	**900,000-854,000**

Types Of Estimation

- There are **three general types** of estimates:
  1. **Rough** – order of magnitude, used for high level planning, inaccurate, range from -30% to +60% of actual values.
  2. **Semi-detailed** - based on historical records, reasonably sophisticated and accurate, -15% to +20% of actual values.
  3. **Detailed** - based on detailed specifications and cost models, very accurate, within -3% to +5% of actual.

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- In considering the three types of estimate it is important to recognize that each has its **unique purpose**, **place**, and **function** in a project's life.
- **Rough estimates** - are used for **general feasibility** activities,
- **semi-detailed estimates** - support **budgeting** and preliminary **design decisions**, and
- **detailed estimates** - are used for establishing **design details** and **contracts**.
- As one moves from rough to detailed design, one moves from **less** to much **more accurate estimates**.

Methods Of Estimation

- Estimating the **future cash flows** for feasible alternatives is a critical step in engineering economy studies.
- Estimating **costs**, **revenues**, **useful lives**, **residual values**, and other **pertinent data** can be the most difficult, expensive, and time-consuming part of the study.

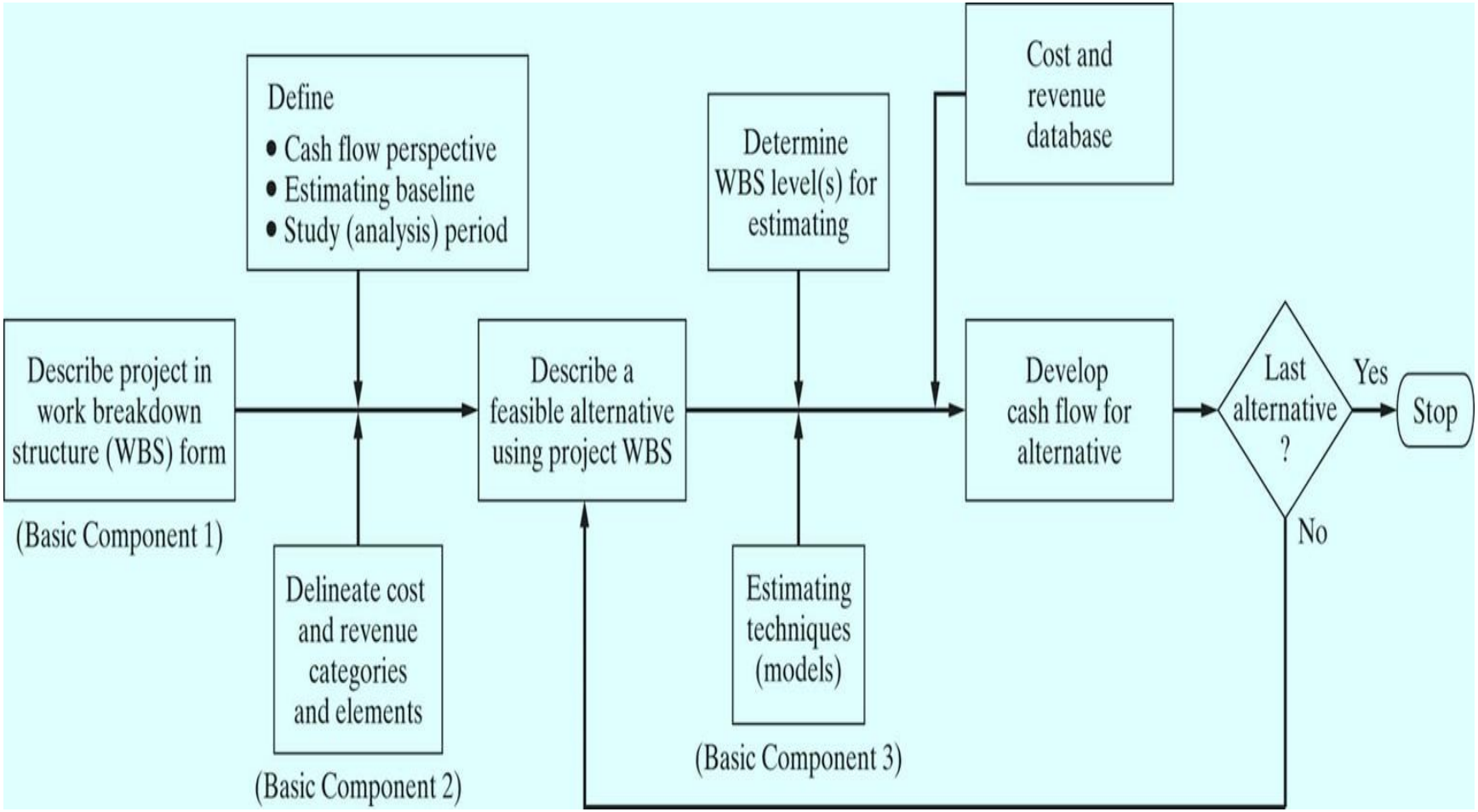
Cost Estimation Approaches

- The two fundamental approaches are "**top-down**" and "**bottom-up.**"
  1. **Top-down** uses **historical data** from similar projects. It is best used when alternatives are still being developed and refined.
  2. **Bottom-up** is more detailed and works best when the detail concerning the desired output (product or service) has been defined and clarified.

Integrated Cost Estimation Approach

- The integrated cost estimation approach has **three major components**. These are ;
  1. Work Breakdown Structure (**WBS**)
  2. Costand Revenue Structure (**Classification**)
  3. Estimating Techniques (**Models**)

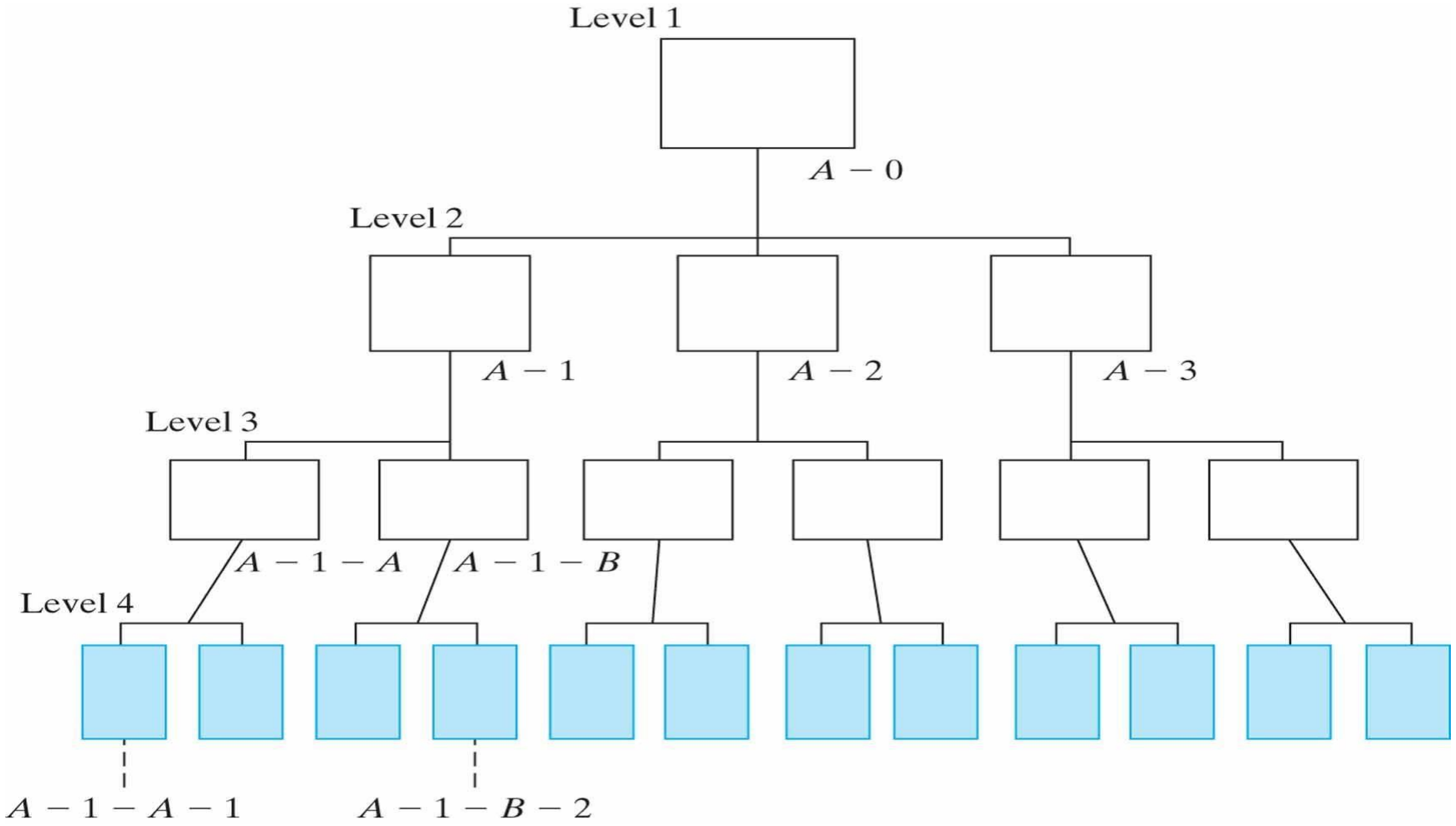
Figure1: Integrated approach for developing the cash flows for alternatives



1. Work Breakdown Structure (WBS)

- A **basic tool** in project management.
- A **framework** for defining all project work elements and their relationships, collecting and organizing information, developing relevant cost and revenue data, and management activities.
- Each level of a WBS divides the **work elements** into **increasing detail**.
- It is used to **identify** and **categorize** the costs and revenues that need to be included in the analysis.
- **WBS** are important **aids** in developing the cost and revenue structure for a project.

Figure 2: Division of a WBS at each level



2. Cost and Revenue Structure

- Used to identify and categorize the costs and revenues that need to be included in the analysis.
- The **life-cycle concept** and **WBS** are important aids in developing the cost and revenue structure for a project.
- Perhaps the **most serious source of errors** in developing cash flows is overlooking important categories of costs and revenues.

3. Estimating techniques (models)

- These **models** can be used in many types of estimates.
  - ✓Indexes (Reading assignment)
  - ✓Unit technique (Reading assignment)
  - ✓Factor technique (Reading assignment)

Purposes of Cost Estimating

- Results of cost estimating are used for a **variety of purposes;**
  - Setting **selling prices** for quoting, bidding, or evaluating contracts.
  - Determining if a **proposed product** can be made and distributed at a profit.
  - Evaluating how **much capital** can be justified for changes and improvements.
  - Setting **benchmarks** for productivity improvement programs.

Data Requirement and Sources

- **A variety of sources** exist for cost and revenue estimation.
- **Accounting records**: good for historical data, but limited for engineering economic analysis.
- Other sources **inside** the firm: e.g., sales, engineering, production, purchasing.
- Sources **outside** the firm: government data, industry surveys, trade journals, and personal contacts.
- **Research and development**: e.g., pilot plant, test marketing program, surveys.

Collection Cost

- **A collection cost** is any cost associated with recovering **debt** on which the borrower has defaulted on his obligation to pay.
- Such items as the **fees charged** by **collection agencies** and **attorneys**, for example, are collection costs, as are the various costs involved in collection the debt through legal process.

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- Other costs associated with borrowing, such as the **cost of obtaining credit reports of potential borrowers,** are related to the lending decision, not collection, and so are **not collection costs**.
- Likewise, the **routine costs of collecting a dept that is in good standing**- printing payment coupons or issuing receipts as payments are made, for example-are also **not considered collection costs**.

Allowance in Estimation

- **Allowance** is an additional resources included in an estimate to cover the cost of known but **undefined requirements** for an activity or work item.
- Is a **base cost item**.

Costing Methods

- Costing methods, therefore, refer to the systems of **cost finding** and **ascertainment**.
- They are devised to suit the methods by which goods are manufactured or services are provided, for example:
  a. Where work is undertaken to customer's special requirements, the method of costing that will be in operation is **job costing** (specific order costing).
  b. Where standardized goods result from a sequence of repetitive and more or less continuous operation or process, then **process costing** is used.

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- There are basically **two methods of accumulating costs**, namely:
  a. **Specific Order Costing** Where expenses are **linked to the cost object**, for example, Job, Contract or a Batch. Hence, **Job Costing, Contract Costing, Batch Costing** fall under specific order costing method.
  b. **Unit Costing (Average Costing)** This is where expenses **cannot be linked directly with the cost object** and are, therefore, charged to the department or process. The total costs are then averaged over the total units produced. Examples of these are **batch costing** (where the cost of a unit within the batch is desired), **Service or Operating Costing**, and **Process or Operation Costing.**

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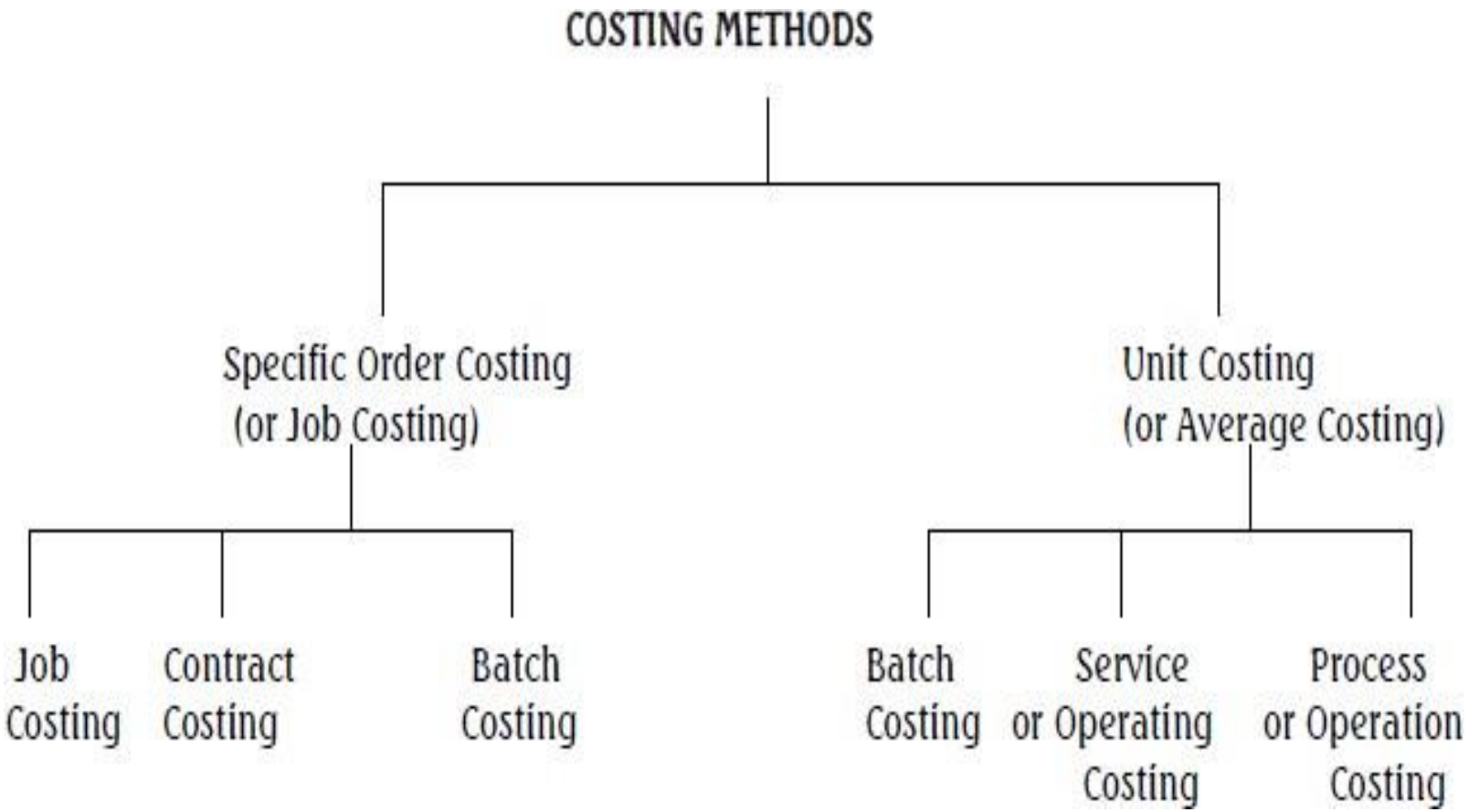

Figure: Costing Methods

Uniform Costing

- **Uniform Costing** is not a distinct method of costing.
- In fact when several undertakings start using the **same costing principles** and or **practices**, they are said to be following uniform costing.
- The basic idea behind uniform costing is that the **different firms** in an industry **should adopt** a common method of coding and **apply uniformly** the same principles and techniques for better cost comparison and common good.

Objectives of Uniform Costing

- Facilitates **cost control** and **cost reduction.**
- Fixing of common **sales price** among the different units.
- Improving **performance** of inefficient units by adopting uniform principle and practices.
- Facilitates **inter-firm comparison** of cost of production.
- Establishment of **common standard** for the operations of different units.

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- Formulation of common **policies**, **methods** and **procedures** for the participating units.
- Ensures **reasonable price** to customers and profits to producers.
- Facilitates exchange of **ideas** and sharing **experience** to improve the overall performance of common units.
- Avoidance of **monopolistic** trade practice among member units.
- To ensures **steady demand** and **supply** of finished goods for participating units.