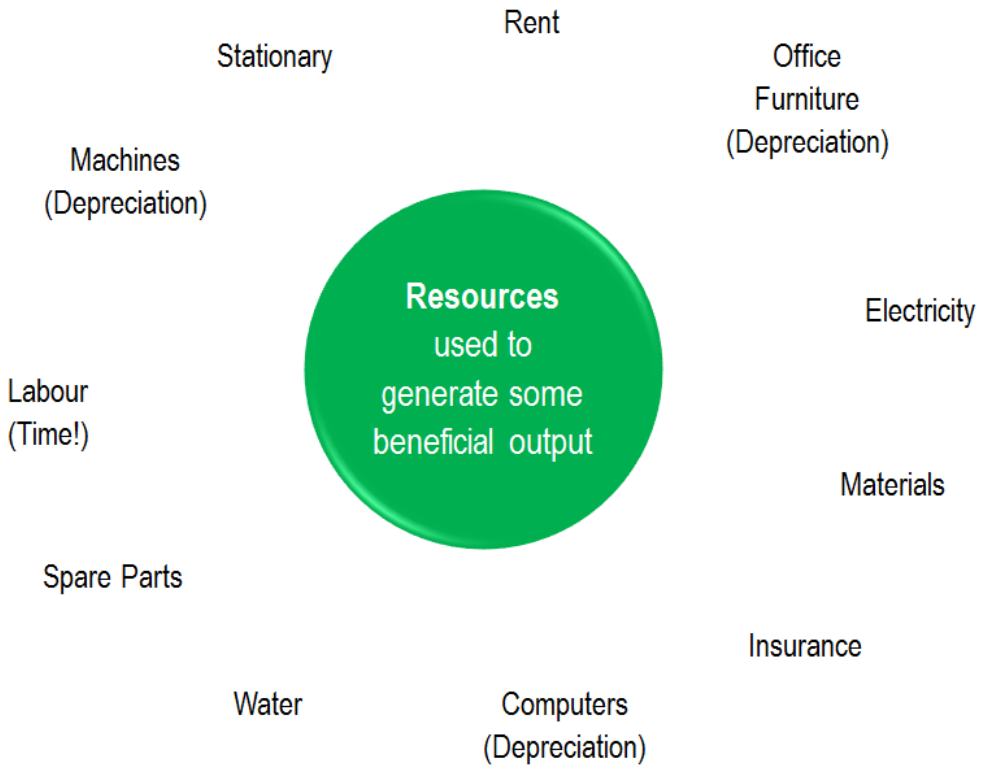
Lecture 1: Cost Behaviour

Introduction

- This topic focuses on the analysis of costs and how they behave in relation to changes in a particular organisational activity (such as production volume).
- Knowing how costs vary by identifying the drivers of costs and being able to distinguish fixed from variable costs are essential to good management decision making.
- Many managerial functions in the planning and control areas require and rely on knowing **how costs behave in relation to activities** (e.g. production output/volume).
- Analysis of cost behaviour patterns allows managers to prepare standard costs, formulate budgets and to predict and control costs.

What is a Cost?



Although costs move with output changes, the cost movement tends to be less sensitive than the activity change, that is, if output doubles, total costs will increase, but not by 100 per cent.

Production Level	Total Costs
1	$200
2	$300

Basic Cost Terminology

- **Cost pools:** Groups of a particular type of cost (e.g. material costs, labour costs, electricity costs, depreciation costs). Cost pools vary by the type of costs included and the level of aggregation.
- **Cost objects:** Factors or items in an organisation that are separated for measurement of their costs (e.g. products, departments, jobs, events). Costs are assigned from cost pools to these items.
- **Cost drivers**: Activities or factors that drive (cause) costs to be incurred. Drivers allow cost pools to be allocated to cost objects.

- **Cost Behaviour**: The relationship between a cost and the level of activity that causes this cost (i.e. cost driver).
- **Volume-based driver**: A cost driver that assumes that costs are driven by production or a factor related to production (e.g. machine hours)
- **Non-volume-based driver**: A cost driver not directly related to production volume (e.g. number of deliveries)

The basic (linear) cost function can be represented in the following manner:

$$Y = a + bX$$

$$Y = FC + VC \times Activity$$

- **Activity Based Costing**: A system where costs are assigned to activities that represent the main tasks or work performed in a business.
- Consider the activities involved in manufacturing cakes:

1. Clean mixers	2. Load mixers	3. Operate mixers
4. Clean trays	5. Fill trays with mixture	6. Move trays to ovens
7. Setup ovens	8. Bake cake mixture	9. Inspect baked cakes
10. Transfer to packing	11. Package cakes	12. Dispatch cakes to retail shops

- Costs (e.g. materials, labour, overheads) are assigned to each of these activity cost pools. Costs within each activity are assumed to be driven by the same driver.

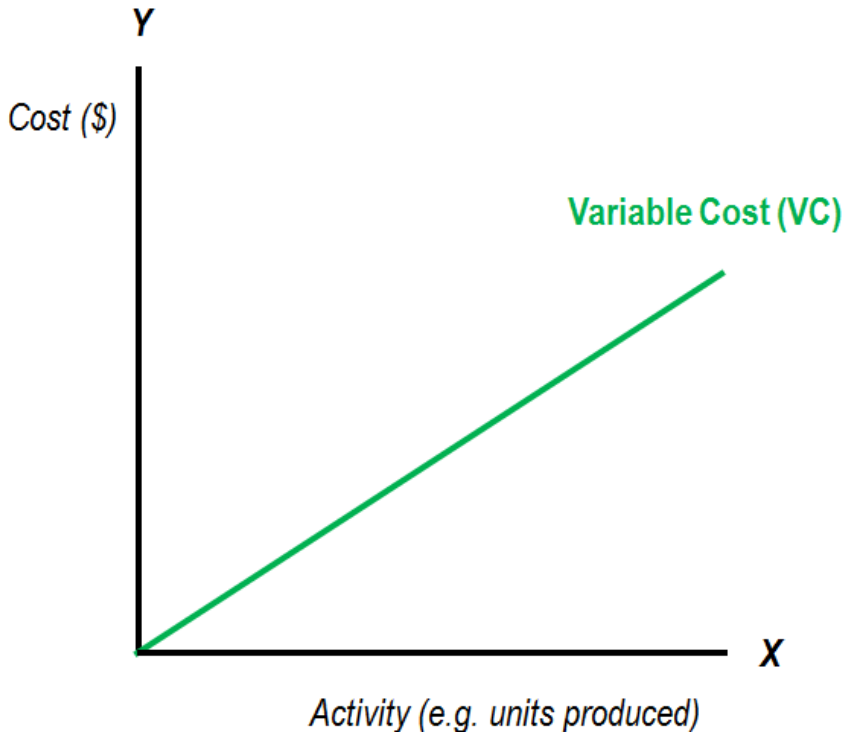
Activities

- Activities can be classified into four distinct levels:

- **Unit**: Relate to activities that are performed for each unit produced. These costs require volume-based drivers.
- **Batch**: Relate to activities that are performed for a group of units. These require non-volume based drivers.
- **Product**: Relate to activities that are performed for specific products or product families. These require product-related cost drivers.
- **Facility**: Costs incurred to run the business but are not caused by specific products. No cost driver in the short-term.

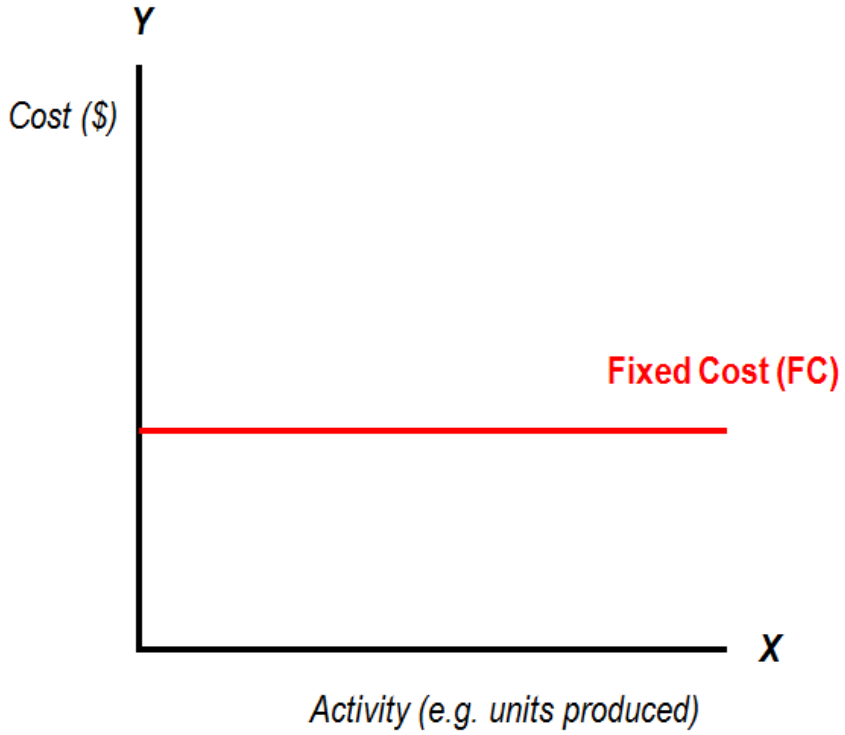
Variable Costs

- Costs that change *in total* in direct proportion to a change in activity.



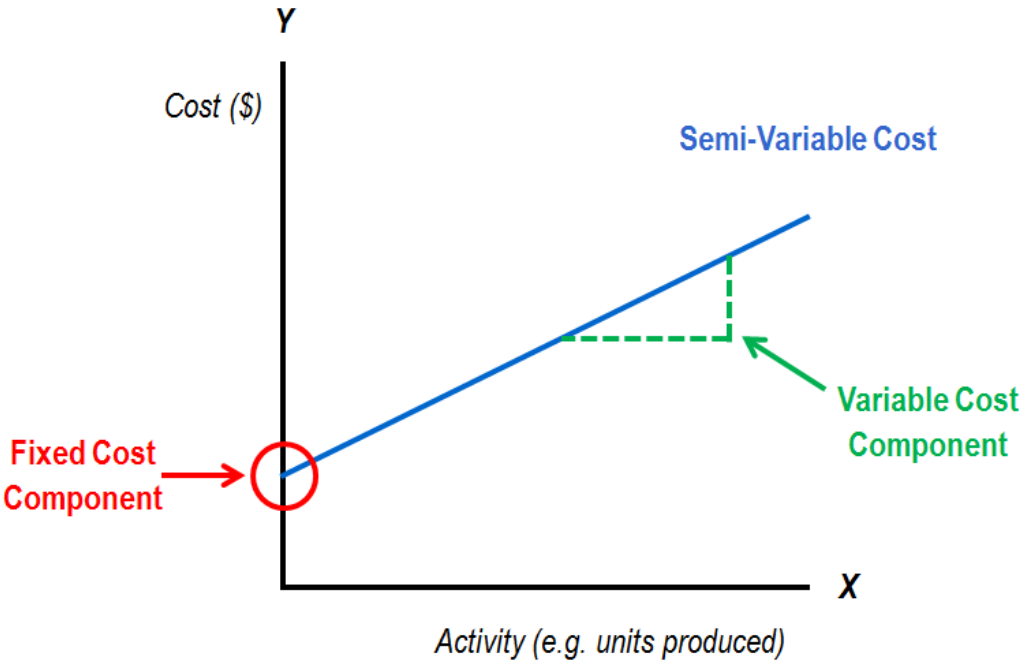
Fixed Costs

- Costs that remain unchanged *in total* as the level of activity varies.
- **Discretionary cost:** Based on a managerial decision that can be changed relatively easily.
- **Committed cost**: Results from the basic organisation structure and difficult to adjust in the short term.



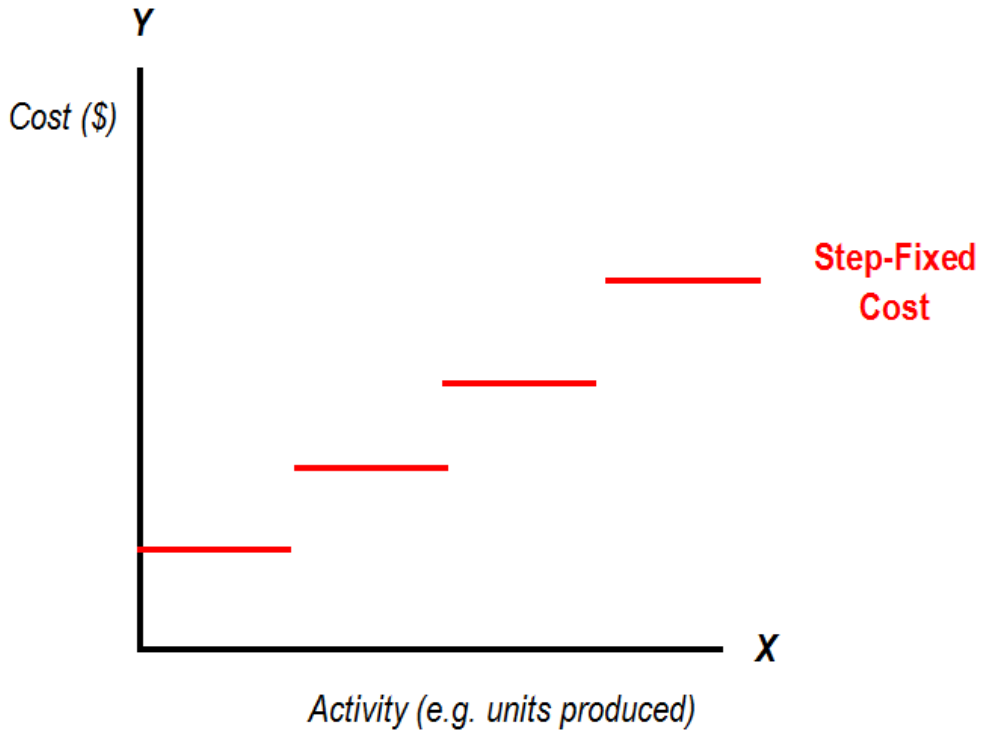
Semi- Variable (Mixed Costs)

- Costs that contain both fixed and variable components.



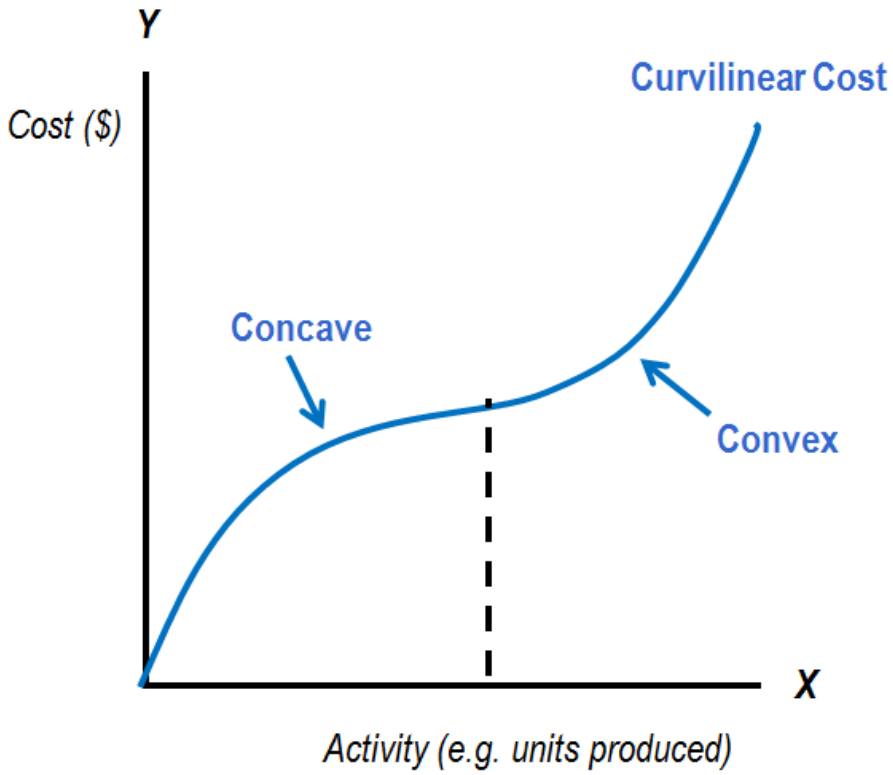
Step- Fixed Costs

- Costs that remain fixed within a certain range of activity, but change to a different amount outside that range.



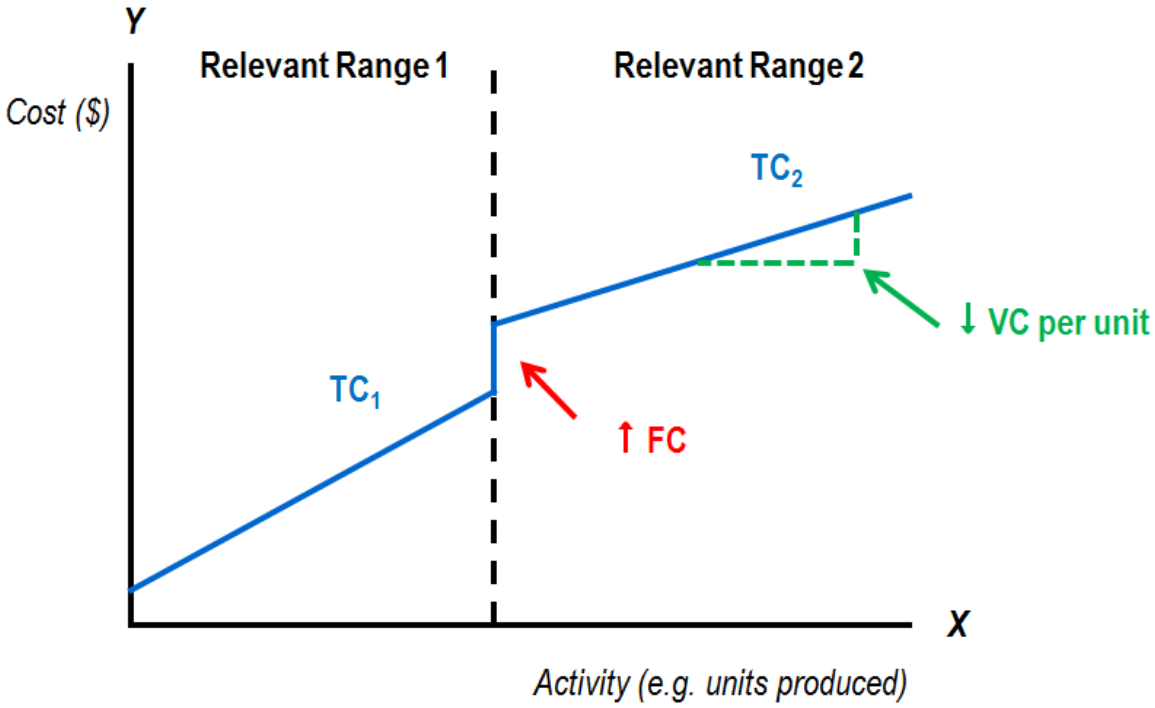
Curvilinear Costs

- Costs that exhibit cost behaviour that can be described by a curved line. **Convex** costs have increasing marginal costs. **Concave** costs have decreasing marginal costs.



Relevant Range

- Refers to the range of activity (i.e. the upper and lower limits of an activity) for which assumptions about cost behaviour hold.
- Assumptions made within one relevant range may not be valid in another range
- VC per unit may change
- Fixed costs are not constant
- Prediction of costs can only be done accurately within a known range



Cost Estimation

- Cost estimation is the process of determining the cost behaviour pattern of a particular cost item. **Cost prediction** is using knowledge of cost behaviour to forecast the level of cost at a particular level of activity.

- The most important issue in estimating a cost function is to determine whether a cause-and-effect relationship exists between the activity or cost driver (X) and the resulting costs (Y). This may arise in several ways:
    - Physical relationship with the cost driver (engineered cost)
    - Contractual arrangement
    - Logic and knowledge of operations

- There are three methods to identify cause and effect relationships

1-Engineering Method

- Identifies the relationship that should exist between input and outputs. Relationships are determined through “time and motion” studies which observe the steps required and time taken to perform particular activities.

2- Managerial Judgment

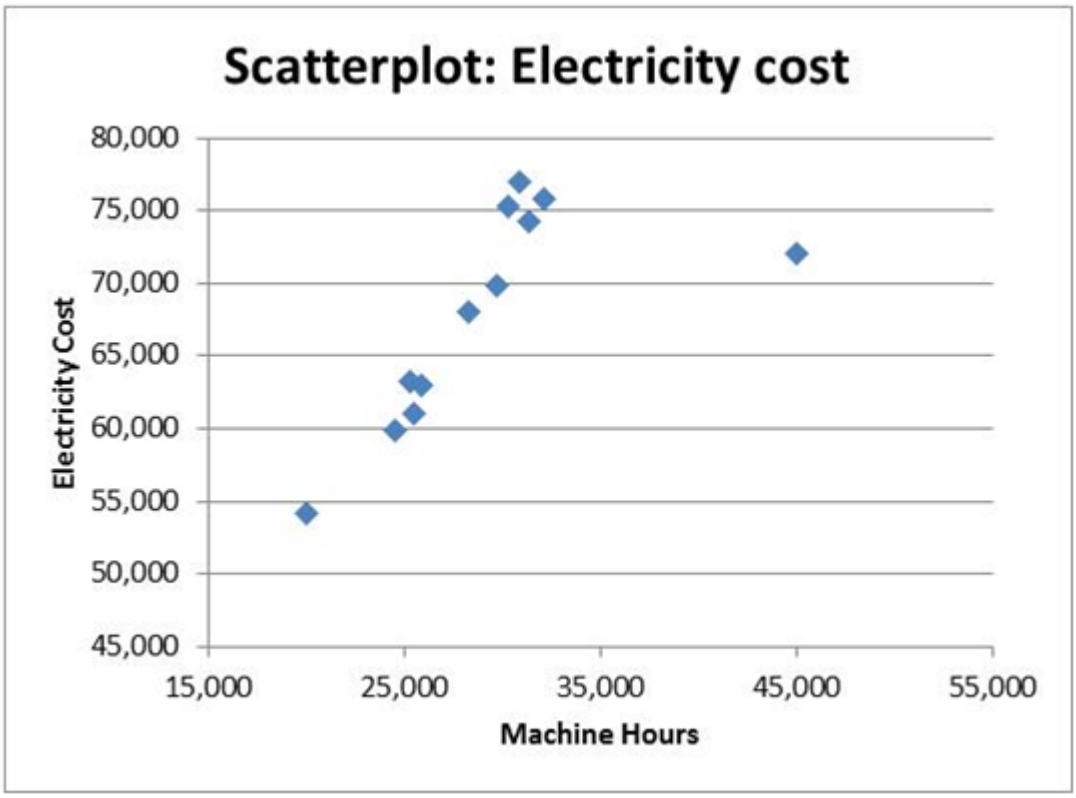
- **A) Conference method**: Estimates cost functions on the basis of opinion about costs and their drivers gathered from various departments of an organisation – purchasing, human resources, engineering, manufacturing, etc. This method relies on the expert knowledge and judgement of managers.
- **B) Account classification (account analysis)**: The account analysis method estimates cost functions by classifying cost accounts in the ledger as variable, fixed or mixed with respect to the identified cost driver. Typically managers’ use qualitative rather than quantitative analysis when making these cost classification decisions.

3- Quantitative Analysis

- These are formal analyses of cost relationships to fit mathematical equations (functions) to past data. There are six steps involved:
    - **Step 1**: Choose the dependent variable (the cost variable you want to estimate). Example: Electricity cost in the manufacturing plant
    - **Step 2:** Identify the independent variable(s) (the activity or activities that cause the cost). Example: Machine hours
    - **Step 3:** Collect data on the dependent variable and the cost driver(s). Example: Monthly electricity cost for the last 12 months

Month	Electricity	Machine Hours
Jan	61,020	25,504
Feb	76,917	30,907
Mar	75,313	30,309
Apr	54,200	20,000
May	68,067	28,325
Jun	63,269	25,322
Jul	59,918	24,518
Aug	69,890	29,707
Sep	72,000	45,000
Oct	75,802	32,159
Nov	63,019	25,862
Dec	74,293	31,356

- **Step 4:** Plot the data – use a scatterplot to visually observe the relationship between the cost and its' driver(s)



- **Step 5**: Estimate the cost function using High-Low or Regression analyses

Cost Estimation: High-Low Method

- The high-low method is a simple method for separating semi-variable costs into their fixed and variable components.
- **VC Calculation**: Two periods of data (high and low) are chosen at based on the levels of activity – both levels should be within the same relevant range.

$$\frac{\text{Total Cost}_{\text{High}} - \text{Total Cost}_{\text{Low}}}{\text{Activity}_{\text{High}} - \text{Activity}_{\text{Low}}} = \text{VC per unit of activity}$$

- **FC Calculation**: Substitute the VC with either the high or low values into the total cost formula.

TC = FC + (VC x Activity)

72000-54200/ 45000-20000= 17800/25000= 0.712 variable cost per unit

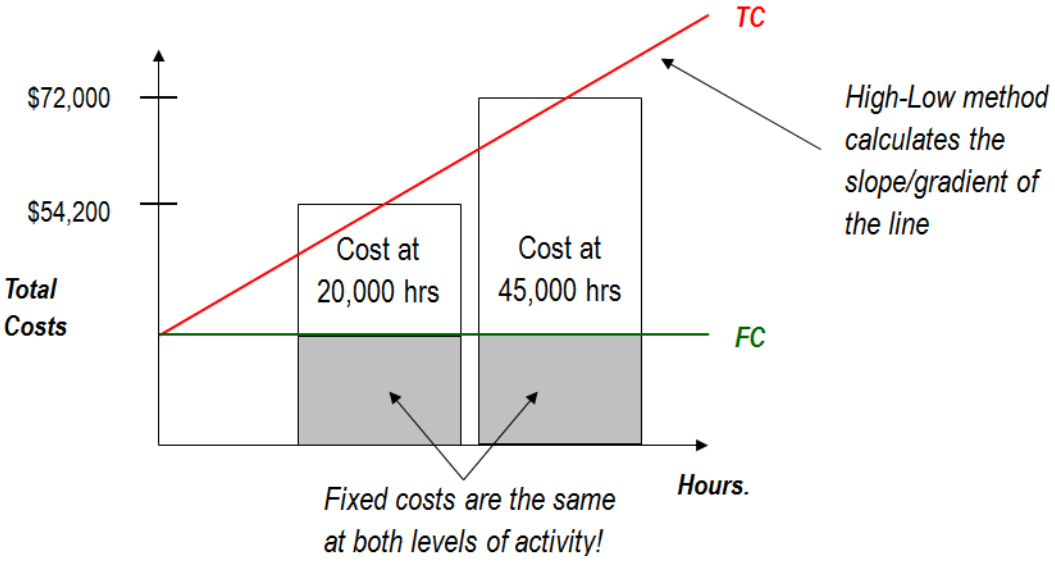
$54200= F +.712 X 20000 F= 39960

Total electricity cost= $39960 + 0.712 X machine hours

Select the highest and lowest values of the cost driver.

	Machine Hours	Electricity
Maximum Value	45,000	$72,000
Minimum Value	20,000	$54,200
Difference	25,000	$17,800

*Difference in costs are due to **variable costs** within the relevant range*



- The dependent variable (Y) is **electricity**. This is predicted or explained by the independent variable (X) of **machine hours**.

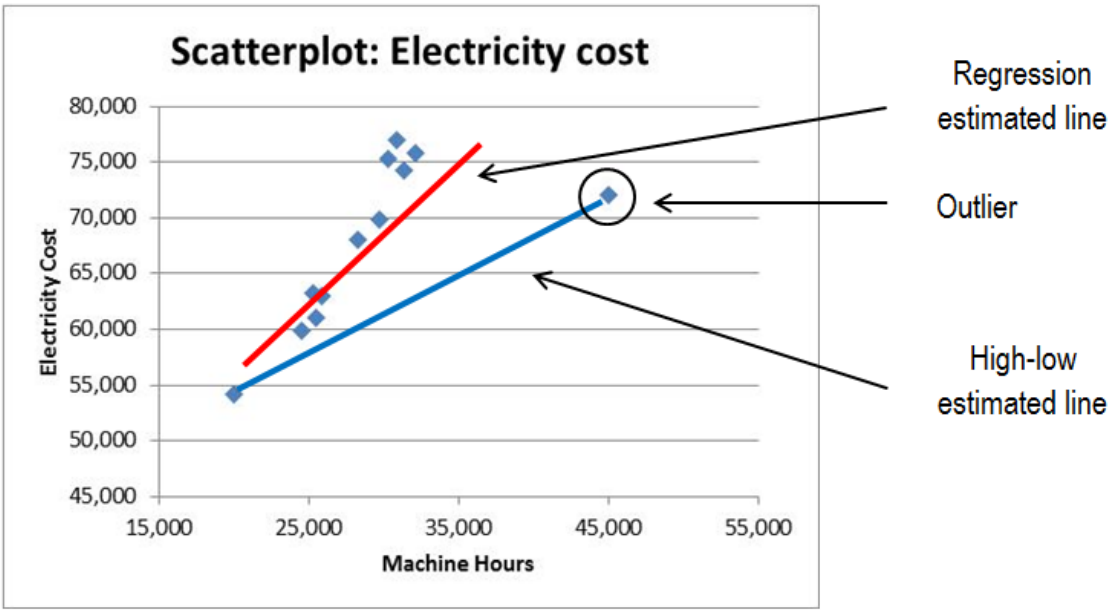
There are two simplifying assumptions in the High-Low method:

1. Changes in the total costs of a cost object are explained by variations of a single cost driver.
2. Cost behaviour is adequately approximated by a linear cost function of the cost driver within the relevant range.

More advanced statistical methods can overcome these limitations. They are still limited to a single relevant range.

Regression Analysis

- Regression analysis is a statistical method that measures the average amount of change in the dependent variable that is associated with a unit change in one or more independent variables. It has **two advantages over high-low**:
  - All available data points are used (high-low uses just two data points). The difference can be seen in the scatterplot below.
  - Multiple cost drivers can be used to estimate costs



Regression analysis for the previous example would give the following output:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.698
R Square	0.487
Adjusted R Square	0.436
Standard Error	5565.3
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	294540335.4	294540335.4	9.5096	0.0116
Residual	10	309729181.4	30972918.14		
Total	11	604269516.8			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	43293.4148	8110.6279	5.3379	0.0003	25221.8	61365.0	25221.8	61365.0
Machine Hours	0.8430	0.2734	3.0838	0.0116	0.2339	1.4521	0.2339	1.4521

Cost Function (Regression):

Electricity= 43,293.4148 + (0.8430 x Machine Hours)

Cost Function (High Low):

Electricity= 27,576.2781 + (0.988 x Machine Hours) + (3.2431 * Batches)

- Regression analysis can also include multiple cost drivers:

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.853
R Square	0.728
Adjusted R Square	0.668
Standard Error	4272.2
Observations	12

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	440007799.2	220003899.6	12.0541	0.0028
Residual	9	164261717.6	18251301.95		
Total	11	604269516.8			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	27576.2781	8352.071	3.302	0.009	8682.580	46469.976	8682.580	46469.976
Machine Hours	0.9880	0.216	4.573	0.001	0.499	1.477	0.499	1.477
Batches	3.2431	1.149	2.823	0.020	0.644	5.842	0.644	5.842

Cost Function (Multiple Regression):

Electricity=

Step 6: Evaluate the estimated cost function

The four most important criteria in evaluating the cost function are:

- **Economic plausibility** – Does the cost function make sense?
- **Goodness of fit** – How well does the line fit the data points?
- **Slope of line** – A relatively flat line indicates a weak or non-existent relationship between the activity and the cost. A steep line would indicate a stronger relationship.
- **Cost v benefit** – A subjective estimate might be good enough!

Incorrectly estimating the cost function has repercussions for cost management and cost control. Managers will have a reduced ability to make accurate plans and budgets and have less understanding of organisational processes.

Lecture 2: Product Costing

Lecture Outline

- Introduction – What is cost?
- Measures of cost
- Organisation value chain and cost incurrence
- Conventional product costing systems
  - Manufacturing
  - Service
- Cost flows in general ledger
- Accounting for overheads
- Product costing and pricing
- Summary of cost classifications
- Lecture demonstration problem

Introduction- What is Cost?

Cost is usually defined by accountants as a resource foregone in order to achieve a particular objective (a beneficial sacrifice). If the benefits arising from this cost extend over a period of time, then it is an **asset** (recorded in the balance sheet). If the benefits are short lived, then it is an **expense** (recorded in the profit and loss).

Last week we learnt about **cost pools, cost objects** and **cost drivers**, and one way of classifying costs according to their pattern of cost behaviour (**fixed, variable and mixed**). This week we learn about another way to classify costs depending on how they are assigned to the cost object.

Measures of Cost

A "cost" can be defined and measured in a number of ways:

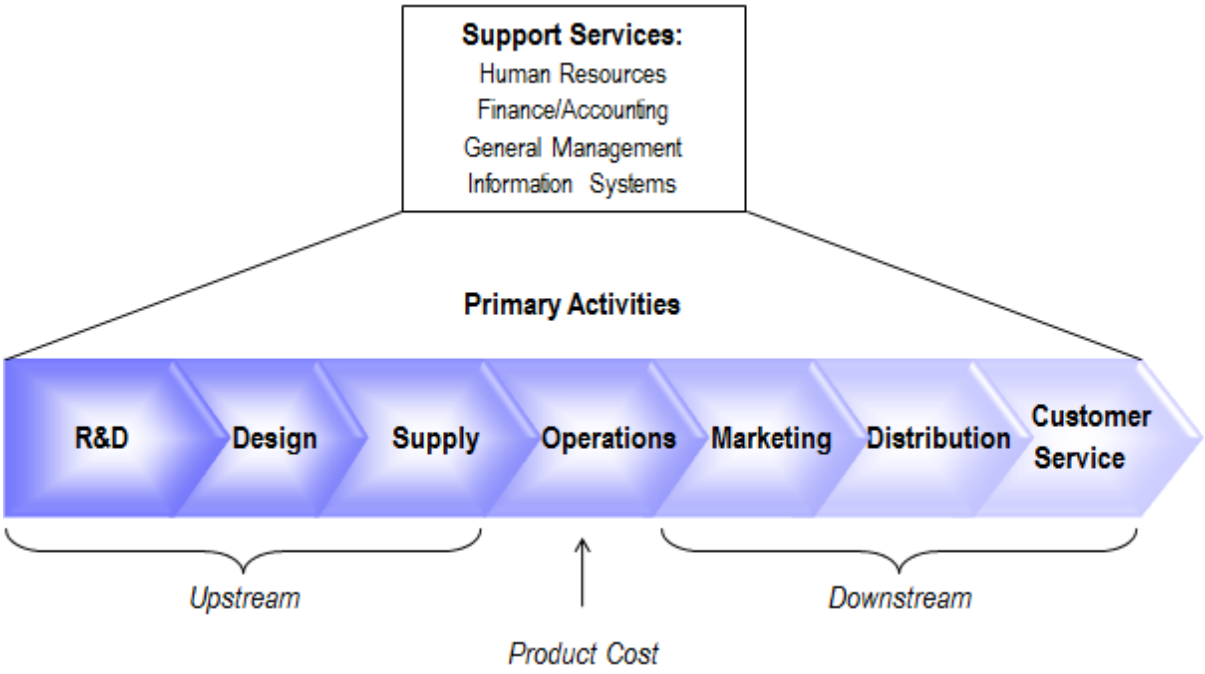
- **Variable cost**
  - Includes DM, DL and VOH (excludes all fixed costs)
- **Absorption cost** (or full product cost)
  - Includes all product-related costs (includes DM, DL, VOH and FOH)
- **Full cost**
  - Includes all costs in the value chain related to the product (including upstream/downstream and corporate support costs)

How a management accounting system assigns costs to cost objects also may vary:

- **Actual costing**
  - Reports only the actual costs of production (accurate but not timely)
- **Normal costing**
  - Reports actual DM and actual DL, but uses a predetermined rate to report OH (timely but not necessarily accurate)
- **Standard costing**
  - Uses a predetermined rate for all production costs (DM, DL and OH are all budgeted)

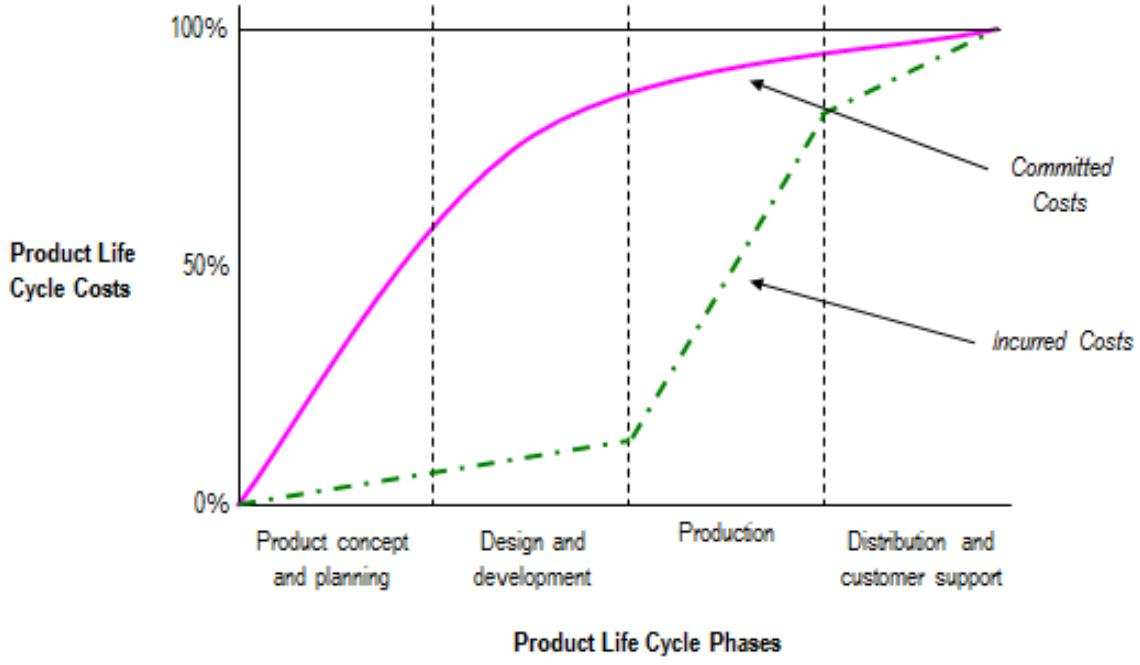
Organisation Value Chain

One way of understanding how costs are incurred in an organisation is to analyse them as part of the organisation value chain. This is a set of linked activities and processes that create value in a service or product.



Cost Incurrence

- **Cost incurrence** occurs when a resource is sacrificed or used up. Costing systems emphasise this, recording costs only when incurred. **Locked-in or committed costs** are costs that have yet to be incurred, but will be incurred because of decisions that have been made in the planning and development stages of a product.



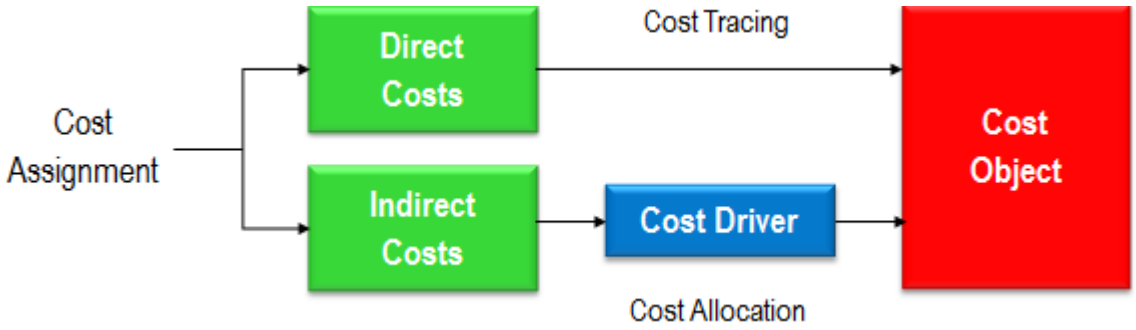
Conventional Product Costing Systems

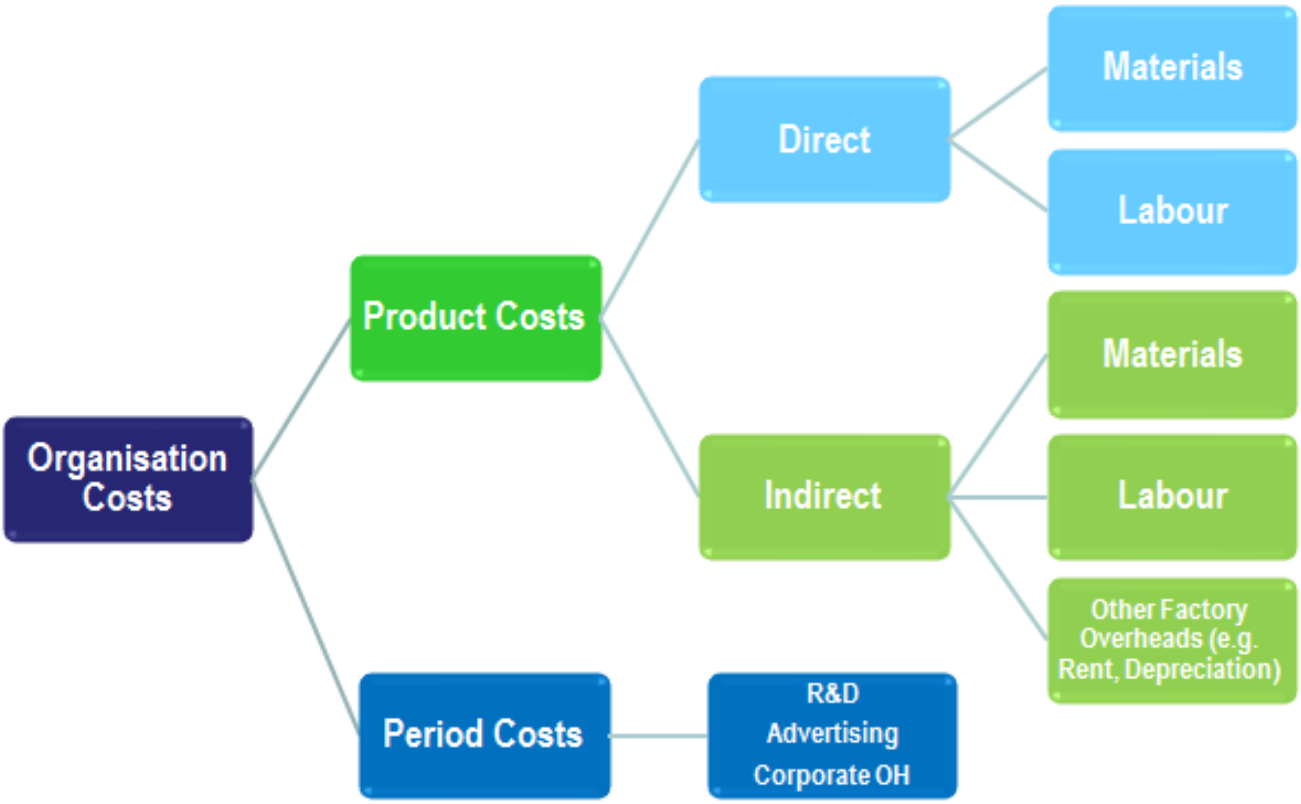
- A **cost system** estimates the cost of a cost object, which for example, could be activities, products, services, a department, or a customer. The cost system does this in two basic stages.
    - Stage 1: Cost accumulation – the process of collecting cost data in some organised way through an accounting system. This is often through self-descriptive classifications (cost pools), such as materials, labour, advertising, etc.
    - Stage 2: Cost assignment – the process of assigning costs to cost objects:
        - Tracing accumulated direct costs to a cost object
        - Allocating accumulated indirect costs to a cost object

Conventional Product Costing Systems

A major consideration is whether the cost has a direct or indirect relationship to a particular cost object (e.g. a unit of production).

- **Direct costs** are those that are related and can be traced easily/economically to the cost object. They often have a physical or observable relationship with the cost object (e.g. the product). These costs are assigned to the cost object directly, based on the measured quantity of the resources consumed.
- **Indirect costs** (also called **overheads**) are those that are related to a particular cost object that cannot be traced easily/economically to the cost object. These costs do not have an observable relationship with the cost object. Indirect costs are allocated to the cost object using an overhead allocation method.





Costing system types can be placed on a continuum. Each type determines the cost of a product or service using different costing techniques.

Job Costing
A costing system that traces manufacturing costs to individual jobs. Each job has a unique cost.

Hybrid Costing
Elements of both job and process costing

Process Costing
A costing system that traces all production costs to processes or departments and averages them across all units of production.

Another costing process is "Joint & By-Product Costing". This is used when two or more products emerge from a single raw material or process.

Cost	Product/Period	Direct/Indirect
1. Cost of grapes purchased by a winery	Product	Direct
2. Salary of a plant manager in a computer production facility	Product	Indirect
3. Salary of the chief financial officer in an investment bank	Period	Indirect
4. Wages of assembly line workers in a car manufacturing plant	Product	Direct
5. Advertising costs of a fast food franchise	Period	Could be either depending on object
6. Depreciation of computers used in the research and development department of a cosmetics company	Period	As above

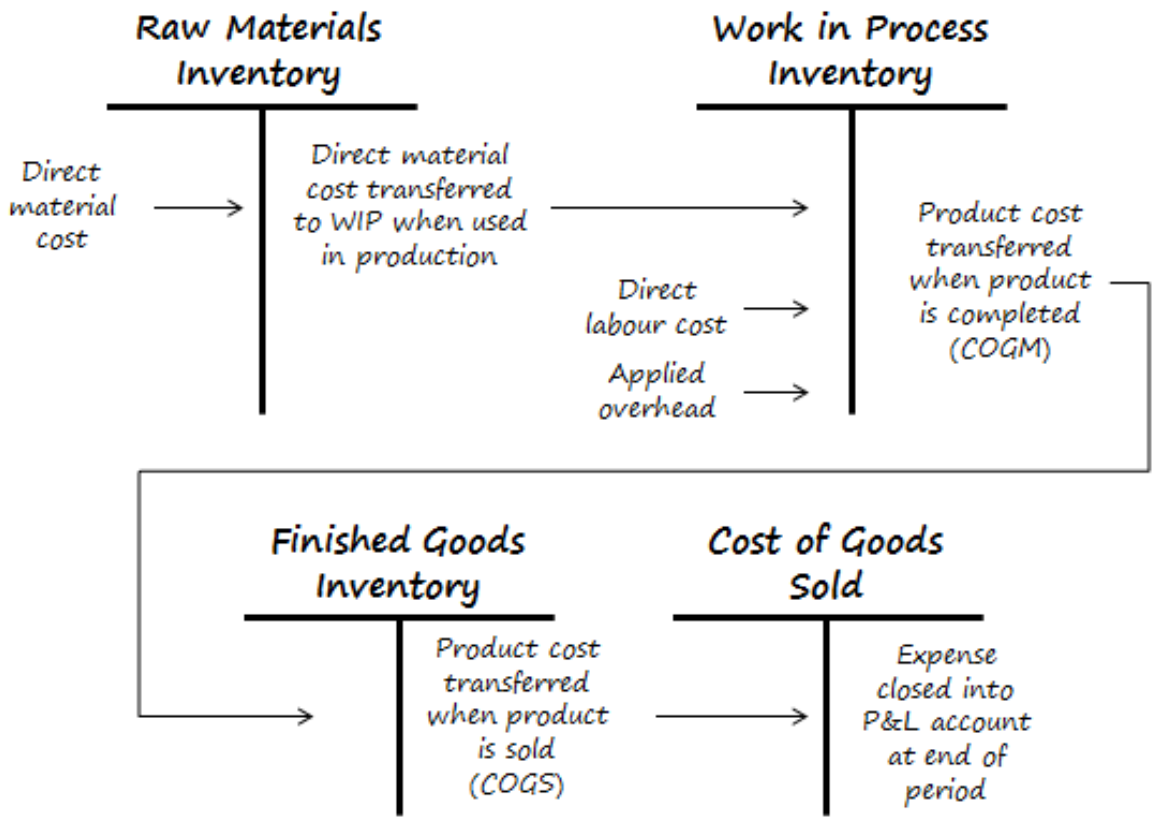
Conventional Product Costing Systems- Continued

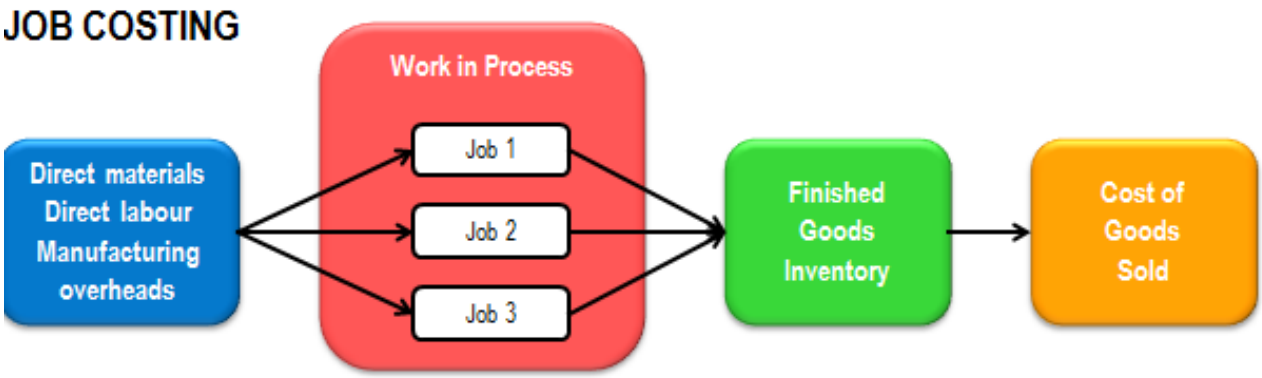
Firm	Job / Process
1. Manufacturer of beer (e.g. Lion Nathan)	Process
2. Construction firm (e.g. Bovis Lend Lease)	Job
3. Producer of bread (e.g. Goodman Fielder)	Process
4. Motion picture producer (e.g. Sony Pictures Entertainment)	Job

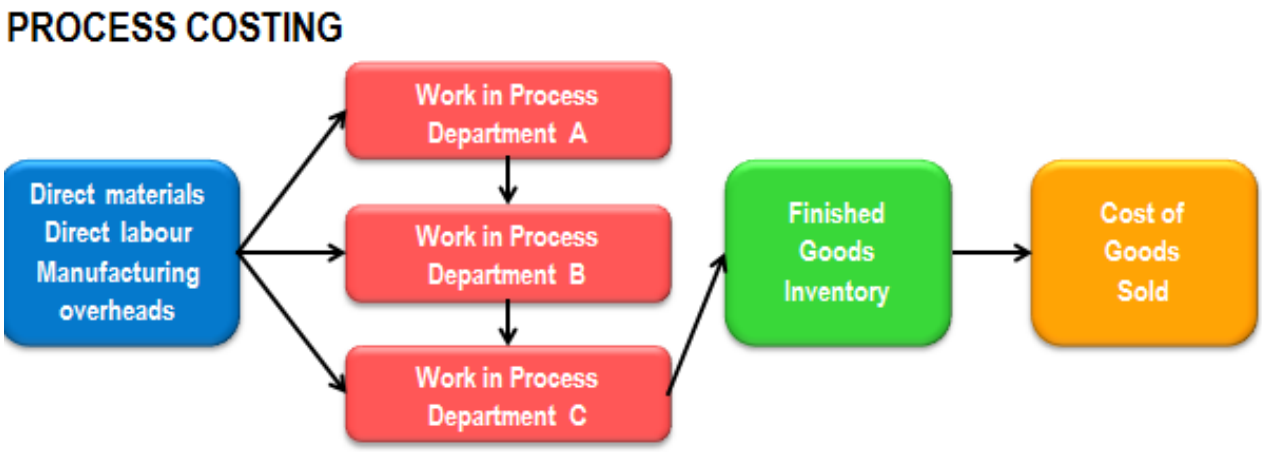
Costing System	Job Costing	Hybrid Costing	Process Costing
Firm Type	Individual or Small Batch Production	Large Batch or Assembly-Line Production	Mass Production
Product Features	Unique, highly customised	Both standard and custom aspects	Identical products
Production Environment	- Low production volume - Each product may have a unique production process - Extensive time with customer before and during production	- High production volume - Production is by repetitive and discrete processes - Moderate customer contact.	- Very high volume - Highly repetitive processes. - Little direct contact with customer during production stage

Costing System	Job Costing	Hybrid Costing	Process Costing
Firm Type	Professional Services	Service Shops	Mass Services
Product Features	Unique, customised	Both standard and custom aspects	Standard service
Production Environment	- Low volume of services - Considerable discretion in how the service is produced. - Extensive contact, time with customer. - Labour is the primary input.	- Many services provided. - Production is by repetitive and discrete processes - Moderate customer contact. - Significant back-office involvement and equipment use.	- Very high number of services produced. - Highly repetitive processes. - Very low contact with each customer. - Mostly back office with equipment as a key input.

Cost Flows in the General Ledger







Accounting for Overheads

Two types of manufacturing overhead are recorded in an accounting system:

- **Actual manufacturing overheads**
  - Accumulated as they are incurred throughout the accounting period.
- **Applied manufacturing overhead**
  - Estimated costs applied to the work in process (WIP) inventory account using a predetermined overhead rate

Why do firms use applied overhead?

- Some overheads are incurred infrequently
- Actual costs not always known during the period

In conventional costing systems, indirect costs are allocated using a single predetermined overhead rate. This is used for applying overhead to units of production.