

ICAN

Management information



**EMILE WOOLF
INTERNATIONAL**
Developing Trusted Professionals



Second edition published by
Emile Woolf International
Bracknell Enterprise & Innovation Hub
Ocean House, 12th Floor, The Ring
Bracknell, Berkshire, RG12 1AX United Kingdom
Email: info@ewiglobal.com
www.emilewoolf.com

© Emile Woolf International, February 2019
Second edition reviewed and updated by Institute of Chartered Accountants of Nigeria
February 2022

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Syllabus

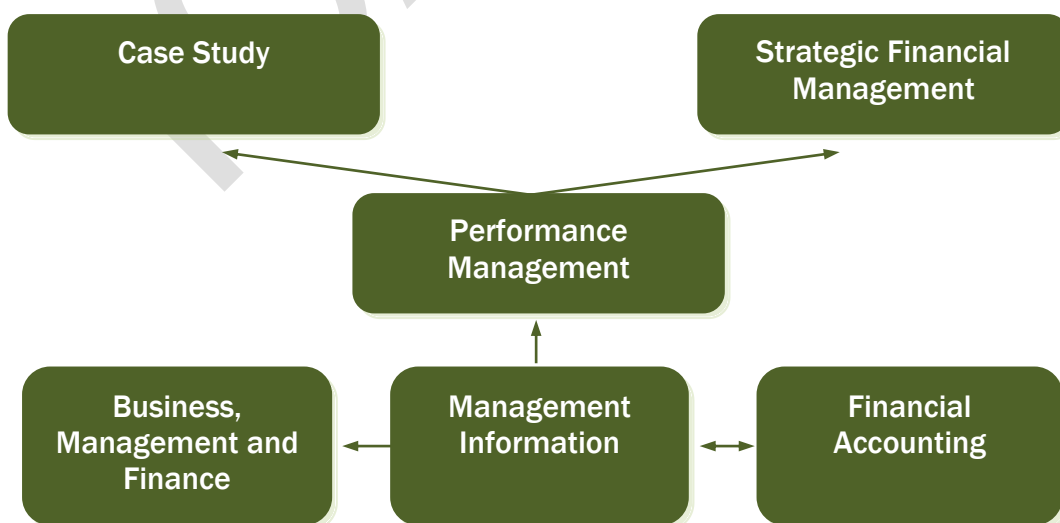
FOUNDATION LEVEL

MANAGEMENT INFORMATION

Accountants play vital roles in management, especially in management decision-making. Management information deals with the production of useful information to support management decision-making. Such information includes costing, management accounting and application of quantitative methods in financial management. Management information takes an integrated approach by developing an awareness of information technology and systems support.

Linkage with other subjects

All the fifteen subjects are interwoven especially in the aspect of Information System; Management Information is related to all other subjects at foundation level and it is a pre-requisite to Performance Management (PM) at Skills level.



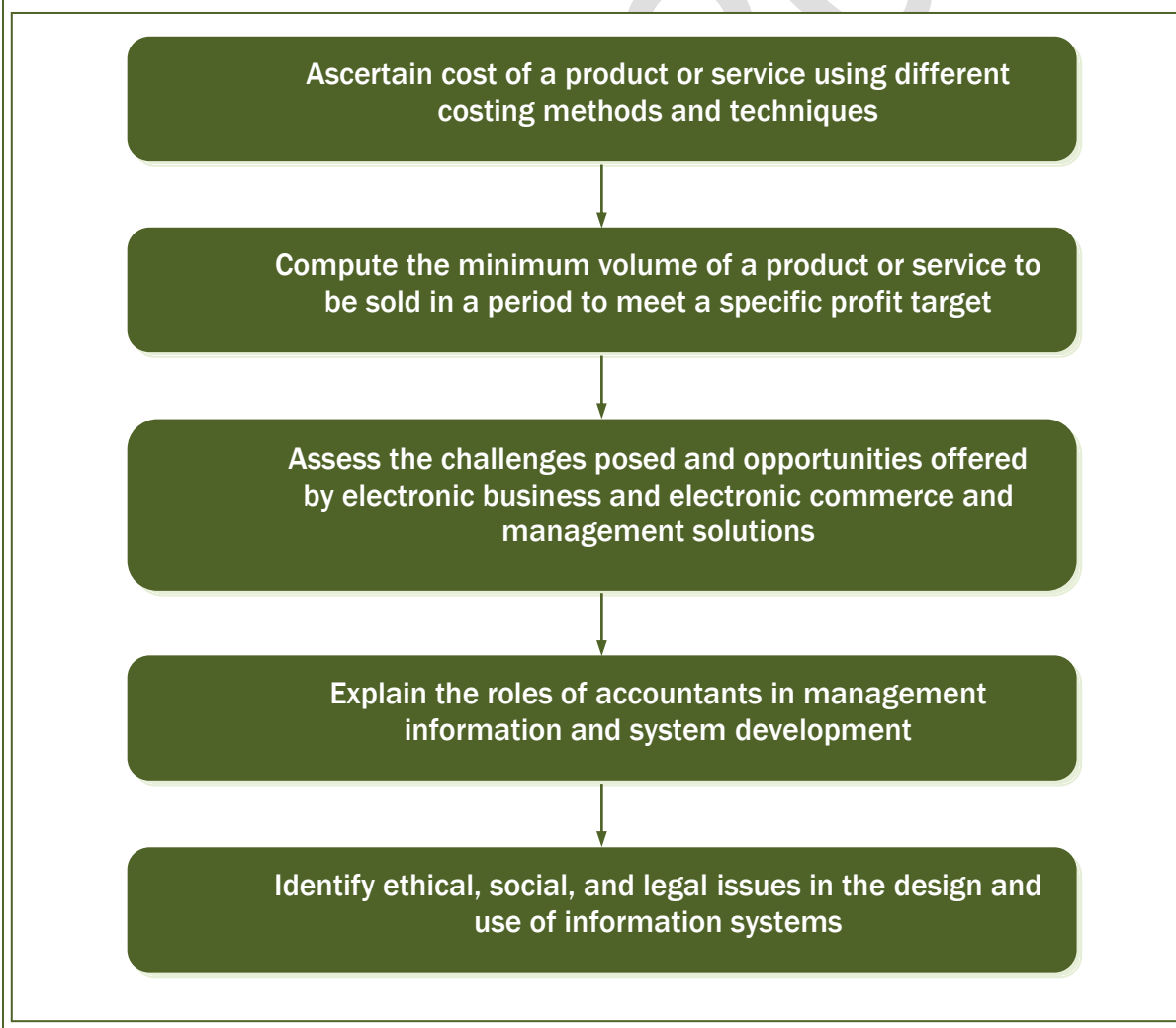
Main competencies

On successful completion of this paper, candidates should be able to:

- Ascertain cost of a product or service using different costing methods and techniques;
- Compute the minimum volume of a product or service to be sold in a period to meet a specific profit target;
- Assess the challenges posed and opportunities offered by electronic business and electronic commerce and management solutions;
- Explain the roles of accountants in information system development;
- Identify ethical, social, and legal issues in the design and use of information systems; and
- Ascertain cost of a product or service using different costing methods and techniques.

Linkage of the main competencies

This diagram illustrates the linkage between the main competencies of the syllabus and to assist candidates studying for the examination.



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Scope of cost and management accounting

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- 2 Cost and management accounting versus financial accounting
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INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

a	Cost accounting		
	1	Introduction to cost accounting	
		a	Describe the purpose and role of cost accounting within an organisation considering the following:
		i	Definition of cost accounting;
		ii	Purpose of cost accounting;
		iii	Role of cost accountants; and
		iv	Advantages and disadvantages of cost accounting.
		b	Differentiate between cost accounting and financial accounting.
		c	Outline the managerial processes of planning, decision making and control.
		d	Explain the concepts of strategic, tactical and operational planning.
		e	Differentiate between cost data and information.
		f	Explain the attributes of good information.

Exam context

This chapter provides background information as a context to the content in later chapters.

By the end of this chapter you should be able to explain the scope of cost accounting and managerial accounting and be in a position to compare them with financial accounting.

1 ACCOUNTING FOR MANAGEMENT

Section overview

- Introduction to accounting information
- Data and information
- Qualities of good information
- Purpose of management information
- Strategic, tactical and operational planning

1.1 Introduction to accounting information

Accounting is one of the key functions for any business; it may be handled by a bookkeeper and accountant at small firms or by sizable finance departments with dozens of employees at larger companies.

There are many definitions of accounting



Definitions: Accounting

The systematic and comprehensive recording of financial transactions pertaining to a business and the process of summarizing, analysing and reporting these transactions.

A systematic process of identifying, recording, measuring, classifying, verifying, summarizing, interpreting and communicating financial information.

The process of identifying, measuring, and communicating economic information to permit informed judgements and decisions by users of the information

The main purposes of accounting are to:

provide a record of the financial value of business transactions, and in doing so establish financial controls and reduce the risks of fraud;

assist with the management of the financial affairs of an entity; and

provide information - mainly information of a financial nature.

Accounting information is provided for:

Management, so that managers have the information they need to run the company;

and

Other users of information, many of them outside the entity. For example, a company produces accounting information for its shareholders in the form of financial statements, and financial statements are also used by tax authorities, investors, trade union representatives and others.

Cost and management accounting is concerned with the provision of information, mainly of a financial nature, for management.

1.2 Data and information

The terms 'data' and 'information' are often used as if they have the same meaning. However, there is a difference between data and information. Data is a term that refers to facts. It must be turned into information in order for it to become useful. Information is derived from facts that have been processed, structured and analysed.

Data consists of unprocessed facts and statistics.

Data is collected and processed to produce information.

Data has no meaning until it has been processed into information.

Information has a meaning and a purpose. It is produced from 'data'. It is processed data that has relevance to a particular useful purpose.

Accounting systems are designed to capture financial data and process it into information.



Illustration: Data and information

A company engages in many different types of transactions (sales, purchases of materials, expenses, and so on).

Each of these is processed into individual records (for example, sales are recorded on sales invoices). This would result in thousands of individual records.

An accounting system summarises these in a meaningful manner to produce information. This is carried out in a series of steps each of which provides information based ultimately on the original transactions.

Sales day book – summarises the total credit sales made in a specified period.

The receivables control account shows the total owed to the company at any point in time.

The receivables subsidiary ledger shows the total amount owed to the company by individual customers at any point in time.

The general ledger is the source of information which can be further processed into periodic reports (financial statements).

A cost accounting system records data about the costs of operations and activities within the entity. The sources of cost accounting data within an organisation include invoices, receipts, inventory records and time sheets.

Many of the documents from which cost data is captured are internally-generated documents, such as time sheets and material requisition notes.



Illustration: Data and information

A ship yard may employ hundreds of workers and be building and refitting several ships at any one time.

Each worker might be required to complete job sheets which specify the length of time taken by that worker and on which contract.

This would produce many thousands of individual records (data) which are not very useful until the facts contained in those records are processed into information. Thus, the system might produce reports (information) to show the labour cost, by type of labour, by week for each ship.

Data is analysed and processed to produce management information, often in the form of: routine reports; specially-prepared reports; and answers to 'one-off' enquiries that are input to a computer system.

Information produced from cost accounting data is management accounting information.

Management accounting systems also obtain information from other sources, including external sources, but the cost accounting system is a major source of management accounting information.

1.3 Qualities of good information

Information is only useful to managers if it possesses certain qualities or attributes.

Understandable.

Information should be understandable to the individuals who use it.

Accounting information must be set out clearly and are properly explained.

Purpose and relevance.

Unless information has a purpose it has no value at all and it makes no sense to provide it.

Information must be relevant to this purpose.

Reliable.

Users of information must be able to rely on it for its intended purpose.

Unreliable information is not useful.

Information does not have to be 100% accurate to be reliable. In many cases, information might be provided in the form of an estimate or forecast.

Sufficiently complete.

Information should include all information necessary for its purpose.

However, information in management reports should not be excessive, because important information may be hidden in the unimportant information, and it will take managers too long to read and understand.

Timeliness.

If information is provided too late for its purpose, it has no value.

With the widespread computerisation of accounting systems, including cost accounting systems, it might be appropriate for up-to-date management accounting information to be available on line and on demand whenever it is needed.

Comparability.

In accounting, it is often useful to make comparisons, such as comparisons of current year results with previous years, or comparisons of actual results with planned results. To make comparisons possible, information should be prepared on the same basis, using the same methods and the same 'rules'.

Communicated to the right person.

Management information should be communicated to the proper person.

This is the person with the authority to make a decision on the basis of the information received and who needs the information to make the decision.

Its value must exceed its cost (Information must be cost effective).

Management information has a value (if information has no value there is no point in having it) but obtaining it involves a cost.

The value of information comes from improving the quality of management decisions. Information is worth having only if it helps to improve management decisions, and the benefits from those decisions exceed the cost of providing the additional information.

1.4 Purpose of management information

The purpose of management accounting is to provide information for:
planning;
control; and
decision-making.

Planning

Planning involves the following:

setting the objectives for the organisation; and
making plans for achieving those objectives.

The planning process is a formal process and the end-result is a formal plan, authorised at an appropriate level in the management hierarchy. Formal plans include long-term business plans, budgets, sales plans, weekly production schedules, capital expenditure plans and so on.

Information is needed in order to make sensible plans – for example in order to prepare an annual budget, it is necessary to provide information about expected sales prices, sales quantities and costs, in the form of forecasts or estimates.

Control

Control of the performance of an organisation is an important management task. Control involves the following:

monitoring actual performance, and comparing actual performance with the objective or plan; taking control action where appropriate; and evaluating actual performance.

When operations appear to be getting out of control, management should be alerted so that suitable measures can be taken to deal with the problem. Control information might be provided in the form of routine performance reports or as special warnings or alerts when something unusual has occurred.

Decision making

Managers might need to make 'one-off' decisions, outside the formal planning and control systems. Management accounting information can be provided to help a manager decide what to do in any situation where a decision is needed.

1.5 Strategic, tactical and operational planning

Managers carry out their responsibilities at different levels in the hierarchy of an organisation, and decisions are made at all levels of management. These may be planning decisions, control decisions or 'one-off' decisions. Decision-making can be categorised into three levels: these different categories are probably most easily understood in relation to planning decisions.

Strategic planning. Strategic planning involves setting overall objectives for the organisation and developing broad plans, mostly over a fairly long-term, about how the objectives should be achieved. An example of a strategic plan is a five-year business plan. Strategic planning is the responsibility of senior management, who plan the strategic direction that the entity should be taking. To make long-term plans, managers need information. Much of this information is not financial in nature, and much of it comes from external sources (from sources outside the organisation). However, some accounting and financial information is needed for strategic planning purposes, and 'strategic management accounting' is a term for the provision of information for strategic planning purposes.

Tactical planning. Tactical planning involves developing shorter-term plans to implement longer-term strategic plans. They have a shorter time frame than strategic plans, and many tactical plans cover a period of six months or one year. They might also be sub-divided into shorter control periods, such as monthly periods, for the purpose of routine control reporting. They are also more detailed than strategic plans. In a large organisation, tactical planning involves managers below the most senior level ('middle management'), although tactical plans might require senior management approval. Much of the information for tactical planning comes from sources within the organisation, such as the cost accounting system, and much of it is financial in nature. An example of a tactical plan is an annual budget.

Operational planning. Operational planning is planning the operational activities of an entity in detail. Operational plans include production schedules, work schedules, machine utilisation plans, maintenance schedules, delivery schedules and so on. They are short-term plans such as daily or weekly operating schedules and most are not financial in nature. Operational planning should involve junior management and supervisors, although they might need the approval of middle management.

Management accounting information is provided mainly for strategic planning and tactical planning purposes, and for senior or middle management. However, the use of management accounting for tactical planning and control is probably more widespread than strategic management accounting.

The techniques described in later chapters of this study text relate mainly to the provision of information for planning and control at the tactical level.

2 COST AND MANAGEMENT ACCOUNTING VERSUS FINANCIAL ACCOUNTING

Section overview

Purpose and role of cost accounting, management accounting and financial accounting.

Comparison of financial accounting and cost and management accounting.

2.1 Purpose and role of cost accounting, management accounting and financial accounting

The terms cost accounting and management accounting are often used as having the same meaning. However, there are differences between the two.

Cost accounting

Cost accounting is concerned with identifying the cost of things. It involves the calculation and measurement of the resources used by a business in undertaking its various activities.

Cost accounting is concerned with gathering data about the costs of products or services and the cost of activities. There may be a formal costing system in which data about operational activities is recorded in a 'double entry' system of cost accounts in a 'cost ledger'. The cost accounting data is captured, stored and subsequently analysed to provide cost information to management.

Cost accounting information is historical in nature, and provides information about the actual costs of items and activities that have been incurred.

Management accounting

Management accounting is concerned with providing information to management that can be used to help run the business.

The purpose of management accounting is to provide detailed financial information to management, so that they can **plan and control** the activities or operations for which they are responsible.

Management accounting information is also provided to help managers make other decisions. In other words, management accounting provides management information to assist with planning, control and 'one-off' decisions.

Management accounting includes cost accounting as one of its disciplines but is wider in scope. Management accounting information is often prepared from an analysis of cost accounting data, although cost estimates and revenue estimates may be obtained from sources other than the cost accounting system.

Management accounting may be forward-looking, and used to provide information about expected costs and profits in the future.

Financial accounting

Financial accounting is concerned with providing information about the financial performance of an entity in a given period and the financial position of the entity at the end of that period.

The information is often provided to a wider range of stakeholders (those with an interest in the business) other than those who have access to management information. The most important of these are the owners of a business who may not take part in the day-to-day running of the business.

2.2 Comparison of financial accounting and cost and management accounting

Financial accounting

A financial accounting system is used to record the financial transactions of the entity, such as transactions relating to revenue, expenses, assets and liabilities.

It provides a record of the assets that the company owns, and what it owes and a record of the income that the entity has earned, and the expenditures it has incurred.

The financial accounting system provides the data that is used to prepare the financial statements of the entity at the end of each financial year (the statement of comprehensive income, statement of financial position, statement of cash flows, and so on).

Managers might use the information in the financial statements, but the main purpose of financial reporting is for '**external purposes**' rather than to provide management information. The main purpose of the financial statements of companies is to inform the company's shareholders (owners) about the financial performance and financial position of the company. They are also used as a basis for computation of the tax that the company should pay on its profits.

Financial statements are produced at the end of the financial year. Management need information much more regularly, throughout the year. They also need much more detailed information than is provided by a company's financial statements. They often need forward-looking forecasts, rather than reports of historical performance and what has happened in the past.

There is a statutory requirement for companies to produce annual financial statements, and other business entities need to produce financial statements for the purpose of making tax returns to the tax authorities.

Managers might find financial statements useful, but the main users of the financial statements of a company should be its shareholders. Other external users, such as potential investors, employees, trade unions and banks (lenders to the business) might also use the financial statements of a company to obtain information.

Cost and management accounting

Whereas financial statements from the financial accounting system are intended mainly for external users of financial information, management accounting information (obtained from the cost accounting system) is prepared specifically for internal use by management.

An entity might have a cost accounting system as well as a financial accounting system, so that it has two separate accounting systems in operation. A cost accounting system records the costs and revenues for individual jobs, processes, activities and products or services.

Like the financial accounting system, a cost accounting system is based on a double entry system of debits and credits.

However, the accounts in a cost accounting system are different from the accounts in the financial accounting systems. This is because the two accounting systems have different purposes and so record financial transactions in different ways.

There is no legal requirement for a cost accounting system. Business entities choose to have a cost accounting system, and will only do so if the perceived benefits of the system justify the cost of operating it.

(In business entities where there is no formal cost accounting system, managers still need management accounting information to run their business. Some management accounting information might be extracted from the financial accounting system, but in much less detail than a cost accounting system would provide.)

A comparison of financial and cost accounting systems of companies is summarised in the table below.

Financial accounting system	Cost accounting system
Prepared to meet a legal or regulatory requirement.	Prepared to meet the needs of management.
Used to prepare financial statements for shareholders and other external users. (Might also provide some information for management but this is not their primary purpose).	Used to prepare information for management (internal use only).
Content usually specified by a regulatory framework.	Content specified by the management of a company.
Prepared within a time frame specified by a legal or regulatory framework.	Prepared within a time frame specified by management.
Records revenues, expenditure, assets and liabilities.	Records costs of activities and used to provide detailed information about costs, revenues and profits for specific products, operations and activities.
Used mainly to provide a historical record of performance and financial position.	Provides historical information, but also used extensively for forecasting (forward-looking).

3 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:
 Explain the scope of cost accounting and managerial accounting and compare them with financial accounting.

Costs and cost behaviour

Contents

- 1 Introduction to costs
- 2 Cost classification by elements and function
- 3 Fixed and variable costs
- 4 Direct and indirect costs
- 5 Product costs and period costs
- 6 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A	Cost accounting			
	2	Cost classifications, codification, segregation and estimation		
		a	Cost classifications	
		I	Explain the meaning of cost classification.	
		ii	Explain the different classifications of cost.	
		iii	Describe different types of cost behaviour using graphical illustrations.	
		b	Cost codification	
		I	Define cost codification.	
		ii	Explain the principles of a coding system	
		iii	Explain and illustrate the use of codes in categorising transactions	

Exam context

This chapter explains different approaches to cost classification. This knowledge is vital in understanding costing and decision-making techniques covered in later chapters.

By the end of this chapter you should be able to:

- Explain the nature and behaviour of costs;
- Explain (with examples) fixed, variable, and semi-variable costs;
- Identify and give examples of fixed, variable, and semi-variable costs;
- Describe direct and indirect cost;
- Identify and give examples of direct and indirect cost; and
- Explain the terms product cost and period cost with appropriate examples.

1 INTRODUCTION TO COSTS

Section overview

Types of organisation

Cost classification: Introduction

1.1 Types of organisation

The following classification of organisations is useful for the purpose of learning about costs:

Manufacturing organisations; and

Service organisations.

Manufacturing organisations

There are different kinds of manufacturing organisations. They can be classified by the type of output produced which in turn implies the type of costing system they might use.

Type of production	Examples	Costing system
Identical (similar) products in large numbers	Bottles of soft drink	Batch costing
	Mobile phones	Standard costing
	Garments	
Identical products in large amounts by passing the product through a series of processes	Pharmaceuticals	Process costing (including joint product and by-product costing)
	Paint	
	Petroleum	
Identical products in large numbers customised in some way for different customers	Aircraft (which may vary in internal fit and external painting)	Job costing
	Own-brand foods for supermarkets	
One-off products to a customer's specification	Ships	Contract costing
	Airport facilities	
	Roads	
	Bridges	

Service organisations

Similar to the manufacturing industry there are different kinds of service organisations. These include, for example:

training and education;

healthcare;

travel and tourism;

financial services; and

entertainment and leisure.

One of the key differences between manufacturing and service industries is the tangibility of the product – manufacturing output is generally tangible and can be stored whereas output from the service industry is generally not tangible. The service is normally consumed at the time of delivery (production). For example, a patient visiting a doctor consumes the consultation as it is given.

However, some work-in-progress (WIP) may be recorded – for example an accountant who has spent 10 hours working on a tax advice project that will take 20 hours in total to complete. The first 10 hours would be described as WIP.

Costing systems typically used in service organisations include:
Standard costing.

For example the standard cost of delivering a doctor's consultation, the standard cost of a package holiday, the standard cost of a flight between Lagos and London
Job costing.

For example bespoke consultation projects in the financial services industry or the cost of an architect designing a ship.

The professional will usually apply a standard hourly rate whilst the total number of hours on each job varies

The need to know about costs

All organisations need to understand their costs.

An organisation needs to know:

how much it costs to make the products that it produces; or
how much it costs to provide its services to customers.

For an organisation that is required to make a profit, it is important to know the cost of items in order to:

make sure that the product or service is sold at a profit;
measure the actual profit that has been made; and
in the case of some companies, such as manufacturing companies, value inventory at the end of each accounting period.

For an organisation that is not required to make a profit (a 'not-for-profit organisation', such as a government department, state-owned agency or charity), it is important to know how much items cost, in order to:

control the entity;

measure to what extent it is achieving its objectives; and
plan expenditure for the future.

Terminology



Definitions: Cost object

Cost object: Any activity for which a separate measurement of costs is needed

Examples of cost objects include:

The cost of a product;

The cost of a service;

The cost of a department; and

The cost of a project



Definitions: Cost unit

Cost unit: A unit of product or service for which costs are determined

A cost unit is the basic unit of production for which costs are being measured.

The term cost unit should not be confused with the term unit cost.



Definitions: Unit cost

Unit cost is the cost incurred by a company to produce, store and sell one unit of a particular product.

Unit cost includes all fixed costs and all variable costs involved in production

Cost objects and cost units should be selected so as to provide management with the cost information they require.

Here are some examples of cost objects and cost units

Industry/activity	Cost object	Cost unit
Car manufacture	Cars produced	A car
Bakery	Bread produced	A batch of bread items
Steel works	Steel produced	Tonne of steel
Carpet manufacture	Carpets produced	Square metre of carpet
Retail operation	Cost of items sold	An item
Passenger transport service	Cost of transporting customers	Cost per passenger/mile (i.e. average cost of transporting a passenger one mile)
Road haulage	Cost of transporting items	Cost per tonne/mile (i.e. average cost of carrying one tonne of items for one mile)
University	Cost of teaching	Cost per student



Examples: Cost objects and cost units

A company manufactures tinned foods.

It has two products, tinned carrots and tinned beans. In its costing system, it has two cost objects, carrots and beans.

	Cost object	Cost unit
1	Carrots	Production cost per tin of carrots
2	Beans	Production cost per tin of beans



Examples: Cost objects and cost units

A transport company has a bus depot.

The company has a cost accounting system that records and measures the cost of operating the bus depot.

The costs of operating the depot are measured in three ways, as follows:

	Cost object	Cost unit
1	Buses	Operating cost per bus per month
2	Bus routes	Operating cost per month for each bus route
3	Bus drivers	Cost of operating the depot per month, per bus driver employed

1.2 Cost classification: Introduction

Costs can be classified in a number of ways including:

Elements of cost (material, labour, other expenses);

Function of the cost:

Production;

Non-production

Selling

Distribution

Administration

Finance;

Cost behaviour – i.e. how the cost varies at different levels of activity:

costs may stay constant at different levels of activity - fixed costs; or costs may stay vary at different levels of activity – variable costs.

Whether the cost can be directly attributed to units of production; and

Whether a cost is recognised in this period (period cost) or is carried forward as part of the inventory valuation (product cost).

Each of these will be explained in turn but before that note that the above classifications are not mutually exclusive.



Illustration: Cost classification

A car maker uses steel:

Steel is material;

Steel is a production cost (you cannot make a car without using steel);

Steel is a cost which varies with the number of cars produced;

Steel can be directly attributable to a car; and

Steel is a product cost.

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Section overview

Cost classification by elements
 Cost classification by function
 Production or non-production?
 Usefulness of classifying costs by function
 The importance of separating production and non-production costs
 Reporting profit

2.1 Cost classification by elements

There are three basic elements of cost, these are: material; labour; and overheads (other expenses)

Material costs

Material costs are the costs of any material items purchased from suppliers, with the intention of using them or consuming them in the fairly short-term future.

In a manufacturing company, material costs include the cost of the raw materials used in producing the manufactured output.

In an office, costs of materials consumed include the costs of stationery and replacement of printer cartridges for the office laser printers.

Labour costs

Labour costs are the remuneration costs of all employees employed and paid by the entity. This includes the wages and salaries of part-time workers and the costs of any bonuses, pension contributions and other items that are paid in addition to basic wages and salaries.

Overheads (Other expenses)

Other expenses include the costs of any items that are not material costs or labour costs. They include the cost of services provided by external suppliers (the charges made by sub-contractors, charges for repairs by external contractors, rental costs, telephone costs, insurance costs, costs of energy (gas, electricity), travelling and subsistence expenses, and depreciation charges for non-current assets.

In a cost accounting system, all these items of cost must be recorded, and there needs to be an organised system for recording them. Cost items need to be grouped into categories of similar costs.

2.2 Cost classification by function

A manufacturing company would classify costs according to their function: categorised as either:

production costs (manufacturing costs); and

non-production costs (non-manufacturing costs).

Production costs

Production costs are the costs incurred in manufacturing finished products, up to the time that the manufacture of the goods is completed, and the goods are either transferred to the finished goods inventory or delivered immediately to the customer.

Production costs include:

the material cost of the raw materials and components, purchased from suppliers and used in the production of the goods that are manufactured;

the labour cost of all employees working for the manufacturing function, such as machine operators, supervisors, factory supervisors and the factory manager; and

other expenses of the factory, such as rental costs for the factory building, energy costs and the cost of depreciation of factory machinery.

Non-production costs

Non-production costs are any items of cost that are not production costs.

Non-production costs can be further classified according to their function as:

selling costs;

distribution costs;

administration costs; and

finance costs.

Administration costs

Administration costs are the costs of providing administration services for the entity. They might be called 'head office costs' and usually include the costs of the human relations department and accounting department. They should include:

the salary costs of all the staff working in the administration departments;

the costs of the office space used by these departments, such as office rental costs; and

other administration expenses, such as the costs of heating and lighting for the administration offices, the depreciation costs of equipment used by the administration departments, fees paid to the company's solicitors for legal services, costs of office stationery and so on.

Selling and distribution costs (marketing costs)

Selling and distribution costs are the costs incurred in marketing and selling goods or services to customers, and the costs of delivering the goods to customers. The costs of

after-sales services, such as customer support services, are usually included in these costs. Sales and distribution costs include:
the wages and salary costs of all employees working in the selling and distribution departments, including sales commissions for sales representatives;
advertising costs and other marketing costs;
operating costs for delivery vehicles (for delivering finished goods to customers), such as fuel costs and vehicle repair costs; and
other costs, including depreciation costs for the delivery vehicles.

Finance costs

Finance costs include costs that are involved in financing the organisation, for example, loan interest or bank overdraft charges.

Finance costs might be included in general administration costs. Alternatively, finance costs might be excluded from the cost accounting system because they are relevant to financial reporting (and the financial accounting system) but are not relevant to the measurement of costs.

2.3 Production or non-production?

Some costs might be partly production costs, partly administration costs and partly sales and distribution costs. For example:

The salary of the managing director, because the managing director spends time on all aspects of the company's operations; and.

Building rental costs, when the same building is used by more than one function. For example administration staff and sales staff might share the same offices.

When costs are shared between two or more functions, they are divided between the functions on a fair basis.

For example, the salary of the managing director might be divided equally manufacturing costs, administration costs and sales and distribution costs. Dividing common costs on a fair basis is called **apportionment** of the cost.



Practice question

1

A company uses three categories of functional cost in its cost accounting system. These are manufacturing costs, administration costs and sales and distribution costs.

Identify the functional cost category for each of the following costs:

- 1 Salary of the chief accountant
- 2 Telephone charges
- 3 Cost of office cleaning services
- 4 Cost of warehouse staff

2.4 Usefulness of classifying costs by function

Separating costs into the costs for each function can provide useful information for management.

Functional costs show managers what they are expected to spend on each function (budgeted costs) and how much they are actually spending.



Example:

Functional costs might be used in an income statement to report the profit or loss of a company during a financial period, as follows:

	₦m	₦m
Sales revenue		600
Manufacturing cost of sales		<u>200</u>
Gross profit		400
Administration costs	120	
Selling and distribution costs	<u>230</u>	
		<u>350</u>
Net profit (or net loss)		<u>50</u>

2.5 The importance of separating production and non-production costs Inventory

It is important to separate production costs from non-production costs in a manufacturing business for the purpose of valuing closing inventory which will consist of:

finished goods that have been produced during the financial period but not yet sold (finished goods inventory); and
partly finished production (work-in-progress or WIP).

The costs of finished goods and work-in-progress consist of their production costs. Total production costs during a period must therefore be divided or shared between:
goods produced and sold in the period;
goods produced but not yet sold (finished goods); and
work-in-progress.

Non-production costs are **never** included in the cost of inventory.

2.6 Reporting profit

Profit is the revenue for a financial period minus the costs for the period. The profit or loss earned during a financial period is reported in a statement of comprehensive income (also known as an income statement).

In most financial accounting examples the cost of sales figure is built from purchases as adjusted by inventory movement.

It is comprised of the cost of goods made (instead of purchases) as adjusted by finished goods inventory movement. The cost of goods made is a more complex figure than purchases. It comprises direct materials used, direct labour and production overheads adjusted by movement in work in progress in the year. It is often constructed in a manufacturing account. The total from this account feeds into the statement of comprehensive income.



Illustration: Manufacturing account

	₦	₦
Raw materials		
Opening inventory		25,000
Purchases		150,000
Raw materials available		<u>175,000</u>
Less: Closing inventory		<u>(20,000)</u>
Raw materials consumed		155,000
Manufacturing wages		100,000
Prime cost		255,000
Overheads		
Light and power	72,000	
Depreciation of production machinery	40,000	
Depreciation of factory	50,000	
		<u>162,000</u>
Manufacturing costs		417,000
Add: Opening work in progress		85,000
Less: Closing work in progress		<u>(95,000)</u>
Cost of goods made		407,000

The cost of goods made is transferred to the statement of comprehensive income.



Illustration: Statement of comprehensive income to show transfer of cost of goods made.

	₦	₦
Sales revenue		800,000
Less cost of goods sold		
Opening inventory of finished goods	50,000	
Cost of goods made	407,000	
		<u>457,000</u>
Closing inventory of finished goods	<u>(40,000)</u>	
Cost of sales		<u>(417,000)</u>
Gross profit		383,000
Administration costs	86,000	
Selling and distribution costs	94,000	
		<u>(180,000)</u>
Net profit for the period		<u>203,000</u>

3 FIXED AND VARIABLE COSTS

Section overview

Cost behaviour
Fixed costs
Variable costs
Semi-variable costs
Stepped costs

3.1 Cost behaviour

Cost behaviour refers to the way in which costs change as the volume of activity changes. The volume of activity may be:

the volume of sales;

the volume of production;

total labour hours worked, machine hours worked;

the number of production units inspected; and

the number of journeys (for buses or trains) or deliveries, and so on.

As a general rule, total costs are expected to increase as the volume of activity rises.

Management might want information about estimated costs, or about what costs should have been. An understanding of cost behaviour is necessary in order to:

forecast or plan what costs ought to be; and

compare actual costs that were incurred with what the costs should have been.

The most important classification of costs for the purpose of cost estimation is the division of costs into fixed costs or variable costs.

3.2 Fixed costs

Fixed costs are items of cost that remain the same in total during a time period, no matter how many units are produced, and regardless of the volume or scale of activity. Fixed costs might be specified for a given period of time. In such cases the fixed costs for a longer period would be scaled up.

Examples of fixed costs include:

The rental cost of a building is ₦40,000 per month. The rental cost is fixed for a given period: ₦40,000 per month, or ₦480,000 per year; and

The salary costs of a worker who is paid ₦11,000 per month. The fixed cost is ₦11,000 per month or ₦132,000 per year.

Note that as activity levels increase the cost remains fixed. However, the cost per unit falls because the cost is being spread over a greater number of units.

3.3 Variable costs

Variable costs are costs that increase, usually by the same amount, for each additional unit of product that is made or each additional unit of service that is provided.

The variable cost of a cost unit is also called the marginal cost of the unit.

The variable cost per unit is often the same amount for each additional unit of output or unit of activity.

This means that total variable costs increase in direct proportion to the total volume of output or activity.

Examples of variable cost items.

The cost of buying raw material is ₦500 per litre regardless of purchase quantity. The variable cost is ₦500 per litre:

the total cost of buying 1,000 litres is ₦500,000; and

the total cost of buying 2,000 litres would be ₦1,000,000.

The rate of pay for hourly-paid workers is ₦150 per hour.

400 hours of labour would cost ₦60,000; and

500 hours would cost ₦75,000.

The time needed to produce an item of product is 4 minutes and labour is paid ₦150 per hour.

direct labour is a variable cost and the direct labour cost per unit produced is ₦10 ($= ₦150 \times 4/60$).

The cost of telephone calls is ₦1 per minute.

The cost of telephone calls lasting 6,000 minutes in total would be ₦6,000.

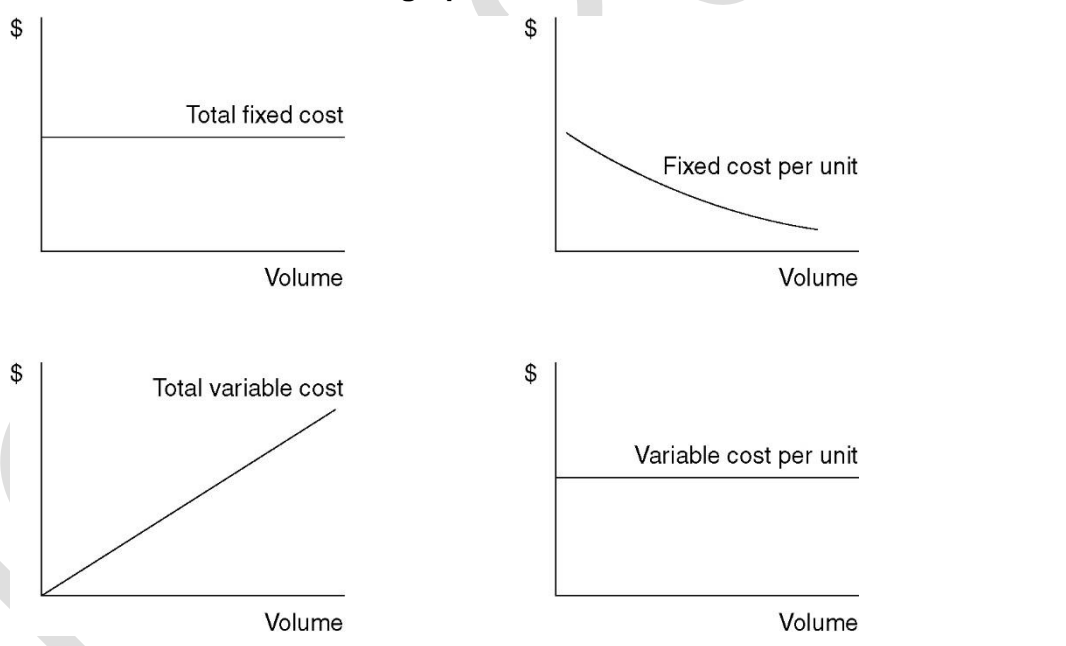
Note that as activity levels increase the cost per unit remains fixed. However, the total cost increases as more units are being made.

Cost behaviour graphs: fixed and variable costs

Cost behaviour for items of cost (or for costs in total) can be shown graphically either showing the total cost incurred at different activity levels or the cost per item at different activity levels.



Illustration: Cost behaviour graphs for fixed costs and variable costs

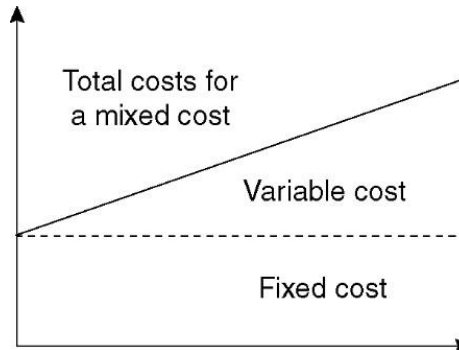


3.4 Semi-variable costs

A semi-variable cost, is a cost that is partly fixed and partly variable. A cost behaviour graph showing the total costs for an item of mixed cost is shown below.



Illustration: Semi variable costs



An item of cost that is a mixed cost is an item with a fixed minimum cost per period plus a variable cost for every unit of activity or output.



Example: Semi variable costs

A company uses a photocopier machine under a rental agreement. The photocopier rental cost is ₦4,000 per month plus ₦2 per copy produced.

The company makes 15,000 copies during a month:

Total cost is as follows:

	₦
Fixed cost	4,000
Variable cost (15,000 × ₦2)	30,000
	34,000

Mixed costs are important in cost and management accounting. It is often assumed that the total costs of an activity are mixed costs, consisting partly of fixed costs and partly of variable costs.

For example, it might be assumed that the total selling and distribution costs for a company each month are mixed costs. If this assumption is used, the total mixed costs can be divided into two separate parts, fixed costs and variable costs.

If costs can be analysed as a fixed amount of cost per period plus a variable cost per unit, estimating what future costs should be, or what actual costs should have been, becomes fairly simple.



Example: Cost forecasting

The management accountant of a manufacturing company has estimated that production costs in a factory that manufactures Product Y are fixed costs of ₦250,000 per month plus variable costs of ₦30 per unit of Product Y output.

The expected output next month is 120,000 units of Product Y.

Expected total costs are therefore:

	₦
Variable costs (120,000 × ₦30)	3,600,000
Fixed costs	<u>250,000</u>
Total costs	<u>3,850,000</u>

Forecasting is covered in more detail in a later chapter.

3.5 Stepped cost

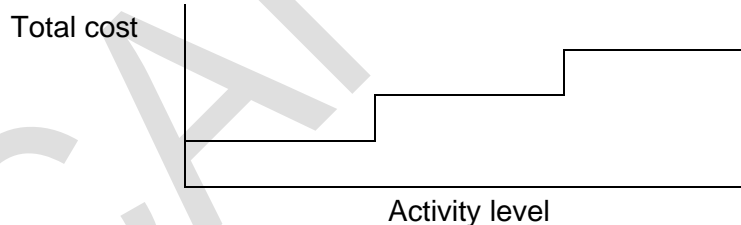
A **stepped fixed cost** is a cost which:

has a fixed cost behaviour pattern within a limited range of activity; and goes up or down in steps when the volume of activity rises above or falls below certain levels.

On a cost behaviour graph, step fixed costs look like steps rising from left to right.



Illustration: Stepped cost





Example: Stepped cost

A company might pay its supervisors a salary of ₦20,000 each month.

When production is less than 2,000 hours each month, only one supervisor is needed:

When production is between 2,001 and 4,000 hours each month, two supervisors are needed.

When output is over 4,000 hours each month, three supervisors are needed.

The cost profile is as follows:

Activity level:	₦
2,000 hours or less (1 × ₦20,000)	20,000
2,001 to 4,000 (2 × ₦20,000)	40,000
Over 4,000 (3 × ₦20,000)	60,000

The supervision costs are fixed costs within a certain range of output, but go up or down in steps as the output level rises above or falls below certain levels.



Practice questions

2



On the axes provided, on which the vertical axis denotes cost and the horizontal axis the appropriate level of activity, show the following cost behaviour graphs:

- (a) Fixed costs;
- (b) Variable costs;
- (c) Semi-variable costs;
- (d) Annual rates bill;
- (e) Direct labour cost;
- (f) Annual telephone bill;
- (g) Direct materials cost if bulk discount is offered on all purchases once the total purchased exceeds a certain level;
- (h) Supervisory costs; and
- (i) Labour costs if staff are paid a fixed weekly wage for a 35-hour week and any additional production is completed in overtime, when staff are paid time and a half.

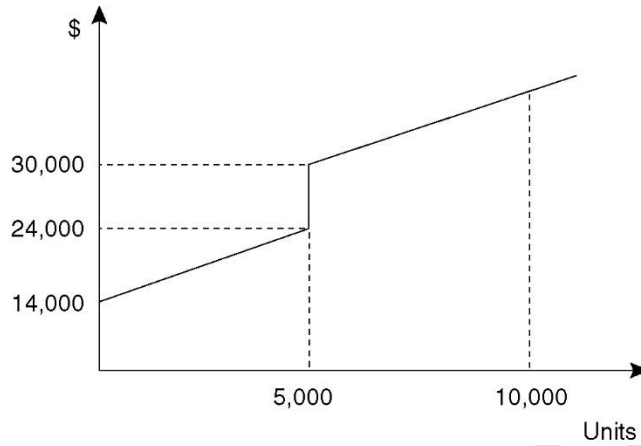
(a)		(b)		(c)
(d)		(e)		(f)
(g)		(h)		(i)



Practice question

3

- 1 From the information in this cost behaviour graph, describe the behaviour of this item of cost, and calculate the total cost at 10,000 units of output.



4 DIRECT AND INDIRECT COSTS

Section overview

Introduction
Direct costs
Indirect costs (overheads)
Full cost
Cost codes

4.1 Introduction

Costs may also be classified as:

direct costs; or

indirect costs (also known as overheads).

There are direct and indirect material costs, direct and indirect labour costs and direct and indirect expenses.

4.2 Direct costs



Definition: Direct costs

Direct costs: Costs that can be traced in full to a cost unit.

A direct cost can be attributed in its entirety to the cost of an item that is being produced.

For example, in a manufacturing company that produces television sets, the direct cost of making a television consists of direct materials and direct labour costs, and possibly some direct expenses.

The direct materials cost is the cost of the raw materials and components that have gone into making the television.

The direct labour cost is the cost of the labour time of the employees who have been directly involved in making the television.

Direct materials



Definition: Direct materials

Direct materials are all materials that become part of the cost unit.

Direct materials are all materials that can be attributed directly in full to a cost unit.

They are used directly in the manufacture of a product or in providing a service.

Direct materials may consist of either or both:

raw materials, such as glass, metals and chemicals; and

components purchased from an external supplier: for example, the direct materials of a car manufacturer include components purchased from other suppliers, such as windows, wheels and tyres.

Examples of direct materials include:



Example: Direct materials

Cost unit	Direct materials
Pair of shoes	Leather, glue, nails, laces
Office chair	Wheels, a stand, a seat (with seat cushion), back rest, arm rests and fabric
Restaurant meal	Ingredients
Car	Steel, aluminium, windows, lights, gear box, engine, wheels etc.
House	Bricks, wood, cement

Services might also incur some direct materials costs. For example, with catering and restaurant services the direct materials include the major items of food (and drink).

Direct labour



Definition: Direct labour

Direct labour is labour time that can be attributed directly in full to a cost unit.

Direct labour costs are the specific costs associated with the labour time spent directly on production of a good or service.

Labour costs are direct costs for work done by direct labour employees. Direct labour employees are employees whose time is spent directly on producing a manufactured item or service.



Example: Direct labour employees

Cost unit	Direct labour
Car	Machinists working in the machining department Assembly workers in the assembly department Workers in the spray painting shop
House	Bricklayers are direct labour employees of a house-building firm
Tonne of coal	Miners

Direct labour costs also include the cost of employees who directly provide a service.



Example: Direct labour employees (service industry).

Cost unit	Direct labour
Day of storage	Warehouse staff
Audit (other consultancy product)	Professional staff
Teaching day	Teachers (tutorial staff at a college)

Direct expenses



Definition: Direct expenses

Direct expenses are expenses that can be attributed directly in full to a cost unit.

Direct expenses are expenses that have been incurred in full as a direct consequence of making a unit of product, or providing a service, or running a department.

In manufacturing, direct expenses are not common for manufactured units of output, and direct costs normally consist of just direct materials and direct labour costs.



Example: Direct expenses

Cost unit	Direct expense
A house	Hire of equipment (for example a cement mixer) Payment of fees to sub-contractors.

Prime cost

The prime cost of an item is its total direct cost.



Definition: Prime cost

The prime cost of a cost unit is the sum of all of the direct costs of making that unit.



Illustration: Prime cost

	₦
Direct material cost	X
Direct labour cost	X
Direct expenses	X
Prime cost	<u>X</u>

4.3 Indirect costs (overheads)



Definition: Indirect cost

An indirect cost (overhead cost) is any cost that is not a direct cost.

Indirect costs (overheads) cannot be attributed directly and in full to a cost unit.

Indirect costs include production overheads and non-production overheads. Each of these might include indirect materials costs, indirect labour costs and indirect expenses costs.

Indirect material costs

Indirect materials are any materials that are used or consumed that cannot be attributed in full to the item being costed. Indirect materials are treated as an overhead cost, and may be classified as production overheads, administration overheads or sales and distribution overheads.

Indirect materials in production include cleaning materials and any materials used by production departments or staff who are not engaged directly in making a product.

Indirect production materials may also include some items of materials that are inexpensive and whose cost or value is immaterial. These may include nails, nuts and bolts, buttons and thread, and so on. The effort of measuring a cost for these materials is not worth the value of the cost information that would be produced; therefore these 'direct' materials are often treated as indirect materials.



Practice question

4



In which of the following types of company would fuel costs be treated as a direct material cost?

- 1 Manufacturing company
- 2 Road haulage (road transport) company
- 3 Construction company
- 4 Motorway fuel station

Indirect labour costs

Indirect labour costs consist mainly of the cost of indirect labour employees. Indirect labour employees are individuals who do not work directly on the items that are produced or the services that are provided.

Some factory workers do not work directly in the production of cost units but are necessary so that production takes place. In a manufacturing environment, indirect labour employees include staff in the stores and materials handling department (for example, fork lift truck drivers), supervisors, and repairs and maintenance engineers.

All employees in administration departments and marketing departments (sales and distribution staff) – including management – are normally indirect employees.

Indirect expenses

Many costs incurred cannot be directly linked to cost units.

For example, the rental costs for a factory and the costs of gas and electricity consumption for a factory cannot be attributed in full to any particular units of production. They are indirect production costs (production overheads).

In a manufacturing company, all costs of administration are usually treated as indirect costs (administration overheads) and all or most sales and distribution costs are also usually treated as sales and distribution overheads.

4.4 Full cost

The full cost of a unit of product (or the full cost of a unit of service) is a cost that includes both direct costs and some overheads. The full cost of a unit of product might be analysed as follows:



Illustration: Full cost

	₦
Direct materials cost	X
Direct labour cost	X
Direct expenses	X
Prime cost	X
Manufacturing overhead (or production overhead)	X
Full production cost	X
Non-production costs	
Administration overhead	X
Selling and distribution overhead	X
Full cost of sale	X

Notes:

- 1 Prime cost plus a share of production overheads are the full production cost or 'fully absorbed production cost' of the cost unit; and
- 2 In cost accounting systems, it is common practice to include production overheads in unit costs and measure the full production cost per unit. However, administration and selling and distribution overhead costs are not usually included in the cost of each unit. Instead, they are treated in total as an expense for the period ('period costs' – see below).

4.5 Cost codes

Once costs have been classified, a coding system can be applied to make it easier to manage the cost data.

Each cost might be given its own code. A code is a collection of symbols used to reference a particular item.

The main purposes of cost codes are to:

assist the communication of precise information; reduce clerical work. For example the code 13422 would replace the title 'selling expense - Eastern Division travel', thus

simplifying communication and improving accuracy;

facilitate electronic data processing. Computer analysis, summarisation and presentation of data can be performed more easily through the medium of codes;

facilitate a logical and systematic arrangement of costing records i.e. accounts can be arranged in blocks of codes permitting additional codes to be inserted in logical order; simplify comparison of totals of similar expenses rather than all the individual items.

This facilitates control; and

incorporate check codes within the main code to check the accuracy of posting.

A coding system should have the following characteristics:

The coding system should be comprehensive allowing every recorded item to be coded easily;

Each item (expense type) should have a unique code, ideally of uniform length and with each code built according to consistent rules;

The system must be easy to use, communicate and interpret;

The system should allow for expansion; and
The allocation of code references should be tightly controlled with strict protocols over additions, deletions or changes to codes.



Illustration: Coding architecture

Suppose a company operated a four digit coding system with the first two digits providing information about why the cost is incurred and the next two providing information about whether the cost is fixed or variable.

	Code
Purpose of the cost:	
Direct production cost	01
Indirect production cost	02
Distribution	03
Administration	04
Cost characteristic:	
Fixed	01
Variable	02
Semi-variable	03

Examples of codes constructed to the above protocol could be as follows:

Factory rent	0201
Raw materials for production	0102
Sales director's salary	0301
Energy used in the factory	0202

In practice, codes would typically be much longer than the above four digits code, carrying more information about the expense.

5 PRODUCT COSTS AND PERIOD COSTS

Section overview

Product costs and period costs

5.1 Product costs and period costs

Costs are typically classified as either product costs or period costs when preparing financial statements.



Definition: Product cost

Product costs are costs associated with goods that are produced or purchased for resale.

Product costs are accounted for as inventory and held on the statement of financial position (subject to accounting valuation rules) until the inventory is sold. Only when the inventory is sold are product costs expensed in the profit and loss account.

Product costs include the prime cost (direct materials + direct labour + direct expenses) plus the production overhead.



Definition: Period cost

Period costs are costs that are deducted as expenses during a particular period. They do not contribute towards the value of inventory and are therefore not held on the statement of financial position. They are therefore expensed when they occur – i.e. in the period in which they occurred.

Period costs are the non-production overheads

In summary then

product costs are expensed when the inventory is sold

period costs are expensed as soon as they are incurred



Example: A retailer

A retailer owns a shop, employs a shop assistant, invests in sales and advertising and acquires goods for resale.

The cost of goods purchased for resale is product costs and accounted for as inventory. These are only expensed when the goods are sold (which may be in a subsequent accounting period).

The sales and advertising costs and the salary of the shop assistant are period costs which are expensed immediately in the accounting period in which they were incurred. Note that the salary of the shop assistant would be called an administration expense.

6 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the nature and behaviour of costs;

Explain (with examples) fixed, variable, and semi variable costs;

Identify and give examples of fixed, variable, and semi variable costs;

Describe direct and indirect cost;

Identify and give examples of direct and indirect cost; and

Explain the terms product cost and period cost with appropriate examples.

SOLUTIONS TO PRACTICE QUESTIONS

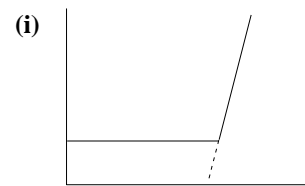
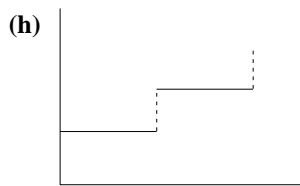
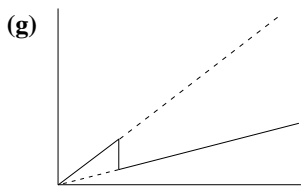
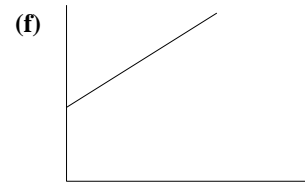
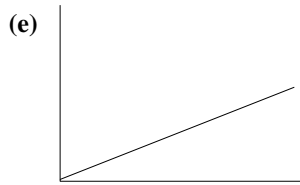
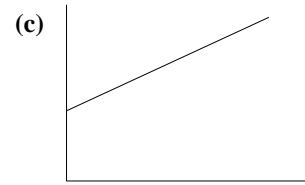
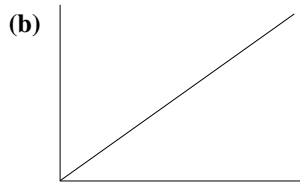
Solutions

1

- 1 **Chief accountant's salary.** Accounting department costs are an administration cost, and the salary of the chief accountant is treated in full as an administration costs.
- 2 **Telephone charges.** These are usually treated as administration costs, unless the charges can be traced directly to telephones in the manufacturing department or the sales and distribution department. When charges can be traced directly to telephones in the manufacturing department, they should be recorded as manufacturing costs.
- 3 **Office cleaning services.** These are usually treated as administration costs, unless the charges can be traced directly to offices used by the sales and distribution staff, or the production staff.
- 4 **Warehouse staff.** These are manufacturing costs when the warehouse is used to store raw materials and components. They are sales and distribution costs when the warehouse is used to store finished goods. If the warehouse stores raw materials and finished goods, the wages costs should be apportioned between production costs and sales and distribution costs.

Solutions

2



Solution**3**

The cost item is a mixed cost. Up to 5,000 units of output, total fixed costs are ₦14,000 and the variable cost per unit is $\text{₦}(24,000 - 14,000)/5,000 \text{ units} = \text{₦}2$ per unit.

At the 5,000 units of output, there is a step increase in fixed costs of ₦6,000 (from ₦24,000 total costs to ₦30,000 total costs). Total fixed costs therefore rise from ₦14,000 to ₦20,000. The variable cost per unit remains unchanged.

At the 10,000 units level, total costs are therefore:

	₦
Variable costs (10,000 × ₦2)	20,000
Fixed costs	<u>20,000</u>
Total costs	<u>40,000</u>

Solutions**4**

- 1 Manufacturing company.** Fuel costs are an indirect expense. Fuel used in the company's vehicles is unlikely to be considered a material cost at all, but would be treated as an overhead expense.
- 2 Road haulage company.** Since fuel is a major cost of operating a road haulage service, fuel costs are likely to be treated as a direct material cost of operations.
- 3 Construction company.** Fuel costs are likely to be an indirect expense, for the same reasons that apply to a manufacturing company.
- 4 Motorway service station.** This sells fuel to customers. In a retail operation, items sold to customers are direct costs of sale. The cost of the fuel sold is therefore a direct material cost (= a cost of sale).

Cost segregation and estimation

Contents

- 1 Introduction to cost segregation
- 2 High/low method
- 3 Linear regression analysis
- 4 Correlation and the correlation coefficient
- 5 Other approaches to cost estimation
- 6 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A	Cost accounting		
	2	Cost classifications, codification, segregation and estimation	
		C	Cost segregation and estimation
		i	Explain the meaning of cost segregation and cost estimation.
		ii	Explain the structure of linear functions and equations.
		iii	Demonstrate the use of the following cost segregation techniques:
			• Industrial engineering;
			• Account analysis;
			• Scatter graph;
			• High/low analysis; and
			• Regression analyses.
		iv	Calculate and explain simple correlation coefficient.

Exam context

This chapter explains the two methods of estimating fixed and variable costs from historical data.

By the end of this chapter, you should be able to:

- Calculate fixed and variable costs by using high-low points method;
- Calculate fixed and variable costs by using regression analysis; and
- Explain correlation and interpret correlation coefficients.

1 INTRODUCTION TO COST SEGREGATION

Section overview

Analysing fixed and variable costs

Scatter graph

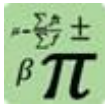
1.1 Analysing fixed and variable costs

The previous chapter explained the concept of semi-variable costs.

The total costs associated with a business (or a part of a business, for example a production line) are the sum of the fixed costs and the variable costs. In other words, the total is semi-variable in nature.

There are techniques available to split the total costs of a business (or part of a business) into fixed cost and variable cost. This is known as **cost segregation**.

If total costs can be divided into fixed costs and variable costs per unit of output or unit of activity, a formula for total costs is:



Formula: Total costs

$$y = a + bx$$

Where:

y = total costs in a period

x = the number of units of output or the volume of activity in the period

a = the fixed costs in the period

b = the variable cost per unit of output or unit of activity.

There are several methods of constructing the total cost function equation. These include:

constructing a scatter graph;

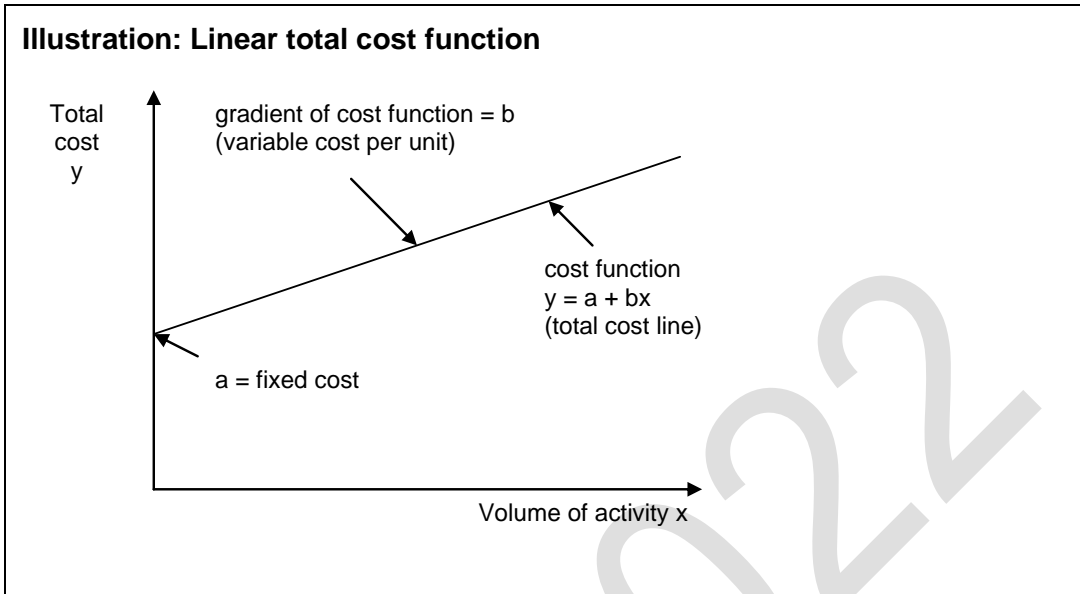
account analysis;

high/low analysis; and

linear regression analysis.

In addition, there is also an industrial engineering approach that can be used to understand cost behaviour.

The linear cost function equation $y = a + bx$ can be drawn on a cost behaviour graph as follows.



The linear total cost function can be used to estimate costs associated with different levels of activities. This is known as **cost estimation**.

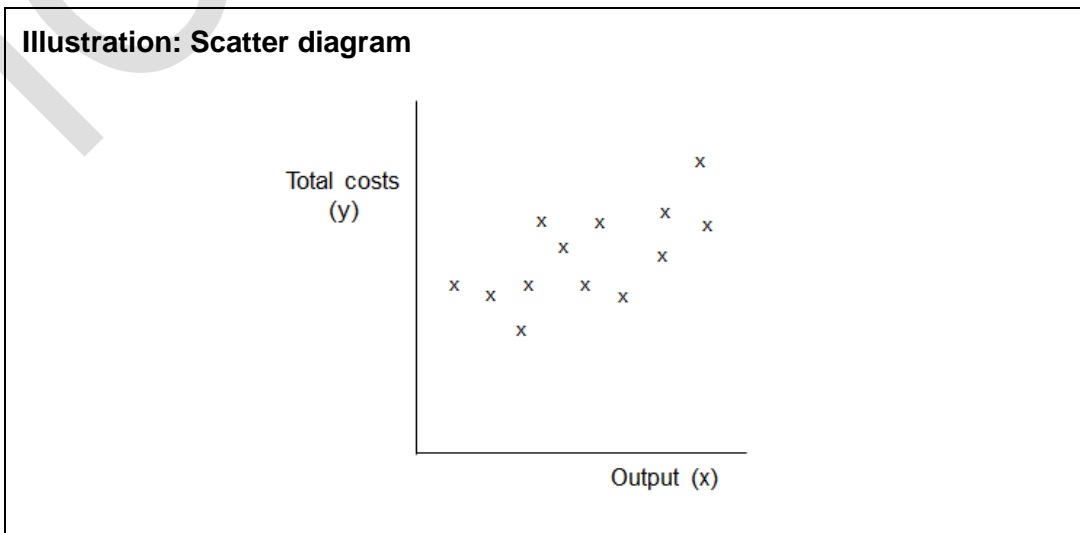
Cost segregation and cost estimation are very useful in forecasting and decision-making.

1.2 Scatter graph

Information about two variables can be plotted on a scatter diagram (scatter graph), with each axis representing one of the variables.

It is important to establish which variable is dependent and which one is independent before plotting the diagram. This is often straightforward but this is not always the case. Each pair of data is then plotted on the diagram.

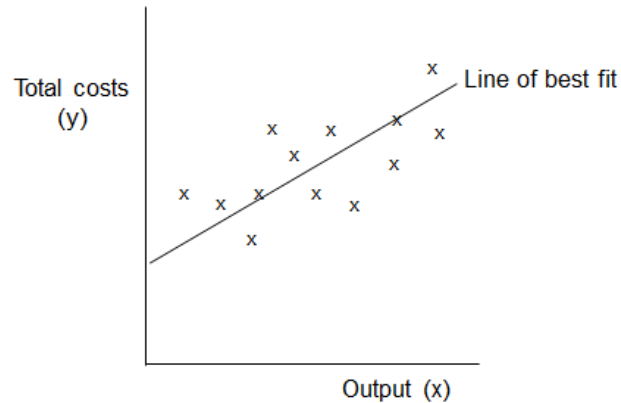
Cost estimation involves collecting information about the total costs (dependent variable = y) associated with different levels of activity (independent variable = x). Each value is plotted on a graph to produce a scatter diagram.



The next step is then to draw a line of best fit on the scatter diagram to produce the scatter graph. The line of best fit is a free hand estimate by whoever is drawing the diagram.



Illustration: Scatter graph (showing line of best fit)



Cost estimation using the scatter graph

The linear cost function equation ($y = a + bx$) can be constructed from the line of best fit. The slope of the line is the variable cost per unit (b), and the fixed cost (a) is the point where the line of best fit intercepts the y-axis.

Alternatively, the line of best fit could be used directly to show the total costs associated with a given level of activity.

This method is the quickest and easiest approach to cost estimation. However, the method suffers from limitations.

Limitations

A scatter diagram can be a useful aid to give a visual impression of the relationship between variables and is a useful starting point in a deeper analysis. However, they suffer from the following limitations:

drawing the line of best fit can be quite subjective;

they might indicate a relationship where there is none;

they can just show relationship between only two variables at a time but the issue under study might be more complex than this; and

they might lead to incorrect conclusions if there are only few data points available or the data collected is atypical for some reason.

2 HIGH/LOW METHOD

Section overview

High/low analysis

High/low analysis and forecasting

High/low analysis when there is a step change in fixed costs

High/low analysis when there is a change in the variable cost per unit

2.1 High/low analysis

High/low analysis can be used to estimate fixed costs and variable costs per unit whenever: there are figures available for total costs at two different levels of output or activity;

it can be assumed that fixed costs are the same in total at each level of activity; and the variable cost per unit is constant at both levels of activity.

High/low analysis uses two historical figures for cost:

the highest recorded output level, and its associated total cost; and the lowest recorded output level, and its associated total cost.

It is assumed that these 'high' and 'low' records of output and historical cost are representative of costs at all levels of output or activity.

The difference between the total cost at the high level of output and the total cost at the low level of output is entirely variable cost. This is because fixed costs are the same in total at both levels of output.

The method

Step 1: Take the activity level and cost for:

the highest activity level; and

the lowest activity level.

Step 2: The variable cost per unit can be calculated as:

$$\text{difference in total costs} / \text{difference in the number of units.}$$

Step 3: Having calculated a variable cost per unit of activity, fixed cost can be calculated by substitution into one of the cost expressions. The difference between the total cost at this activity level and the total variable cost at this activity level is the fixed cost.

Step 4: Construct the total cost function.

This is best seen with an example.



Example: High/low method

A company has recorded the following costs in the past six months:

Month	Production (units)	Total cost (₦)
January	5,800	40,300
February	7,700	47,100
March	8,200	48,700
April	6,100	40,600
May	6,500	44,500
June	7,500	47,100

Step 1: Identify the highest and lowest activity levels and note the costs associated with each level.

	Production (units)	Total cost (₦)
March	8,200	48,700
January	5,800	40,300

Step 2: Compare the different activity levels and associated costs and calculate the variable cost:

	Production (units)	Total cost (₦)
March	8,200	48,700
January	5,800	40,300
	<hr/>	<hr/>
	2,400	8,400

Therefore: 2,400 units cost an extra ₦8,400.

Therefore: The variable cost per unit = $\frac{₦8,400}{2,400 \text{ units}} = ₦3.5 \text{ per unit}$

Step 3: Substitute the variable cost into one of the cost functions (either high or low).

Total cost of 8,200 units:

$$\text{Fixed cost} + \text{Variable cost} = ₦48,700$$

$$\text{Fixed cost} + (8,200 \times ₦3.5) = ₦48,700$$

$$\text{Fixed cost} + ₦28,700 = ₦48,700$$

$$\text{Fixed cost} = ₦48,700 - ₦28,700 = ₦20,000$$

Step 4: Construct total cost function

$$\text{Total cost} = a + bx = 20,000 + 3.5x$$

Note that at step 3 it does not matter whether the substitution of variable cost is into the high figures or the low figures.



Example: Cost of other levels of activity

Returning to step 3 above but this time substituting into the low figures.

Step 3: Substitute the variable cost into one of the cost functions (either high or low).

Total cost of 5,800 units:

$$\text{Fixed cost} + \text{Variable cost} = \text{N}40,300$$

$$\text{Fixed cost} + (5,800 \times \text{N}3.5) = \text{N}40,300$$

$$\text{Fixed cost} + \text{N}20,300 = \text{N}40,300$$

$$\text{Fixed cost} = \text{N}40,300 - \text{N}20,300 = \text{N}20,000$$

2.2 High/low analysis and forecasting

Once derived, the cost function can be used to estimate the cost associated with levels of activity outside the range of observed data. Thus it can be used to forecast costs associated with future planned activity levels.



Example: High/low method

The company is planning to make 7,000 units and wishes to estimate the total costs associated with that level of production.

$$\text{Total cost} = \text{N}20,000 + \text{N}3.5x$$

$$\text{Total cost of 7,000 units} = \text{N}20,000 + (\text{N}3.5 \times 7,000) = \text{N}44,500$$



Practice questions

1

- 1 A manufacturing company has budgeted to operate for 110,500 hours in the year, which is 85% capacity. Expected total costs for the year are ₦615,200.

The management accountant has also estimated that at 100% capacity, total annual costs would be ₦662,000.

Required

Using high/low analysis, estimate the variable cost per hour worked and the total annual fixed costs.

- 2 Entity Z is trying to obtain a cost estimate for the costs of repairs. The following monthly repair costs have been recorded for the past six months.

Month	Number of machines repaired	Cost of repairs ₦
1	38	31,000
2	41	32,700
3	25	26,500
4	21	23,600
5	36	29,900
6	32	28,900

Required

Use high/low analysis to estimate the fixed costs of repairs each month and the variable cost per machine repaired.

Estimate the expected costs of repairs in a month when 30 machines are repaired.

2.3 High/low analysis when there is a step change in fixed costs

High/low analysis can also be used when there is a step increase in fixed costs between the 'low' and the 'high' activity levels, provided that the amount of the step increase in fixed costs is known.

If the step increase in fixed costs is given in naira value, the total cost of the 'high' or the 'low' activity level should be adjusted by the amount of the increase, so that total costs for the 'high' and 'low' amounts use the same fixed cost figure. After this adjustment the difference between the high and low costs is solely due to variable cost. The variable cost can be identified and cost functions constructed for each side of the step.

The method

Step 1: Take the activity level and cost for:

the highest activity level; and

the lowest activity level.

Step 2: Make an adjustment for the step in fixed costs;
add the step in fixed costs to the total costs of the lower level of activity; or
deduct the step in fixed costs from the total costs of the higher level of activity.

Step 3: The variable cost per unit can be calculated as:

$$\text{difference in total costs} / \text{difference in the number of units.}$$

Step 4: Having calculated a variable cost per unit of activity, fixed cost can be calculated by substitution into one of the cost expressions. (use the unadjusted pair).

Step 5: Construct the total cost function of the unadjusted level.

Step 6: Construct the total cost function for the adjusted level by reversing the adjustment to its fixed cost.

This is best seen with an example.



Example: High/low method with step in fixed costs

A company has identified that total fixed costs increase by ₦15,000 when activity level equals or exceeds 19,000 units. The variable cost per unit is constant over this range of activity.

The company has identified the following costs at two activity levels. (Step 1)

	Production (units)	Total cost (₦)
High	22,000	195,000
Low	17,000	165,000

Step 2: Make an adjustment for the step in fixed costs.

	Production (units)	Total cost (₦)
High	22,000	195,000
Low (165,000 + 15,000)	17,000	180,000

Step 3: Compare the different activity levels and associated costs and calculate the variable cost:

	Production (units)	Total cost (₦)
High	22,000	195,000
Low	17,000	180,000
	<hr/>	<hr/>
	5,000	15,000

Therefore: 5,000 units cost an extra ₦15,000.

Therefore: The variable cost per unit = $\frac{₦15,000}{5,000 \text{ units}} = ₦3$ per unit

Step 4: Substitute the variable cost into one of the cost functions (either high or low).

Total cost of 22,000 units:

$$\text{Fixed cost} + \text{Variable cost} = ₦195,000$$

$$\text{Fixed cost} + (22,000 \times ₦3) = ₦195,000$$

$$\text{Fixed cost} + ₦66,000 = ₦195,000$$

$$\text{Fixed cost} = ₦195,000 - ₦66,000 = ₦129,000$$

Step 5: Construct total cost function (unadjusted level) above 19,000 units

$$\text{Total cost} = a + bx = 129,000 + 3x$$

Step 6: Construct total cost function below 19,000 units

$$\text{Total cost} = a + bx = (129,000 - 15,000) + 3x$$

$$\text{Total cost} = a + bx = 114,000 + 3x$$

The cost functions can be used to estimate total costs associated with a level as appropriate.

**Example: High/low method**

The company is planning to make 20,000 units and wishes to estimate the total costs associated with that level of production.

$$\text{Total cost} = \text{N}129,000 + \text{N}3x$$

$$\text{Total cost of 20,000 units} = 129,000 + (\text{N}3 \times 20,000) = \text{N}189,000$$

The step increase in fixed costs given as a percentage amount

When the step change in fixed costs between two activity levels is given as a percentage amount, the problem is a bit more complex.

The costs associated with a third activity level must be found. This activity level could be either side of the activity level that triggers the step increase in fixed costs. This means that there are two activity levels which share the same fixed cost (though it is unknown). These can be compared to identify the variable cost.

The fixed cost at any level can then be calculated by substitution and the fixed cost on the other side of the step can be calculated from the first fixed cost.



Example: High/low method with step in fixed costs

A company has identified that total fixed costs increase by 20% when activity level equals or exceeds 7,500 units. The variable cost per unit is constant over this range of activity.

The company has identified the following costs at three activity levels. (Step 1)

	Production (units)	Total cost (₦)
High	11,000	276,000
Middle	8,000	240,000
Low	5,000	180,000

Step 2: Choose the pair which is on the same side as the step.

	Production (units)	Total cost (₦)
High	11,000	276,000
Middle	8,000	240,000

Step 3: Compare the different activity levels and associated costs and calculate the variable cost:

	Production (units)	Total cost (₦)
High	11,000	276,000
Middle	8,000	240,000
	<hr/>	<hr/>
	3,000	36,000

Therefore: 3,000 units cost an extra ₦36,000.

Therefore: The variable cost per unit = $\frac{₦36,000}{3,000 \text{ units}} = ₦12 \text{ per unit}$

Step 4: Substitute the variable cost into one of the cost functions

Total cost of 11,000 units:

$$\text{Fixed cost} + \text{Variable cost} = ₦276,000$$

$$\text{Fixed cost} + (11,000 \times ₦12) = ₦276,000$$

$$\text{Fixed cost} + ₦132,000 = ₦276,000$$

$$\text{Fixed cost} = ₦276,000 - ₦132,000 = ₦144,000$$

Step 5: Construct total cost function above 7,500 units

$$\text{Total cost} = a + bx = 144,000 + 12x$$

Step 6: Construct total cost function below 7,500 units

$$\text{Total cost} = a + bx = (144,000 \times \frac{100}{120}) + 12x$$

$$\text{Total cost} = a + bx = 120,000 + 12x$$

The cost functions can be used to estimate total costs associated with a level as appropriate.

2.4 High/low analysis when there is a change in the variable cost per unit

High/low analysis can also be used when there is a change in the variable cost per unit between the 'high' and the 'low' levels of activity. The same approach is needed as for a step change in fixed costs, as described above.

When the change in the variable cost per unit is given as a percentage amount, a third 'in between' estimate of costs should be used, and the variable cost per unit will be the same for:

the 'in between' activity level; and

either the 'high' or the 'low' activity level.

High/low analysis may be applied to the two costs and activity levels for which unit variable costs are the same, to obtain an estimate for the variable cost per unit and the total fixed costs at these activity levels. The variable cost per unit at the third activity level can then be calculated making a suitable adjustment for the percentage change.



Example: High/low method with step in fixed costs

A company has identified that total fixed costs are constant over all levels of activity but there is a 10% reduction in the variable cost per unit above 24,000 units of activity. This reduction applies to all units of activity, not just the additional units above 24,000..

The company has identified the following costs at three activity levels. (Step 1)

	Production (units)	Total cost (₦)
High	30,000	356,000
Middle	25,000	320,000
Low	20,000	300,000

Step 2: Choose the pair which is on the same side as the change.

	Production (units)	Total cost (₦)
High	30,000	356,000
Middle	25,000	320,000

Step 3: Compare the different activity levels and associated costs and calculate the variable cost:

	Production (units)	Total cost (₦)
High	30,000	356,000
Middle	25,000	320,000
	<hr/>	<hr/>
	5,000	36,000

Therefore: 5,000 units cost an extra ₦36,000.

Therefore: The variable cost per unit above 24,000 units
 $= \text{₦}36,000 / 5,000 \text{ units} = \text{₦}7.2 \text{ per unit}$

Therefore: The variable cost per unit below 24,000 units
 $= \text{₦}7.2 \text{ per unit} \times 100/90 = \text{₦}8 \text{ per unit}$

Step 4: Substitute the variable cost into one of the cost functions.

Total cost of 30,000 units:

$$\text{Fixed cost} + \text{Variable cost} = \text{₦}356,000$$

$$\text{Fixed cost} + (30,000 \times \text{₦}7.2) = \text{₦}356,000$$

$$\text{Fixed cost} + \text{₦}216,000 = \text{₦}356,000$$

$$\text{Fixed cost} = \text{₦}356,000 - \text{₦}216,000 = \text{₦}140,000$$

Step 5: Construct total cost function above 24,000 units

$$\text{Total cost} = a + bx = 140,000 + 7.2x$$

Step 6: Construct total cost function below 24,000 units

$$\text{Total cost} = a + bx = 140,000 + 8x$$

The cost functions can be used to estimate total costs associated with a level as appropriate.

3 LINEAR REGRESSION ANALYSIS

Section overview

The purpose of linear regression analysis

The linear regression formulae

Linear regression analysis and forecasting

3.1 The purpose of linear regression analysis

Linear regression analysis is a statistical technique for calculating a line of best fit from a set of data:

$$y = a + bx$$

The data is in 'pairs', which means that there are different values for x , and for each value of x there is an associated value of y in the data.

Linear regression analysis can be used to estimate fixed costs and the variable cost per unit from historical data for total costs. It is an alternative to the high-low method.

Linear regression analysis can also be used to predict future sales by projecting the historical sales trend into the future (on the assumption that sales growth is rising at a constant rate, in a 'straight line').

Regression analysis and high-low analysis compared

There are important differences between linear regression analysis and the high-low method., These include:

High-low analysis uses just two sets of data for x and y , the highest value for x and the lowest value for x . Regression analysis uses as many sets of data for x and y as are available;

Because regression analysis calculates a line of best fit for all the available data, it is likely to provide a more reliable estimate than high-low analysis for the values of a and b ;

In addition, regression analysis can be used to assess the extent to which values of y depend on values of x . For example, if a line of best fit is calculated that estimates total costs for any volume of production, we can also calculate the extent to which total costs do seem to be linked (or 'correlated') to the volume of production. This is done by calculating a **correlation co-efficient**, which is explained later; and

Regression analysis uses more complex arithmetic than high-low analysis, and a calculator or small spreadsheet model is normally needed.

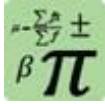
In summary, linear regression analysis is a better technique than high-low analysis because:

it is more reliable; and
its reliability can be measured.

3.2 The linear regression formulae

Linear regression analysis is a statistical technique for calculating a line of best fit where there are different values for x , and for each value of x there is an associated value of y in the data.

The linear regression formulae for calculating a and b are shown below.



Formula: Regression analysis formula

Given a number of pairs of data, a line of best fit ($y = a + bx$) can be constructed by calculating values for a and b using the following formulae.

$$a = \frac{\sum y}{n} - \frac{b \sum x}{n}$$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

Where:

x, y values of pairs of data.

=

n = the number of pairs of values for x and y .

Σ = A sign meaning the sum of. (The capital of the Greek letter sigma).

Note: the term b must be calculated first as it is used in calculating a .

Approach

Set out the pairs of data in two columns, with one column for the values of x and the second column for the associated values of y . (For example, x for output and y for total cost.

Set up a column for x^2 , calculate the square of each value of x and enter the value in the x^2 column.

Set up a column for xy and for each pair of data multiply x by y and enter the value in the xy column.

Sum each column.

Enter the values into the formulae and solve for b and then a . (It must be in this order as you need b to find a).

Linear regression analysis is widely used in economics and business. One application is that it can be used to estimate fixed costs and variable cost per unit (or number of units) from historical total cost data.

The following example illustrates this use:



Example: Linear regression analysis

A company has recorded the following output levels and associated costs in the past six months:

Month	Output (000 of units)	Total cost (₦m)
January	5.8	40.3
February	7.7	47.1
March	8.2	48.7
April	6.1	40.6
May	6.5	44.5
June	7.5	47.1

Required: Construct the equation of a line of best fit for this data.

Working:

	x	y	x ²	xy
January	5.8	40.3	33.64	233.74
February	7.7	47.1	59.29	362.67
March	8.2	48.7	67.24	399.34
April	6.1	40.6	37.21	247.66
May	6.5	44.5	42.25	289.25
June	7.5	47.1	56.25	353.25
	<u>41.8</u>	<u>268.3</u>	<u>295.88</u>	<u>1,885.91</u>
	= $\sum x$	= $\sum y$	= $\sum x^2$	= $\sum xy$

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2} \quad b = \frac{6(1,885.91) - (41.8)(268.3)}{6(295.88) - (41.8)^2}$$

$$b = \frac{11,315.46 - 11,214.94}{1,775.28 - 1,747.24} = \frac{100.52}{28.04} = 3.585$$

This is the cost in millions of naira of making 1,000 units

$$a = \frac{\sum y}{n} - \frac{b \sum x}{n}$$

$$a = \frac{268.3}{6} - \frac{3.585(41.8)}{6}$$

$$a = 44.72 - 24.98 = 19.74$$

Line of best fit:

$$y = a + bx$$

$$y = 19.74 + 3.585x$$

3.3 Linear regression analysis and forecasting

Once derived, the cost function can be used to estimate the cost associated with levels of activity outside the range of observed data. Thus, it can be used to forecast costs associated with future planned activity levels.



Example: Linear regression analysis

The company is planning to make 9,000 units and wishes to estimate the total costs associated with that level of production.

$$y = 19.74 + 3.585x$$

$$y = 19.74 + 3.585 \times 9$$

$$y = 52.00$$

Linear regression analysis can also be used to forecast other variables (e.g., demand, sales volumes etc.).

This is done by constructing an equation to describe a change in value over time. Regression analysis is carried out in the usual way with time periods identified as the independent variable. The dependent variable under scrutiny can then be estimated for various periods into the future.

This rests on the assumption that a linear trend in the past will continue into the future.



Practice question

2

Construct a line of best fit for the following information and estimate the total costs when output is 15,000 units.

Output (000s)	Total cost (£m)
17	63
15	61
12	52
22	74
18	68

4 CORRELATION AND THE CORRELATION COEFFICIENT

Section overview

Correlation
Degrees of correlation
Correlation coefficient r

4.1 Correlation

Linear regression analysis can be used to construct a regression line for any pairs of data. This does not prove that a relationship exists between the data and if one does exist the regression line gives no indication of how well the line fits the observations.

Correlation is a measure of how close the points on a scatter graph are to the line of best fit. If all of the points are very close to the line of best fit, then it is highly suggestive that there is a relationship between x and y . However, this is not necessarily the case. Correlation is not causation.

4.2 Degrees of correlation

The following scatter graphs show the different degrees of correlation that may be seen to exist between two variables:



Illustration: Types of correlation

Positive correlation means that the value of y increases as the value of x increases (and vice versa).

Perfect positive correlation is when all the data points lie in an exact straight line and a linear relationship exists between the two variables. This implies that the value of x and the value of y increase in a direct proportion.

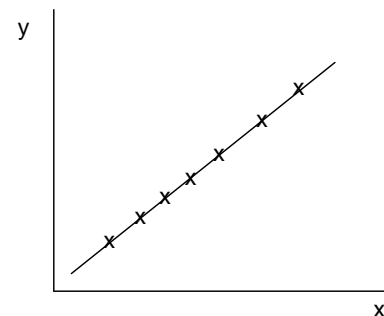
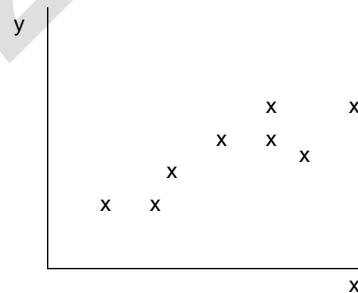
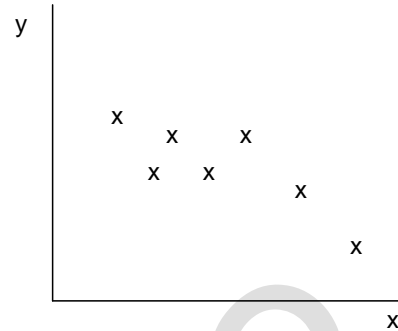


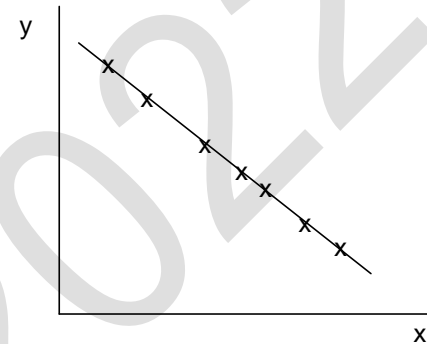


Illustration: Types of correlation (continued)

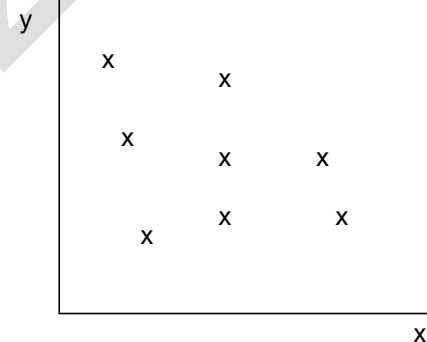
Negative correlation is where the value of y decreases as the value of x increases (and vice versa).



Perfect negative correlation is when all the data points plotted lie in an exact straight line. This implies that the value of x and the value of y decrease in a direct proportion.



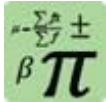
'Uncorrelated' means that no correlation is seen to exist between the variables.



4.3 Correlation coefficient r

Correlation between different variables can be measured as a **correlation coefficient**.

The formula for the correlation coefficient (r) will be given to you in the examination.



Formula: Correlation coefficient (r)

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{(n \sum x^2 - (\sum x)^2)(n \sum y^2 - (\sum y)^2)}}$$

Where:

x, y values of pairs of data.

=

n = the number of pairs of values for x and y .

This formula might seem difficult, but it is fairly similar to the formula for calculating 'b' in the linear cost equation. The only additional value needed to calculate the correlation coefficient is a value for $[n \sum y^2 - (\sum y)^2]$.

In order to do this a further column is needed for y^2 .

Significance of the correlation coefficient

The value of the correlation coefficient must always be in the range -1 to $+1$.

A value of -1 indicates that there is perfect negative correlation between the values for y and the values for x that have been used in the regression analysis estimates.

Perfect negative correlation means that all the values for x and y , plotted on a graph, would lie on a straight downward-sloping line.

A value of $+1$ indicates that there is perfect positive correlation between the values for y and the values for x that have been used in the regression analysis estimates.

Perfect positive correlation means that all the values for x and y , plotted on a graph, would lie on a straight upward-sloping line.

A value of $r = 0$ indicates no correlation at all between the values of x and y .

For cost estimation, a value for r close to $+1$ would indicate that the cost estimates are likely to be very reliable.

As a general guide, a value for r between $+0.90$ and $+1$ indicates good correlation between the values of x and y , suggesting that the formula for costs can be used with reasonable confidence for cost estimation.



Example: Correlation coefficient

As before.

Working:

	x	y	x²	xy	y²
January	5.8	40.3	33.64	233.74	1,624.09
February	7.7	47.1	59.29	362.67	2,218.41
March	8.2	48.7	67.24	399.34	2,371.69
April	6.1	40.6	37.21	247.66	1,648.36
May	6.5	44.5	42.25	289.25	1,980.25
June	7.5	47.1	56.25	353.25	2,218.41
	41.8	268.3	295.88	1,885.91	12,061.21
	= Σx	= Σy	= Σx^2	= Σxy	= Σy^2

$$r = \frac{n \Sigma xy - \Sigma x \Sigma y}{\sqrt{(n \Sigma x^2 - (\Sigma x)^2)(n \Sigma y^2 - (\Sigma y)^2)}}$$

$$r = \frac{6(1,885.91) - (41.8)(268.3)}{\sqrt{(6(295.88) - 41.8^2)(6(12,061.21) - 268.3^2)}}$$

$$r = \frac{100.52}{\sqrt{(28.04)(382.37)}} = \frac{100.52}{103.55} = +0.97$$

The correlation coefficient r is + 0.97.



Practice question

3



Calculate the correlation coefficient of the following data:

Output	Total cost
17	63
15	61
12	52
22	74
18	68

5 OTHER APPROACHES TO COST ESTIMATION

Section overview

Accounts analysis
Industrial engineering

5.1 Account analysis

The account analysis method of estimating fixed and variable costs involves a review of appropriate accounts from the general ledger to determine whether, in the judgement of the reviewer, costs in each account are fixed or variable.

The total of all costs identified as fixed provides the estimate of total fixed costs. The total of all costs identified as variable divided by the production volume provides the variable cost per unit.

The method requires a high level of expertise and knowledge of the content of the general ledger accounts and would normally be carried out by accountants or otherwise experienced employees with familiarity of the nature of costs within general ledger accounts.

Advantages

Account analysis is the only method that can be used to estimate costs from a single period of data.

The method can be used to identify fixed costs and variable cost per unit for individual departments (as long as the general ledger collects information on a departmental basis).

Disadvantages

The method requires a considerable level of knowledge, expertise and understanding.

5.2 Industrial engineering

This approach examines the relationship between inputs to a manufacturing process (labour, materials, expenses, etc.) and the outputs from that process (finished goods or services).

This analysis can help managers to better understand costs and as a result improves cost control.

The analysis might include elements such as a time-and-motion study that identifies how much direct labour time is needed to produce a certain amount of output. The process can be used to examine such relationships in a more sophisticated way by taking cost drivers into consideration.



Example: Industrial engineering

A company makes tables and chairs to be sold as a set comprising 4 chairs with a table.

A study has shown that during a particular week:

Week	
Numbers of sets produced	10 (i.e. 10 tables and 40 chairs)
Hours worked	100 hours

This of course means that each set took 10 hours to produce. This information could be used to estimate how long it would take to make a different number of sets.

The data was analysed further to show the activities necessary to make each table and each chair. The analysis showed that 90 hours were spent making chairs and 10 hours spent making tables.

Time taken to make a chair = $90 \text{ hours} / 40 \text{ chairs} = 2.25 \text{ hours per chair}$

Time taken to make a table = $10 \text{ hours} / 10 \text{ tables} = 1 \text{ hour per table}$.

This information would be useful if the company were planning to offer a set comprising 6 chairs with a table. The company would have to understand how long the new set would take (and thus, cost) in order to arrive at a selling price for the set.

The industrial engineering method is a physical way of examining the relationship between cost drivers (activities that drive costs) and costs by analysing the inputs coming into the company, the outputs that are created, and the work that goes into the process. In other words, it is a detailed look at the entire production process and how that process affects the costs of an organisation.



Example: Cost estimation: account analysis

ABV Airbus Limited cleans aircraft between landing and take-off at Nnamdi Azikiwe International Airport.

The company wish to construct a monthly cost estimate for their business.

The following costs were incurred in February during which 300 aircraft were cleaned:

	Costs (₦'000)
Cleaning supplies	8,000
Hourly wages	5,500
Depreciation - cleaning equipment	1,000
Manager's salary	40
Office rent	650

Step 1: Classify each cost as variable or fixed based on judgment (and total each)

	Costs (₦'000)	Variable (₦'000)	Fixed (₦'000)
Cleaning supplies	8,000	8,000	
Hourly wages	5,500	5,500	
Depreciation - cleaning equipment	1,000		1,000
Manager's salary	40		40
Office rent	650		650
Total costs	<u>15,190</u>	<u>13,500</u>	<u>1,690</u>

Step 2: Variable cost per
unit

Number of units (aircraft cleaned)	<u>÷300</u>
Cleaning cost per aircraft	<u>45</u>

Step 3: Construct the total cost equation (per month in thousands of naira)

$$\text{Total costs} = 1,690 + 45x$$

6 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:
 Calculate fixed and variable costs by using high-low points method;
 Calculate fixed and variable costs by using regression analysis; and
 Explain correlation and interpret correlation coefficients.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1 110,500 hours = 85% capacity.

Therefore 100% capacity = 110,500 hours/85% = 130,000 hours.

	hours	=	₦
High: Total cost of	130,000	=	662,000
Low: Total cost of	110,500	=	615,200
Difference: Variable cost of	19,500	=	46,800

Therefore, the variable cost per hour = $\text{₦}46,800/19,500 \text{ hours} = \text{₦}2.40$.

Substitute in high equation

	Cost
	₦
Total cost of 130,000 hours	662,000
Variable cost of 130,000 hours ($\times \text{₦}2.40$)	312,000
Therefore fixed costs	350,000

2

	hours	=	₦
High: Total cost of	41	=	32,700
Low: Total cost of	21	=	23,600
Difference: Variable cost of	20	=	9,100

Therefore variable cost per unit repaired = $\text{₦}9,100/20 \text{ hours} = \text{₦}455$.

Substitute in low equation

	Cost
	₦
Total cost of 21 units	23,600
Variable cost of 21 units ($\geq \text{₦}455$)	9,555
Therefore fixed costs per month	14,045

Cost estimate for 30 units

	Cost
	₦
Fixed costs	14,045
Variable cost of 30 units ($\times \text{₦}455$)	13,650
Estimated total costs	27,695

If this estimate is used to prepare a budget for a period, it might be rounded to a convenient number, say $\text{₦}27,700$.

Solution**2**

Working:

x	y	x²	xy
17	63	289	1,071
15	61	225	915
12	52	144	624
22	74	484	1,628
18	68	324	1,224
84	318	1,466	5,462
= Σx	= Σy	= Σx^2	= Σxy

$$b = \frac{n \Sigma xy - \Sigma x \Sigma y}{n \Sigma x^2 - (\Sigma x)^2} \quad b = \frac{5(5,462) - (84)(318)}{6(1,466) - (84)^2}$$

$$b = \frac{27,310 - 26,712}{7,330 - 7,056} = \frac{598}{274} = 2.22$$

$$a = \frac{\Sigma y}{n} - \frac{b \Sigma x}{n} \quad a = \frac{318}{5} - \frac{2.22(84)}{5}$$

$$a = 63.6 - 37.3 = 26.3$$

Line of best fit:

$$y = a + bx$$

$$y = 26.33 + 2.22x$$

15,000 units

$$y = 26.33 + 2.22(15) = 59.63$$

Solution**3**

Working:

x	y	x²	xy	y²
17	63	289	1,071	3,969
15	61	225	915	3,721
12	52	144	624	2,704
22	74	484	1,628	5,476
18	68	324	1,224	4,624
84	318	1,466	5,462	20,494
$= \Sigma x$	$= \Sigma y$	$= \Sigma x^2$	$= \Sigma xy$	$= \Sigma y^2$

$$r = \frac{n \Sigma xy - \Sigma x \Sigma y}{\sqrt{(n \Sigma x^2 - (\Sigma x)^2)(n \Sigma y^2 - (\Sigma y)^2)}}$$

$$r = \frac{5(5,462) - (84)(318)}{\sqrt{(5(1,466) - 84^2)(5(20,494) - 318^2)}}$$

$$r = \frac{598}{\sqrt{(274)(1,346)}} = \frac{598}{607} = +0.985$$

The correlation coefficient r is + 0.985.

Accounting for inventory

Contents

- 1 Materials: procedures and documentation
- 2 Valuation of inventory
- 3 Material purchase quantities: Economic order quantity
- 4 Just-in-Time (JIT) and other inventory management methods
- 5 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including, costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A		Cost accounting (continued)	
	3	Accounting for cost elements	
		a	Accounting for inventory
		i	Describe the different procedures and documents necessary for material management:
			• Ordering;
			• Purchasing;
			• Receiving;
			• Storage; and
			• Issuing.
		ii	Explain inventory management and control procedures.
		iii	Identify, explain and calculate relevant inventory costs.
		iv	Compute optimal re-order quantities (involving quantity discounts).
		v	Explain and calculate the value of closing inventory and material issues to production using LIFO, FIFO and average methods.
		vi	Explain Just-In-Time (JIT).

Exam context

This chapter explains the measurement of inventories of items and various approaches to inventory management.

By the end of this chapter you should be able to:

- Measure inventory at the lower of cost and net realisable value;
- Explain and apply FIFO, AVCO and LIFO;
- Describe the economic order quantity (EOQ) and apply the concept in given scenarios;
- Calculate the EOQ from data provided; and
- Explain JIT.

1 MATERIALS: PURCHASING PROCEDURES AND DOCUMENTATION

Section overview

The need for procedures and documentation of materials
The procedures and documents
Monitoring physical inventory: comparison with the inventory records
Entries and balances in a materials inventory account

1.1 The need for procedures and documentation of materials

When an entity purchases materials from a supplier, the purchasing process should be properly documented. There are several reasons for this.

- Any purchase of materials from a supplier should be properly authorised and approved at the appropriate management level. Documentation of the purchasing process provides evidence that approval has been obtained;
- The receipt of materials from a supplier should also be documented, to make sure that the goods that were ordered have actually been delivered;
- There should be an invoice from the supplier for the goods that have been delivered. (In rare cases when goods are bought for cash, there should be a receipt from the supplier). The amount payable for the materials provides documentary evidence about their cost; and
- When materials are received from a supplier, they might be held in a store or warehouse until needed. When they are issued from the store, there should be a documentary record of who has taken the materials and how many were taken. This is needed to provide a record of the cost of materials used by different departments or cost centres.

Documentation of materials is therefore needed:

- to ensure that the procedures for ordering, receiving and paying for materials has been conducted properly, and there is no error or fraud;
- to provide a record of materials purchases for the financial accounts; and
- to provide a record of materials costs for the cost and management accounts.

1.2 The procedures and documents

The detailed procedures for purchasing materials and the documents used might differ according to the size and nature of the business. However the basic requirements should be the same for all types of business where material purchases are made.

Purchasing procedures and documents

In a large company with a purchasing department (a buying department) and a stores department, the procedures for purchasing materials might be as follows:

The stores department identifies the need to re-order an item of raw materials for inventory. It produces a request to the purchasing department to buy a quantity of the materials. This request is called a **purchase requisition**. It should be properly authorised by a manager with the authority to approve any such requisition;

A buyer in the purchasing department selects a supplier and provides the supplier with a **purchase order**, stating the identity of the item to be purchased, the quantity required and possibly also the price that the supplier has agreed;

When the supplier delivers the goods, the goods are accompanied by a **delivery note** from the supplier. The delivery note is a statement of the identity and quantity of the items delivered, and it provides confirmation that the items have been delivered. One copy is kept with the stores department, and another copy is retained by the supplier (the driver of the delivery vehicle), as evidence of the delivery;

The stores department prepares a **goods received note**, recording the details of the materials received. This should include the inventory identity code for the item, as well as the quantity received;

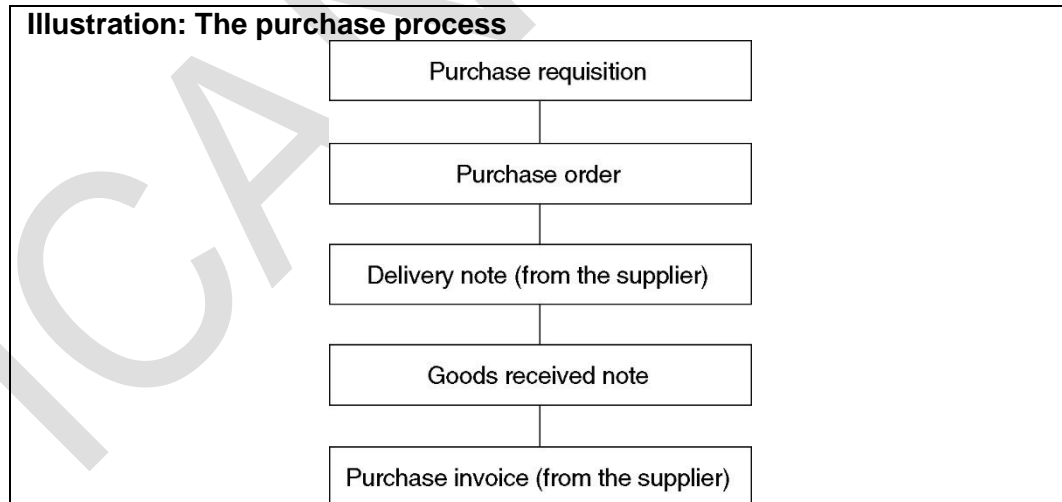
Copies of the delivery note and goods received note are sent to the accounts department, where they are matched with a copy of the purchase order;

A **purchase invoice** is received from the supplier, asking for payment. The accounts department checks the invoice details with the details on the purchase order and goods received note, to confirm that the correct items have been delivered in the correct quantities;

The purchase invoice is used to record the purchase in the **accounting records**; and In the cost accounting system, there should be **inventory records** to record the quantities and costs of materials received. Data for recording costs of purchases for each item of inventory is obtained from the goods received note (quantity and inventory code) and purchase invoice (cost).



Illustration: The purchase process



Inventory records

An entity should keep an up-to-date record of the materials that it is holding in inventory.

In the stores department, the materials should be kept secure, and there should be systems, processes and controls to prevent loss, theft or damage. The stores department should keep a record of the quantity of each item of material currently held in inventory. For each item of material, there might therefore be an inventory record card, or 'bin card'. This card is used to keep an up-to-date record of the number of units of the material currently in the stores department, with records of each receipt and issue of the inventory item. This process of continuous record-keeping is known as **perpetual inventory**. The inventory record should be updated every time materials are delivered into store from a supplier, and every time that materials are issued to an operating department. Instead of having a 'physical' card for each stores item, there may be a computerised record containing similar information.

In the cost accounting department, another separate record of inventory might be kept, with an **inventory ledger record** for each item of material. The inventory ledger record is a record of the quantity of the materials currently held in inventory, the quantities received into store from suppliers and the quantities issued to operational departments. In addition, the inventory ledger record also records the **cost** of the materials currently held in inventory, the cost of new materials purchased and the cost of the materials issued to each operating department (cost centre).

In a computerised inventory control system, the stores department and the cost accounting department should use the same computerised records for inventory.

Issues and returns of materials

A cost accounting system also needs to record the quantities and cost of items of materials that are issued to the user departments and the quantities and cost of any items that are subsequently returned to store unused.

The documentation for the issue and returns of materials are:

A **materials requisition note**: this is a formal request from a user department to the stores department for a quantity of an item of materials; and

A material return note: when items are returned to store unused, the stores department should record the return on a **material returns note**.

A materials requisition note is used to record:

the details of the quantity of materials issued;

the department (cost centre) that receives them; and

(in a cost accounting system) their cost.

The inventory records are updated from the requisitions notes and returns notes to record all issues and returns of materials.

Examples of this are shown in the next section.

1.3 Monitoring physical inventory: comparison with the inventory records

For various reasons, the inventory records in the cost accounts might not agree with the physical quantities of materials actually held in store. There are several reasons for this.

Errors in recording receipts, issues and returns. Mistakes might be made in recording transactions for materials received from the supplier, materials issued from store and returns to store. For example, an issue of material item 1234 from inventory might be recorded as an issue of item 1243. This would result in inaccurate inventory records for both item 1234 and item 1243.

Omissions. Similarly, some purchases, issues and returns to store might not be recorded, due to mistakes.

Theft or physical loss. Some inventory might be stolen or might get lost, and the theft or loss might not be noticed or recorded.

Damage to stores items or deterioration of items. Stores items might deteriorate in quality when they are stored, particularly if they are stored in poor conditions. Damaged items might be thrown away, but the write-off might not be recorded.

Management should try to minimise these discrepancies between inventory records (in a perpetual inventory system) and physical inventory in the store.

It is the responsibility of the stores manager to minimise losses due to theft, loss or deterioration and damage.

Documentation and record keeping should be accurate and mistakes should be minimised. All movements of materials should be properly recorded in a document, and the data from the document should be transferred accurately into the inventory records. Even so, good record keeping and goods stores management will not prevent some discrepancies between inventory records and physical inventory in store. This discrepancy should be checked from time to time. The stores department staff can do this by carrying out a **physical count** of the quantity of each material item currently held, and comparing this 'physical count' with the figures in the stores records. The records should then be adjusted to the correct quantities. (Quantities of materials that are 'missing' will be recorded as a write-off of materials in the accounts).

Minimising discrepancies and losses

When physical inventory is checked against the inventory records, there will often be some differences. When the differences are large, there could be a serious problem with either:

Poor control over inventory: Some losses through theft, deterioration and breakages should be expected, but the losses should not be large; and

Poor inventory records: If the inventory records are inaccurate, the information prepared for management from inventory records will be unreliable.

Whichever is the reason for large discrepancies between physical inventory and inventory records, management should take measures to deal with the problem. Theft can be reduced by keeping inventory locked in a safe place. Close Circuit Television (CCTV) can be used to monitor activities in the warehouse.

Deterioration of inventory can be reduced by keeping the inventory in better storage condition.

Poor procedures for recording inventory movements in and out of the store can be improved through better procedures and suitable controls, such as better supervision of the recording process and better staff training.

1.4 Entries and balances in a materials inventory account

In a system of cost accounting, a separate record is kept for each inventory item. This record – an inventory account – is used to maintain a record of all movements in the materials, in terms of both quantities and cost.

The main contents of an inventory record are shown in the previous example. An inventory record in the cost accounts provides a continual record of the following:

Purchases/deliveries from suppliers: quantity and cost;

Returns to suppliers: quantity and cost;

Issues of the item to user departments: quantity, cost and department identity;

Returns from user departments to the stores: quantity, cost and department identity;

and

The balance held in inventory (quantity and cost or value).

The inventory records are combined into a total record for all inventory, which is used for reporting purposes, such as the preparation of a cost statement or an income statement of the profit or loss made in a period. The system for recording inventory and materials costs might also be a part of a bigger cost accounting system.

A cost accounting system is a system for recording all costs and in large organisations, it is maintained in the form of a double entry accounting system of cost records in a 'cost ledger'.

2 VALUATION OF INVENTORY

Section overview

Basic rule: Lower of cost and net realisable value (NRV)

Cost formulas

First-in, first-out method of valuation (FIFO)

Weighted average cost (WAVCO) method

Last-in, first-out (LIFO) method

Comparison of methods

2.1 Basic rule: Lower of cost and NRV

The valuation of inventory can be extremely important for financial reporting, because the valuations affect both the cost of sales (and profit) and also total asset values in the statement of financial position.

Inventory must be measured in the financial statements at the **lower** of:

Cost; or

net realisable value (NRV).

Net realisable value is the amount that can be obtained from disposing of the inventory in the normal course of business, less any further costs that will be incurred in getting it ready for sale or disposal.

Net realisable value is usually higher than cost. Inventory is therefore usually valued at cost.

However, when inventory loses value, perhaps because it has been damaged or is now obsolete, net realisable value will be lower than cost.

The cost and net realisable value should be compared for each separately-identifiable item of inventory, or group of similar inventories, rather than for inventory in total.



Example: Lower of cost and NRV

A business has four items of inventory. A count of the inventory has established that the amounts of inventory currently held, at cost, are as follows:

	₦	₦	₦
	Cost	Sales price	Selling costs
Inventory item A1	8,000	7,800	500
Inventory item A2	14,000	18,000	200
Inventory item B1	16,000	17,000	200
Inventory item C1	6,000	7,500	150

The value of closing inventory in the financial statements:

	Lower of:	₦
A1	8,000 or (7,800 – 500)	7,300
A2	14,000 or (18,000 – 200)	14,000
B1	16,000 or (17,000 – 200)	16,000
C1	6,000 or (7,500 – 150)	6,000
Inventory valuation		<u>43,300</u>

2.2 Cost formulas

With some inventory items, particularly large and expensive items, it might be possible to recognise the actual cost of each item.

In practice, however, this is unusual because the task of identifying the actual cost for all inventory items is impossible because of the large numbers of such items. A system is therefore needed for measuring the cost of inventory.

The historical cost of inventory is usually measured by one of the following methods: First in, first out (FIFO).

Weighted average cost (WAVCO)



Illustration

On 1 January a company had an opening inventory of 100 units which cost ₦50 each.

During the year it made the following purchases:

- 5 April: 300 units at ₦60 each
- 14 July: 500 units at ₦70 each
- 22 October: 200 units at ₦80 each.

During the period it sold 800 units as follows:

- 9 May: 200 units
- 25 July: 200 units
- 23 November: 200 units
- 12 December: 200 units

This means that it has 300 units left $(100 + 300 + 500 + 200) - (200 + 200 + 200 + 200)$ but what did they cost?

There are various techniques that have been developed to answer this question.

The easiest of these is called FIFO (first in first out). This approach assumes that the first inventory sold is always the inventory that was bought on the earliest date. This means closing inventory is always assumed to be the most recent purchased.

In the above example a FIFO valuation would assume that the 300 items left were made up of the 200 bought on 22 October and 100 of those bought on 14 July giving a cost of ₦23,000 {i.e. $(200 @ 80) + (100 @ 70)$ }.

2.3 First-in, first-out method of valuation (FIFO)

The FIFO and weighted average cost (WAVCO) methods of inventory valuation are used within perpetual inventory systems. They can also be used to establish a cost for closing inventory with the period-end inventory system.

With the first-in, first-out method of inventory valuation, it is assumed that inventory is consumed in the strict order in which it was purchased or manufactured. The first items that are received into inventory are the first items that go out.

To establish the cost of inventory using FIFO, it is necessary to keep a record of: the date that units of inventory are received into inventory, the number of units received and their purchase price (or manufacturing cost); and

the date that units are issued from inventory and the number of units issued.

With this information, it is possible to put a cost to the inventory that is issued (sold or used) and to identify the cost of the items still remaining in inventory.

Since it is assumed that the first items received into inventory are the first units that are used, it follows that the value of inventory at any time should be the cost of the most recently-acquired units of inventory.



Example (as before): FIFO

On 1 January a company had an opening inventory of 100 units which cost ₦50 each.

During the year it made the following purchases:

- 5 April: 300 units at ₦60 each
- 14 July: 500 units at ₦70 each
- 22 October: 200 units at ₦80 each.

During the period it sold 800 units as follows:

- 9 May: 200 units
- 25 July: 200 units
- 23 November: 200 units
- 12 December: 200 units

Inventory movement can be shown on a cost ledger card as follows.



Example: Inventory ledger card (FIFO)

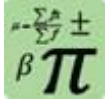
Date	Receipts			Issues			Balance		
	Qty	@	₦	Qty	@	₦	Qty	@	₦
1 Jan b/f	100	50	5,000				100	50	5,000
5 Apr	300	60	18,000				300	60	18,000
							400	50/60	23,000
9 May				100	50	5,000	100	50	5,000
				100	60	6,000	100	60	6,000
				200	50/60	11,000	(200)	50/60	(11,000)
							200	60	12,000
14 Jul	500	70	35,000				500	70	35,000
							700	60/70	47,000
25 Jul				200	60	12,000	(200)	60	(12,000)
							500	70	35,000
22 Oct	200	80	16,000				200	80	16,000
							700	70/80	51,000
23 Nov				200	70	14,000	(200)	70	(14,000)
							500	70/80	37,000
12 Dec				200	70	14,000	(200)	70	(14,000)
	1,100		74,000	800		51,000	300	70/80	23,000

Note 1,100 minus 800 equals 300
 :
 74,000 minus 51,000 equals 23,000

2.4 Weighted average cost (WAVCO) method

With the weighted average cost (WAVCO) method of inventory valuation it is assumed that all units are issued at the current weighted average cost per unit.

The normal method of measuring average cost is the **perpetual basis method**. With the perpetual basis WAVCO method, a new average cost is calculated whenever more items are purchased and received into store. The weighted average cost is calculated as follows:

**Formula: Weighted average cost**

$$\frac{\text{Cost of inventory currently in store} + \text{Cost of new items received}}{\text{Number of units currently in store} + \text{Number of new units received}}$$

**Example (as before): WAVCO**

On 1 January a company had an opening inventory of 100 units which cost ₦50 each.

During the year it made the following purchases:

- 5 April: 300 units at ₦60 each
- 14 July: 500 units at ₦70 each
- 22 October: 200 units at ₦80 each.

During the period it sold 800 units as follows:

- 9 May: 200 units
- 25 July: 200 units
- 23 November: 200 units
- 12 December: 200 units

Inventory movement can be shown on a cost ledger card as follows:

**Example: Inventory ledger card (weighted average cost method)**

Date	Receipts			Issues			Balance		
	Qty	@	₦	Qty	@	₦	Qty	@	₦
1 Jan b/f	100	50	5,000				100	50	5,000
5 Apr	300	60	18,000				300	60	18,000
							400	57.5	23,000
9 May				200	57.5	11,500	(200)	57.5	(11,500)
							200	57.5	11,500
14 Jul	500	70	35,000				500	70	35,000
							700	66.43	46,500
25 Jul				200	66.43	13,286	(200)	66.43	(13,286)
							500	66.43	33,214
22 Oct	200	80	16,000				200	80	16,000
							700	70.31	49,214
23 Nov				200	70.31	14,062	(200)	70.31	(14,062)
							500	70.31	35,152
12 Dec				200	70.31	14,062	(200)	70.31	(14,062)
	1,100		74,000	800		52,910	300	70/80	21,090

Note	1,100	minus	800	equals	300
:					
			74,000	minus	52,910
				equals	21,090

2.5 Last-in, first-out (LIFO) method

With the last-in, first-out (LIFO) method of inventory valuation it is assumed that: the most recent units received into store are the first materials issued, and are priced accordingly; and at any time, the remaining units in store are likely to have been purchased some time ago.



Example (as before): LIFO

On 1 January a company had an opening inventory of 100 units which cost ₦50 each.

During the year it made the following purchases:

- 5 April: 300 units at ₦60 each
- 14 July: 500 units at ₦70 each
- 22 October: 200 units at ₦80 each.

During the period it sold 800 units as follows:

- 9 May: 200 units, 25 July: 200 units, 23 November: 200 units, 12 December: 200 units

Inventory movement can be shown on a cost ledger card as follows:



Example: Inventory ledger card (LIFO method)

Date	Receipts			Issues			Balance		
	Qty	@	₦	Qty	@	₦	Qty	@	₦
1 Jan b/f	100	50	5,000				100	50	5,000
5 Apr	300	60	18,000				300	60	18,000
							400	50/60	23,000
9 May				200	60.0	12,000	(200)	60.0	(12,000)
							200	50/60	11,000
14 Jul	500	70	35,000				500	70	35,000
							700	50/60/70	46,000
25 Jul				200	70.00	14,000	(200)	70.00	(14,000)
							500	50/60/70	32,000
22 Oct	200	80	16,000				200	80	16,000
							700	50/60/70/80	48,000
23 Nov				200	80.00	16,000	(200)	80.00	(16,000)
							500	50/60/70	32,000
12 Dec				200	70.00	14,000	(200)	70.00	(14,000)
							300	50/60/70	18,000
	1,100		74,000	800		56,000			

Note	1,100	minus	800	equals	300
:					
			74,000	minus	56,000
				equals	18,000

2.6 Comparison of methods

Choice of inventory valuation method

The value of inventory and the cost of materials issued and used in the period are determined by the selected inventory valuation method, such as FIFO, LIFO, weighted average cost or standard cost.

The choice of valuation method – FIFO, weighted average cost, LIFO – therefore affects the reported profit for each period.

LIFO is not allowed as a valuation method in financial reporting, but it may be used in cost accounting systems, which are not governed by the rules of accounting standards and external financial reporting.

Costing of issues from inventory and inflation

As a general rule, the different methods of inventory valuation will give different valuations for the cost of sales and the value of closing inventory during a period of inflation and this becomes more pronounced as inflation increases.

When prices are rising, the cost of sales under FIFO will be lower than the current replacement cost of materials used. The closing inventory value should be close to current value since they will be the units bought most recently ('last').

When prices are rising, the cost of sales under WAVCO will be higher and the value of closing inventory lower than with FIFO valuation.

When prices are rising, the cost of sales under LIFO will be higher and the value of closing inventory lower than with FIFO valuation.

With WAVCO during a period of high inflation, the cost of sales will be higher and the value of closing inventory lower than with FIFO valuation.

In the example used above to illustrate the different methods when prices were rising, the valuations of the cost of goods issued and closing inventory were as follows:



Example: FIFO vs WAVCO vs LIFO when prices are rising

Valuation method	Cost of goods issued ₦	Closing inventory ₦
FIFO	51,100	23,000
WAVCO	52,900	21,090
LIFO	56,000	18,000

The valuation of closing inventory is higher and the cost of goods issued is lower using FIFO. This is typical during a period when prices are rising steadily.

The opposite is true when prices are falling. The valuation of closing inventory is lower and the cost of goods issued is higher using FIFO.

Advantages and disadvantages of FIFO

Advantages

Logical (probably represents physical reality).
Easy to understand and explain to managers.
Gives a value near to replacement cost.

Disadvantages

Can be cumbersome to operate.
Managers may find it difficult to compare costs and make decisions when they are charged with varying prices for the same materials.
In a period of high inflation, inventory issue prices will lag behind current market value.

Advantages and disadvantages of AVCO

Advantages

Smooths out price fluctuations.
Easier to administer than FIFO and LIFO.

Disadvantages

Issue price is rarely what has been paid.
Prices tend to lag a little behind current market values when there is gradual inflation.

Advantages and disadvantages of LIFO

Advantages

Issue price is up to date therefore enhances profit reporting.
Easy to apply.

Disadvantages

In reality, managers will try to sell older inventory first and LIFO does not reflect this reality.
Inventory can be stated at well below replacement cost thus giving lower quality information about inventory.
Not allowed under IFRS.

3 MATERIAL PURCHASE QUANTITIES: ECONOMIC ORDER QUANTITY

Section overview

Costs associated with inventory

Economic order quantity (EOQ)

Optimum order quantity with price discounts for large orders

3.1 Costs associated with inventory

Many companies, particularly manufacturing and retailing companies, might hold large amounts of inventory. They usually hold inventory so that they can meet customer demand as soon as it arises. If there is no inventory when the customer asks for it (if there is a 'stock-out' or 'inventory-out'), the customer might buy the product from a competitor instead. However holding inventory creates costs.

The costs associated with inventory are:

Purchase price of the inventory;

Re-order costs are the costs of making orders to purchase a quantity of a material item from a supplier. They include costs such as:

the cost of delivery of the purchased items, if these are paid for by the buyer;
the costs associated with placing an order, such as the costs of telephone calls;
costs associated with checking the inventory after delivery from the supplier; and
batch set up costs if the inventory is produced internally.

Inventory holding costs

cost of capital tied up;

insurance costs;

cost of warehousing; and

obsolescence, deterioration and theft.

Shortage costs

lost profit on sale;

future loss of profit due to loss of customer goodwill; and

costs due to production stoppage due to shortage of raw materials.

Investment in inventory has a cost. Capital is tied up in inventory and the capital investment has a cost. Inventory has to be paid for, and when an organisation holds a quantity of inventory it must therefore obtain finance to pay for it.



Example: Cost of holding inventory

A company holds between 0 units and 10,000 units of an item of material that costs ₦1,000 per unit to purchase.

The cost of the materials held in store therefore varies between ₦0 and ₦10,000,000.

If demand for the inventory is constant throughout the year, the average cost of inventory held is ₦5,000,000 (half the maximum).

This inventory must be financed, and it is usual to assume (for simplicity) that it is financed by borrowing that has an interest cost.

If the interest cost of holding inventory is 5% per year, the cost per year of holding the inventory would be ₦250,000 ($₦5,000,000 \times 5\%$).

There are also running expenses incurred in holding inventory, such as the warehousing costs (warehouse rental, wages or salaries of warehouse staff).

A distinction can be made between variable inventory holding costs (cost of capital, cost of losses through deterioration and loss) and fixed inventory costs (wages and salaries, warehouse rental). Changing inventory levels will affect variable inventory holding costs but not fixed costs.

Trade off

Note that there is a trade-off between holding costs and ordering costs.



Example: Trade-off between holding costs and ordering costs

A company requires 12,000 of a certain component every year.

Demand for the component is constant. (This condition means that the average inventory is half of the maximum as long as there is no safety stock).

The company can decide on the number it orders and this affects the holding cost and ordering costs.

Let: Q = Order size
D = Annual demand

	Order size (Q)		
	12,000	6,000	3,000
Average inventory ($Q/2$)	6,000	3,000	1,500
Number of orders (D/Q)	1	2	3

The average inventory falls as the order size falls thus reducing holding cost. However, smaller orders mean more of them. This increases the order cost.

A business will be concerned with minimising costs and will make decisions based on this objective. Note that any decision making model must focus on those costs that are relevant to the decision. The relevant costs are only those that change with a decision. When choosing between two courses of action, say A and B, any cost that will be incurred whether action A or action B is undertaken can be ignored. This is covered in more detail in chapter 14.

3.2 Economic order quantity (EOQ)

The Economic Order Quantity model (EOQ) is a mathematical model used to calculate the quantity of inventory to order from a supplier each time that an order is made. The aim of the model is to identify the order quantity for any item of inventory that minimises total annual inventory costs.

The model is based on simplifying assumptions.

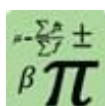
Assumption	Implication
There are no bulk purchase discounts for making orders in large sizes. All units purchased for each item of material cost the same unit price.	Order size (Q) does not affect the total annual purchase cost of the items. Purchase price can be ignored in the decision as it does not affect the outcome.
The order lead time (the time between placing an order and receiving delivery from the supplier) is constant and known.	Delivery of a new order is always timed to coincide with running out of inventory so the maximum inventory is the order size (Q). There is no risk of being out of stock. Shortage costs can be ignored.
Annual demand for the inventory item is constant throughout the year.	Average inventory is the $\frac{\text{order size}}{2}$ because the maximum inventory is Q

As a result of the simplifying assumptions, the relevant costs are the annual holding cost per item per annum and the annual ordering costs.

If the price of materials is the same, no matter what the size of the purchase order, the purchase order quantity that minimises total costs is the quantity at which ordering costs plus the costs of holding inventory are minimised.

The EOQ model formula

The order quantity or purchase quantity that minimises the total annual cost of ordering the item plus holding it in store is called the economic order quantity or EOQ.



Formula: Economic order quantity (Q)

$$Q = \sqrt{\frac{2C_o D}{C_H}}$$

Where:

Q = Quantity purchased in each order to minimise costs

C_o = Fixed cost per order

C_H = the cost of holding one item of inventory per annum

D = Annual demand

Notes:

There will be an immediate supply of new materials (Q units) as soon as existing quantities in store run down to zero. The minimum quantity held in store is therefore zero and this always occurs just before a new purchase order quantity is received.

The maximum quantity held is Q units. The average amount of inventory held is therefore $Q/2$ and total holding costs each year are $(Q/2) \times C_H$.

The number of orders each year is D/Q . Total ordering costs each year are therefore $(D/Q) \times C_O$.

The economic order quantity (EOQ) is the order size that minimises the sum of these costs during a period (normally one year), given the assumptions stated above.



Example:

A company uses 120,000 units of Material X each year, which costs ₦300 for each unit. The cost of placing an order is ₦6,500 for each order. The annual cost of holding inventory each year is 10% of the purchase price of a unit.

The economic order quantity for Material X is as follows:

$$C_O = \text{Fixed cost per order} = \text{₦ } 6,500$$

$$C_H = \text{the cost of holding one item of inventory per annum} = 10\% \times 300 = \text{₦ } 30$$

$$D = \text{Annual demand} = 120,000 \text{ units}$$

$$Q = \sqrt{\frac{2C_O D}{C_H}} = \sqrt{\frac{2 \times 6,500 \times 120,000}{30}} = 7,211.1 \text{ units}$$

The EOQ is the quantity that minimises the sum of the annual order costs and the annual holding costs. The annual holding costs equal the annual order costs at this level.



Example:

Using information from the previous example

Annual order costs:	₦
Number of orders \times fixed cost per order $D/Q \times C_O = 120,000/7,211.1 \times 6,500$	108,166
Annual holding costs:	
Average inventory \times cost of holding one item per annum: $Q/2 \times 30 = 7,211.1/2 \times 30$	108,166
Total annual cost that is minimised by the EOQ	216,332
Annual purchase price ($D \times \text{Price} = 120,000 \times 300$)	36,000,000
Total annual cost	36,216,332

The costs that are minimised are often very small compared to the purchase price in the model. The purchase price is irrelevant in deciding the order quantity because it is not affected by the order size when the annual demand is constant.

Total annual ordering costs and annual holding costs are always the same whenever the purchase quantity for materials is the EOQ and the assumptions on which the EOQ

is based (described earlier) apply. This would not be the case if safety inventory was held (but the simplifying assumptions preclude this from happening).



Practice questions

1

- 1 A company uses the Economic Order Quantity (EOQ) model to determine the purchase order quantities for materials.

The demand for material item M234 is 12,000 units every three months.

The item costs ₦80 per unit, and the annual holding cost is 6% of the purchase cost per year. The cost of placing an order for the item is ₦250.

What is the economic order quantity for material item M234 (to the nearest unit)?

- 2 A company uses the Economic Order Quantity (EOQ) model to determine the purchase order quantities for materials.

The demand for material item M456 is 135,000 units per year. The item costs ₦100 per unit, and the annual holding cost is 5% of the purchase cost per year.

The cost of placing an order for the item is ₦240.

What are the annual holding costs for material item M456?

- 3 A company uses a chemical compound, XYZ in its production processes.

XYZ costs ₦1,120 per kg. Each month, the company uses 5,000 kg of XYZ and holding costs per kg. per annum are ₦20.

Every time the company places an order for XYZ it incurs administrative costs of ₦180.

What is the economic order quantity for material item XYZ (to the nearest unit)?

3.3 Optimum order quantity with price discounts for large orders

When the EOQ formula is used to calculate the purchase quantity, it is assumed that the purchase cost per unit of material is a constant amount, regardless of the order quantity.

If a supplier offers a discount on the purchase price for orders above a certain quantity, the purchase price becomes a relevant cost. When this situation arises, the order quantity that minimises total costs will be either:

the economic order quantity; or

the minimum order quantity necessary to obtain the price discount.

The total costs each year including purchases, ordering costs and holding costs, must be calculated for the EOQ and the minimum order quantity to obtain each discount on offer.

**Example:**

A company uses 120,000 units of Material X each year, which costs ₦300 for each unit.

The cost of placing an order is ₦6,500 for each order.

The annual cost of holding inventory each year is 10% of the purchase cost.

The EOQ based on the above information is 7,211 units.

The supplier offers a price discount of ₦ 5 per unit for orders of 10,000 or more.

The order quantity that will minimise total costs is found as follows:

Order quantity:	7,211.1 units	10,000 units
	₦	₦
Annual ordering costs (
$D/Q \times C_o = 120,000/7,211.1 \times 6,500$	108,166	
$D/Q \times C_o = 120,000/10,000 \times 6,500$		78,000
Holding costs		
$Q/2 \times 30 = 7,211.1/2 \times 30$	108,166	
$Q/2 \times 30 = 10,000/2 \times 30$		150,000
	216,332	228,000
Annual purchase costs		
120,000 × ₦ 300	36,000,000	
120,000 × ₦ (300 – 5)		35,400,000
Total costs	36,216,332	35,628,000

Conclusion: The order quantity that minimises total costs is 10,000 units.

(The sum of the annual ordering costs plus the annual holding costs is greater for 10,000 units as would be expected from our knowledge of the EOQ model. However, this increase is more than compensated for by the saving in purchase price at this order level.)

**Practice question****2**

A company uses 120,000 units of Material X each year, which costs ₦3 for each unit before discount.

The costs of making an order are ₦605 for each order. The annual cost of holding inventory is 10% of the purchase cost.

The supplier offers a price discount of ₦0.10 per unit for orders of 25,000 up to 40,000 units, and a discount of ₦0.20 per unit for orders of 40,000 units or more.

Find the quantity that will minimise total costs.

4 JUST-IN-TIME (JIT) AND OTHER INVENTORY MANAGEMENT METHODS

Section overview

JIT production and JIT purchasing
Practical implications of JIT
Other inventory control systems

4.1 JIT production and JIT purchasing

Just-in-Time (JIT) management methods originated in Japan in the 1970s. JIT is a radically different approach to inventory management compared with management using the EOQ model and reorder levels.

The principle of JIT is that producing items for inventory is wasteful, because inventory adds no value, and holding inventory is therefore an expense for which there is no benefit.

If there is no immediate demand for output from any part of the system, a production system should not produce finished goods output for holding as inventory. There is no value in achieving higher volumes of output if the extra output goes into inventory as it has no immediate use.

Similarly, if there is no immediate demand for raw materials, there should not be any of the raw materials in inventory. Raw materials should be obtained only when they are actually needed.

It follows that in an ideal production system:
there should be no inventory of finished goods: items should be produced just in time to meet customer orders, and not before (just in time production); and

there should be no inventories of purchased materials and components: purchases should be delivered by external suppliers just in time for when they are needed in production (just in time purchasing).

4.2 Practical implications of JIT

JIT production

It is important that items should be available when required. Finished goods must be available when customers order them, and raw materials and components must be supplied when they are needed for production.

In practice, this means that:

Production times must be very fast. If there is no inventory of finished goods, production has to be fast in order to meet new customer orders quickly;

Production must be reliable, and there must be no hold-ups, stoppages or bottlenecks. Poor quality production, leading to rejected items and scrap, is unacceptable; and

Deliveries from suppliers must be reliable: suppliers must deliver quickly and purchased materials and components must be of a high quality (so that there will be no scrapped items or rejected items in production).

JIT purchasing

JIT depends for its success not only on highly efficient and high-quality production, but also on efficient and reliable supply arrangements with key suppliers. For successful JIT purchasing, there must be an excellent relationship with key suppliers.

Collaborative long-term relationships should be established with major suppliers, and purchasing should not be based on selecting the lowest price offered by competing suppliers.

By implementing a JIT system, an entity will be working with its key ('strategic') suppliers to implement a manufacturing system that will:

reduce or eliminate inventories and WIP;

reduce order sizes, since output is produced to meet specific demand and raw material deliveries should be timed to coincide with production requirements; and

ensure deliveries arrive in the factory exactly at the time that they are needed.

The overall emphasis of a JIT purchasing policy is on consistency and quality, rather than looking for the lowest purchase price available.

Problems with JIT

There might be several problems with using JIT in practice.

Zero inventories cannot be achieved in some industries, where customer demand cannot be predicted with certainty and the production cycle is quite long. In these situations, it is necessary to hold some inventories of finished goods.

It might be difficult to arrange a reliable supply system with key suppliers, whereby suppliers are able to deliver materials exactly at the time required.

If the EOQ model succeeds in minimising total costs of holding costs and ordering costs, this suggests that with a JIT purchasing system, ordering costs might be very high.

4.3 Other inventory control systems

EOQ and JIT are two methods of managing and controlling inventory and purchasing quantities. Other systems might be used.

Two-bin system

When a two-bin system is used in a warehouse or stores department, each item of inventory is stored in two bins or large containers. Inventory is taken from Bin 1 until it is empty, and a new order is placed sufficient to fill Bin 1 again.

However, the delivery of more units of the item will take time, and since Bin 1 is empty, units are now taken from Bin 2. Bin 2 is large enough to continue supplying the item until the new delivery arrives. On delivery, both bins are replenished and units are once again supplied from Bin 1.

This cycle continues indefinitely.

Periodic review system

In a periodic review system, there is a reorder quantity and a reorder level for each item of inventory.

Inventory levels are checked periodically, say every one, two, three or four weeks. If the inventory level for any item has fallen below its reorder level, a new order for the reorder quantity is placed immediately.



Example:

The demand for an inventory item each week is 400 units, and inventory control is applied by means of a three-weekly periodic review. The lead-time for a new order is two weeks.

The minimum inventory level should therefore be $(3 \text{ weeks} + 2 \text{ weeks}) = 5 \text{ weeks} \times 400 \text{ units} = 2,000 \text{ units}$.

If the inventory level is found to be lower than this level at any periodic review, a new order for the item should be made.

5 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

- Measure inventory at the lower of cost and net realisable value;
- Explain and apply FIFO, WAVCO and LIFO;
- Describe the economic order quantity (EOQ) and apply the concept in given scenarios;
- Calculate the EOQ from data provided; and
- Explain JIT.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1

1 Economic order quantity

$$Q = \sqrt{\frac{2C_oD}{C_H}} = \sqrt{\frac{2 \times 250 \times (4 \times 12,000)}{6\% \times 80}} = 2,236 \text{ units}$$

2 Economic order quantity

$$Q = \sqrt{\frac{2C_oD}{C_H}} = \sqrt{\frac{2 \times 240 \times 135,000}{5\% \times 100}} = 3,600 \text{ units}$$

Annual holding cost

$$\frac{Q}{2} \times C_H = \frac{3,600}{2} \times 5 = \text{₦ } 9,000$$

3 Economic order quantity

$$Q = \sqrt{\frac{2C_oD}{C_H}} = \sqrt{\frac{2 \times 180 \times (5,000 \times 12)}{20}} = 1,039 \text{ units}$$

Solutions**2****EOQ**

$$EOQ = \sqrt{\frac{2C_oD}{C_H}}$$

Where:

$$C_o = 605$$

$$D = 120,000$$

$$C_H = 10\% \times 3 = 0.3$$

$$= \sqrt{\left(\frac{2 \times 120,000 \times 605}{0.3}\right)} = \sqrt{484,000,000} = 22,000 \text{ units}$$

The economic order quantity is 22,000 units

The order quantity that will minimise total costs is found as follows:

	Order quantity		
	22,000 units	25,000 units	40,000 units
	₦	₦	₦
Annual purchase costs			
120,000 × ₦3	360,000		
120,000 × ₦(3 – 0.10)		348,000	
120,000 × ₦(3 – 0.20)			336,000
Annual ordering costs (D/Q × C _o)			
(120,000/22,000) × ₦605	3,300		
(120,000/25,000) × ₦605		2,904	
(120,000/40,000) × ₦605			1,815
Holding costs (Q/2 × C _H)			
(22,000/2) × ₦0.3	3,300		
(25,000/2) × ₦0.29		3,625	
(40,000/2) × ₦0.28			5,600
Total costs	366,600	354,529	343,415

Conclusion

The order quantity that minimises total costs is 40,000 units.

Accounting for labour

Contents

- 1 Labour costs: direct and indirect labour costs
- 2 Remuneration methods
- 3 Labour turnover
- 4 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A		Cost accounting		
	3	Accounting for cost elements		
		B	Accounting for labour	5
		i	Explain labour recording and monitoring procedures.	5
		ii	Determine direct and indirect costs of labour.	5
		iii	Describe different remuneration methods: time-based systems, piecework systems and individual and group incentive schemes.	5
		iv	Determine the level and ascertain the causes and costs of labour turnover.	5
		v	Prepare and explain the entries in payroll accounting.	5

Exam context

This chapter provides information about labour costs, explaining how they might be analysed and accounted for.

By the end of this chapter, you should be able to:

- Identify whether production labour cost should be classified as direct or indirect;
- Explain idle time and overtime premium;
- Explain different remuneration schemes including time-based systems, piecework systems and incentive schemes;
- Calculate labour costs arising from a variety of remuneration schemes;
- Account for payroll costs; and
- Calculate and comment on labour turnover.

1 LABOUR COSTS: DIRECT AND INDIRECT LABOUR COSTS

Section overview

- Elements of labour costs

Direct and indirect labour costs

Recording labour costs

Payroll accounting entries

1.1 Elements of labour costs

Labour costs consist of:

the basic wages and salaries of employees;

additional payments for overtime working; and

bonuses and other payments on top of basic pay and overtime (such as contributions paid by the employer into a pension scheme for its employees).

Employers do not pay the total earned by employees directly to those employees. Employers must withhold some amounts (e.g. income tax) and pay them to the other bodies (e.g. the State Internal Revenue Service) on behalf of the employee.

1.2 Direct and indirect labour costs

In cost accounting there is distinction between direct labour employees and indirect labour employees. Direct labour employees are those who work directly on the goods or services produced by the entity.

The general rule is that direct labour costs are the costs of direct labour employees and indirect labour costs are the costs of indirect labour employees. However, there are some exceptions to this general rule, and some costs of direct labour employees are treated as indirect labour costs.

Two exceptions are:

the cost of idle time; and

the cost of overtime premium.

Idle time

Idle time is time when employees are paid and are available to work, but are not doing any active work. The cause of idle time could be a breakdown in production equipment or a delay in the delivery of materials from a supplier. Idle time might also occur when there are no orders from customers, and there will be no more work until the next order arrives.

Idle time should be treated as an indirect labour cost. However, in order to treat idle time as an indirect cost, the cost accounting system must be able to identify the amount of time that is lost as idle time. To do this, idle time must be recorded on labour

time sheets (which are often used to document the use of labour time, for the purpose of cost accounting).

Overtime premium

When hourly-paid employees work hours in excess of their normal working hours, they are usually paid 'overtime' at a higher rate of pay per hour than the basic rate.

The total rate of pay per hour is the basic rate per hour plus an overtime 'premium'.

Total overtime hourly rate = Basic hourly rate + Overtime premium.



Example

During one week, Masha works 46 hours. This includes 8 hours of overtime working. Her basic rate of pay is ₦1,000 per hour and overtime is paid at time and a half.

The overtime rate per hour is $₦1,000 \times 150\% = ₦1,500$, consisting of the ₦1,000 basic rate plus a premium of ₦500 per hour.

Her weekly cost is calculated as follows, keeping the overtime premium separate from the basic pay for the hours worked.

	₦
Basic pay – 46 hours × ₦1,000	46,000
Overtime premium (8 hours × ₦1,000 × 50%)	4,000
Total weekly pay	50,000

In costing systems, it is usual to separate the labour cost at the basic rate per hour from the cost of the overtime premium. This is because overtime premium costs are usually treated as an indirect labour cost (an overhead cost) and should be measured separately.

The reason why overtime premium is usually treated as an indirect labour cost is that when employees are paid for working hours of overtime, it is a matter of chance what work they are doing in normal hours and what work they do in overtime. It is therefore 'unfair' to charge the work done in overtime directly with the overtime premium.

The main rules about whether production labour costs should be treated as a direct labour cost or as an indirect labour cost can be summarised as follows.

Labour cost of		
Classified as:	direct labour employees	indirect labour employees
Direct labour costs	Basic wage or salary for hours worked. Overtime premium only if the overtime hours are worked specifically at a customer's request	
Indirect labour costs	Other overtime premium Cost of all hours recorded as 'idle time'	All labour costs of indirect labour employees

Labour cost of		
Classified as:	direct labour employees	indirect labour employees
	Cost of other hours spent away from direct production work (e.g. time spent on training courses).	

1.3 Recording labour costs

In a cost accounting system, there must be a system for relating the cost of labour to work that is done. There are various ways in which labour time might be recorded, but the main methods are:

payroll records; and
time sheets or similar time records.

Payroll records can be used to:

identify employees as direct labour or indirect labour employees; and
charge the labour costs of each employee to the department (cost centre) where he or she is employed

Time sheets or similar time recording systems can be used within a cost centre to record the time spent by each employee on different activities or tasks (or as idle time). Time sheets are not necessary if an employee does the same work all the time. For example, it is not necessary to prepare time sheets for a machine worker if the employee spends all his time working at the same machine producing the same items of output.

However, time sheets are needed if employees spend time on more than one cost item, so that their labour cost has to be allocated to the different cost items. For example, a manufacturing centre might produce two products, Product A and Product B, and a direct labour employee might spend time working on both products. Time sheets can be used to record the time spent on each product, so that the labour cost can be allocated to each product according to the amount of time spent on each. Similarly, time sheets are needed to work out the labour cost of specific jobs or contracts: the time spent by employees on each job or contract should be recorded, so that the cost of the time can be allocated and the labour cost for each job or contract can be calculated.

Accounting for labour costs

Within a cost accounting system, indirect and direct labour costs are recorded and charged to the appropriate cost centres and cost units. The records of labour costs are included within the double-entry cost accounting system (where such a costing system is used).

1.4 Payroll accounting entries

Employers must make deductions from the gross pay earned by employees and pay amounts withheld to various third parties.

The double entry necessary to reflect this is achieved by two journals.

The first recognises the payroll expenses with the other side of the entry recognised as a series of creditors representing the parties to whom payment should be made.

The second records the payment of the various balances to the respective creditors.



Example: Payroll accounting

The following information is the summary of a single month's payroll of a business employing 25 people.

	₦
Gross pay	4,625,000
Less deductions:	
PAYE tax	284,978
Pension	328,125
National housing fund contribution	109,375
Life assurance (premium paid)	250,000
NHI scheme	218,750
	<u>(1,191,228)</u>
Net pay	<u>3,433,772</u>

This is accounted for using two journals as follows:

Journal 1: To recognise the expenses and various creditors

	Dr	Cr
Wages and salaries	4,625,000	
PAYE tax		284,978
Pension		328,125
National housing fund contribution		109,375
Life assurance (premium paid)		250,000
NHI scheme		218,750
Employees		1,191,228
Cash/Bank (net pay)		3,433,772



Example: Payroll accounting

Journal 2: To record the payment of amounts owed

	Dr	Cr
Paye tax	284,978	
Pension	328,125	
National housing fund contribution	109,375	
Life assurance (premium paid)	250,000	
NHI scheme	218,750	
Cash/bank		1,191,228

2 REMUNERATION METHODS

Section overview

- Calculating the cost of labour

Time-based systems

Piecework systems

Incentive schemes

2.1 Calculating the cost of labour

The labour cost of a product, service, job or activity is calculated as the cost of paying the employees to do the work. Labour costs are allocated between different jobs or activities on the basis of the time spent working on each job or activity.

Many employees are paid a fixed salary each month. Their costs are allocated to the departments they work in and to the activities they perform on a time basis. For example, if an employee spends half his time on one type of activity and half of his time on another activity, the cost of his labour will be divided 50:50 between the two activities.

Some employees are paid by the hour, and a few are paid a piecework rate. The labour costs of these employees can be measured and charged to the units of work they produce.

2.2 Time-based systems

When employees are paid an hourly rate, their basic pay (per week or month) is calculated as follows:

Basic pay = Hours worked × Rate of pay per hour

Production records should reflect the time spent by these employees on specific jobs or batches of production, so that the labour cost for this work can be measured accurately.

As explained earlier, any overtime premium for overtime working is usually treated as an indirect labour cost. (Overtime premium is charged as a direct cost only when the overtime is worked for a specific purpose, for example to meet specific demands by a customer for meeting a delivery date).

2.3 Piecework systems

In piecework systems, employees are usually paid a certain amount for the number of units of output produced:

Basic pay = Units produced × Rate paid per unit produced



Example: Piecework

A worker in a textile company sews buttons on shirts. She is paid ₦20 for each shirt that she completes. During one week, she completes 800 shirts.

Her pay for the week, and the labour cost of sewing buttons on the 800 shirts, is:

$$800 \times \text{₦}20 = \text{₦}16,000.$$

Differential piecework systems

Differential piecework systems encourage employees to increase the number of units they produce by paying higher rates per unit when more units are produced.

It is quite common for employees involved in piecework schemes to be paid a guaranteed minimum wage so that their earnings do not suffer too much when production levels are low because of circumstances outside of their control.



Example: Differential piecework systems

An employee is paid the following rates of pay:

Production Units	Rate of pay per unit ₦
0 – 100	150
101 – 200	175
201 – 300	200

The company pays a guaranteed minimum wage of ₦30,000 per week.

In a week, the employee produces 220 units.

The employee's earnings for the week are calculated as follows.

Production Units	Actual units produced Units	Rate of pay per unit ₦	Earnings ₦
0 – 100	100	150	15,000
101 – 200	100	175	17,500
201 – 300	20	200	4,000
	<u>220</u>		<u>36,500</u>

If the employee had earned less than ₦30,000 under the arrangement, he still would have been paid the guaranteed minimum wage of ₦30,000 per week.

2.4 Incentive schemes

Employees might be offered an incentive or bonus payment for improving their productivity, or for achieving certain production targets during a period. The purpose of an incentive scheme for greater productivity should be to:

increase total production output with the same number of employees; or

achieve the same total output volume, but in fewer hours of work.

Some of the benefits of the productivity improvement are given to the employees, in the form of a bonus. This should give them an incentive to achieve the productivity improvement. Incentive schemes may be based on:

an individual's performance; or

the performance of a work group as a whole.

Individual incentive schemes and group incentive schemes are similar for the purpose of cost accounting.

(If the cost of a bonus payment can be traced directly to a cost unit it should be treated as a direct labour cost. If it is difficult to trace the cost of a bonus payment to a specific cost unit, for example because it is paid at a much later date, it will be recorded as an indirect labour cost).

The employer (company) also benefits from the productivity improvements, because the unit cost of production should be reduced. If the total reduction in costs is greater than the additional amount paid to employees, the company will benefit.



Example: Incentive schemes

A manufacturing company produces 1,000 units of a product each week. This requires 900 direct labour hours. Direct labour employees are paid ₦1,200 per hour.

The company introduces an incentive scheme, in which it will pay a bonus of 5% of the basic rate per hour worked if productivity can be improved by 10%, and either:

- i) the employees can make 10% more units each week in 900 hours; or
- ii) the employees can produce 1,000 units each week in 10% fewer hours.

The company wishes to know how the bonus scheme will affect the company.

This can be assessed as follows

	Current scheme	Scheme i	Scheme ii
Number of hours	900	900	
(900 × 90%)			810
Cost per hour	1,200		
1,200 × 1.05		1,260	1,260
Total weekly cost	1,080,000	1,134,000	1,020,600
Number of units	1,000		1,000
1,000 × 1.1		1,100	
Cost per unit	1,080	1,031	1,021

The company would prefer scheme (ii) as it achieves the greatest reduction in cost per unit.

The employees would prefer scheme (i) as it results in more money paid to them.

3 LABOUR TURNOVER

Section overview

Labour turnover rate

Costs and causes of labour turnover

3.1 Labour turnover rate

Labour turnover is the number of employees who leave their job during a period in relation to the number of workers employed during the period due to resignation, new appointment, retrenchment, old age, ill health, pregnancy, death, etc.

The labour turnover rate is a measure of the rate at which employees are leaving and have to be replaced.

$$\frac{\text{Number of employees leaving/being replaced each year}}{\text{Average number of employee positions in the year}} \times 100\%$$



Example

A company employs 4,800 employees. During the past 12 months, 660 employees left the company and had to be replaced.

$$\text{Labour turnover rate} = 100\% \times \left(\frac{660}{4,800} \right) = 13.75\%$$



Example

A company employed 2,800 people at the beginning of the year. During the year 420 people left and 450 were recruited. There were 2,830 employees at the end of the year.

$$\text{Average number of employees} = (2,800 + 2,830)/2 = 2,815$$

$$\text{Labour turnover rate} = (420/2,815) \times 100\% = 14.9\%$$

3.2 Costs and causes of labour turnover

The main causes of labour turnover are summarised as follows: Employees leaving their job may be because of ill-health, unhealthy environment, low wages and salaries, lack of promotion opportunities, or unhealthy behaviours of employer to employees; and Employer may relieve employees of their services because of retrenchment, inefficiency, disciplinary actions, etc.

Labour turnover can be very costly for an employer, and result in higher costs. When employees leave, their experience is lost. New employees taking their place are less experienced, and will be less efficient until they learn how to do the job. A high labour turnover, by reducing efficiency, increases costs.

New employees might make many more mistakes, and so there will be additional costs of correcting faulty work.

New employees might have to be trained, and there will be additional training costs. A very high labour turnover rate could have an adverse effect on the morale and efficiency of the employees who remain in their jobs.

4 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

- Identify whether production labour cost should be classified as direct or indirect;
- Explain idle time and overtime premium;
- Explain different remuneration schemes including time-based systems, piecework systems and incentive schemes;
- Calculate labour costs arising from a variety of remuneration schemes;
- Account for payroll costs; and
- Calculate and comment on labour turnover.

Accounting for overheads

Contents

- 1 Manufacturing overheads
- 2 Introduction to absorption costing
- 3 Stages in absorption costing
- 4 Overhead apportionment
- 5 Apportionment of service department costs
- 6 Overhead absorption
- 7 Under-absorbed and over-absorbed overheads
- 8 Fixed and variable overheads
- 9 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A	Cost accounting		
	3	Accounting for cost elements	
		c	Accounting for overheads
		i	Explain the components of overheads.
		ii	Distinguish amongst allocation, apportionment and absorption of overheads.
		iii	Describe the bases of overheads apportionment.
		iv	Apportion and re-apportion overhead costs between production and service centres (including using the reciprocal method where service cost centres work for each other and simultaneous equation method).
		v	Describe the bases and procedures involved in determining production overhead absorption rates.
		vi	Explain and calculate under and over-absorption of overheads.

Exam context

This chapter explains overheads in more detail and shows how manufacturing overheads can be included in production costs.

By the end of this chapter you should be able to:

- Explain the meaning of overheads;
- Identify manufacturing and non-manufacturing overheads;
- Explain allocation and apportionment and apply the techniques to identify the total overhead costs associated with different departments (including techniques of secondary apportionment);
- Explain absorption;
- Calculate departmental overhead absorption rates from data supplied;
- Calculate the overhead costs absorbed by applying overhead absorption rate in an appropriate manner; and
- Calculate and account for over and under absorption of overhead.

1 MANUFACTURING OVERHEADS

Section overview

- Direct and indirect expenses
- Manufacturing, administration and selling costs

1.1 Direct and indirect expenses

Chapter 2 introduced and explained costing terminology.

The following table provides a classification which shows how the terms may be combined in a way that is useful in providing costing information.

	Part of inventory value?	Examples
Direct costs (always variable):		
Direct materials	Yes	Raw materials and components
Direct labour	Yes	Factory labour
Direct expenses	Yes	Any incidental expense related directly to production, for example machine hire, sub-contractor fees etc.
Indirect costs (overheads)		
Variable production (manufacturing)	Yes	Electricity to operate machinery Small consumables (small parts, lubricants etc.)
Variable non-production (manufacturing)	No	Finance costs Sales bonuses Distribution costs (delivering goods to customers)
Fixed production (manufacturing)	Depends on the costing system	Factory rent Supervisors' salaries Depreciation of production machinery
Fixed non-production (manufacturing)	No	Depreciation of non-production assets. Salaries of non-production staff Occupancy expenses for non-production facilities (rent, light, heat, property taxes, maintenance, etc.) Insurance.

Direct and indirect costs are treated differently.

Direct costs are charged directly to the cost of production. They are directly identified with cost units, batches of production, a production process or a job or a contract.

Overheads are indirect costs, and cannot be identified directly with specific cost units, jobs or processes, etc. They are therefore recorded as overhead costs, and a distinction is made between production overheads (overheads occurring for example in the factory where the product is produced), administration overheads and sales and distribution (marketing) overheads.

Fixed production overhead costs can then be treated in either of two ways.

Method 1 – Marginal costing. They might be treated as period costs, and charged as an expense against the period in which they are incurred, without any attempt to add a share of the fixed overhead costs to the cost of units of production.

Method 2 – Absorption costing. They might be shared out among cost units or processes. Fixed production overhead costs might be charged to cost units in addition to direct material, direct labour and variable overhead so that the cost of goods sold (cost units) fairly reflects the actual cost of production. When fixed production overheads are charged to cost units they are said to be absorbed by them.

The next chapter explains marginal costing and the different methods on profit measurement.

This chapter explains absorption costing in more detail but first talks more about the different types of cost.

1.2 Manufacturing, administrative and selling costs

Manufacturing costs

Manufacturing costs are product costs. They are the costs of making cost units and are included as part of the cost of inventory in accordance with financial reporting rules (set out in *IAS 2: Inventories*).

IAS 2 says that “the cost of inventories shall comprise all costs of purchase, costs of conversion and other costs incurred in bringing the inventories to their present location and condition”.

Costs of conversion include costs directly related to the units of production, such as direct labour. They also include a systematic allocation of fixed and variable production overheads that are incurred in converting materials into finished goods.

Fixed production overheads are indirect costs of production that remain relatively constant regardless of the volume of production. They include depreciation and maintenance of factory buildings and equipment, and the cost of factory management and administration.

Variable production overheads are those indirect costs of production that vary directly, or nearly directly, with the volume of production, such as indirect materials and indirect labour.

Selling and administrative costs are overheads by definition (because they cannot be direct costs). These costs are not “incurred in bringing the inventories to their present location and condition”.

Selling costs

Selling overheads are expenses related to the process of selling inventory to customers rather than the actual production of the inventory. Selling overhead might be incurred before the production of the inventory in cases where sales people obtain orders in advance of production but it is more commonly associated with costs incurred after the inventory is completed.

Selling overheads include distribution costs where these relate to transferring goods to customers.

Selling costs are period costs and are expensed in the period to which they relate.

Administration costs

Some administration costs might be manufacturing costs, for example the factory management might be said to have an administrative function. However, the term administration generally relates to the functions necessary for the overall running of the business.

These are costs like accountancy, human resources and purchasing.

Administration costs are period costs and are expensed in the period to which they relate.

Overhead	Classification
Factory machinery	Manufacturing overhead
Factory insurance	Manufacturing overhead
Salary of the Finance Director	Administration overhead
Depreciation of the accounts clerk's computer	Administration overhead
Petrol used in delivery vehicles	Selling overhead
Cost of an advertising campaign	Selling overhead

2 INTRODUCTION TO ABSORPTION COSTING

Section overview

Introduction
Absorption costing
Commentary on absorption costing

2.1 Introduction

Manufacturing companies are concerned to understand what units have cost them to produce or will cost them to produce in the future.

Absorption costing adds a share of fixed production overhead to direct material, direct labour and variable overhead to obtain a 'full cost' or a 'fully absorbed cost' for cost units.

Consider the following.



Example: Unit cost

	₦(000)
Direct materials	50
Direct labour	20
Variable overhead	8
Marginal production cost	<u>78</u>
Fixed production overhead	24
Total absorption cost	<u><u>102</u></u>

This chapter explains the methods that are used to calculate the amount of fixed production overhead costs to add to unit costs in order to obtain a full cost per unit. It tries to explain how a company arrives at the figure for fixed production overhead (₦24,000 above).

2.2 Absorption costing

Absorption costing measures cost of a product or a service as:

its direct costs (direct materials, direct labour and sometimes direct expenses and variable production overheads); plus

a share of fixed production overhead costs

It is a system of costing in which a share of fixed overhead costs is added to direct costs and variable production overheads, to obtain a full cost.

This might be:

a full production cost; or

a full cost of sale.

**Illustration:**

	₦ in '000	₦ in '000
Sales		950
Cost of inventory at the beginning of the period	80	
Production cost of items manufactured in the period:		
Direct materials	280	
Direct labour	120	
Direct expenses (if any)	0	
Variable overhead	40	
Fixed production overhead added to cost ('absorbed')	200	
	640	
	720	
Less: Cost of inventory at the end of the period	(120)	
Production cost of items sold		(600)
Gross profit		350
Administration overhead	100	
Selling and distribution overhead	200	
		(300)
Net operating profit		50

Inventory valuation is an important feature of absorption costing, because the cost of production in any period depends partly on the valuation of opening and closing inventory, including work-in-progress and finished goods inventory.

2.3 Commentary on absorption costing

Absorption costing is necessary to measure the cost of inventory for financial reporting purposes. It can be argued that inventory should be valued in a similar way in the cost accounting system. (However, inventory valuations may differ between the cost accounts and the financial accounts).

There is also a view that in order to assess the profitability of products or services, it is appropriate to charge products and services with a fair share of overhead costs.

Unless products contribute sufficiently to covering indirect costs, its 'profitability' might be too low, and the business as a whole might not be profitable.

However, the technique is open to criticism as follows:

The methods used to charge fixed production overhead costs to products often rely on fairly arbitrary assumptions; and

Absorption costing does not provide cost information to help managers make decisions (relevant costs). Marginal costing and relevant costs are explained in later chapters.

Also, it has been argued by many that absorption costing is no longer relevant in a modern manufacturing environment. It originated at a time when manufacturing was labour intensive and total overhead costs were small compared with direct costs.

Modern manufacturing environments are often not labour intensive and total overhead costs are high.

Absorption costing might result in an incorrect view of what production actually costs.

3 STAGES IN ABSORPTION COSTING

Section overview

Introduction

Cost centres

Allocation, apportionment and absorption (recovery)

Overhead cost allocation

3.1 Introduction

Absorption costing requires a company to calculate a fixed overhead absorption rate. This is then used to measure the fixed overhead that relates to each unit of production.

Note that this is usually calculated in advance for a period rather than being retrospective. For example, towards the end of 20X8 a company would calculate a fixed overhead absorption rate to be used in 20X9 based on what it expected to happen in 20x9.

In order to carry out absorption costing a company must first identify the fixed production overheads that it expects to incur in the future period.

The fixed production overheads are then attached to some kind of production variables in order to load them into units of production. This is explained in much more detail later but for now, what it means is that a company needs to find something which varies with production (for example, the number of units or number of hours worked) and divide the total fixed production overhead by that figure in order to arrive at a fixed production overhead per unit.



Example: Basic absorption

A company has estimated that its fixed production overhead will be ₦1,000,000 next year.

It expects to produce 20,000 units next year.

Each unit is expected to use 2 hours of labour (i.e. the company expects to use 40,000 hours next year).

A company could calculate a fixed overhead absorption rate as follows:

$$\begin{aligned} & \text{Fixed production overheads} / \text{Number of units} \\ & = \text{₦1,000,000} / 20,000 \text{ of units} = \text{₦50 per unit} \end{aligned}$$

or

$$\begin{aligned} & \text{Fixed production overheads} / \text{Number of hours} \\ & = \text{₦1,000,000} / 40,000 \text{ hours} = \text{₦25 per hour} \end{aligned}$$

Each unit would take 2 hours and therefore would absorb ₦50 (2 hours @ ₦25 per hour).

This can seem a little strange as it treated a fixed cost as if it is variable! Every time a unit is made, an amount of fixed cost is treated as being incurred. This means that a system might absorb too much fixed production overhead (known as over absorption) or too little fixed production overhead (known as under absorption). This is covered later.

The above example is simplistic. In practice, a company will produce more than one type of item and the overheads will relate to more than one department. Each item will have different direct costs and use the different department to different degrees. This means that simply dividing the total fixed production overhead by the total number of units or total hours to be worked may not arrive at a fair allocation of fixed production overhead to different inventory lines.

A company must undertake a series of steps in order to arrive at meaningful rates:

Identify the fixed production overheads;

Share the fixed production overheads to departments (cost centres, a term which will be explained shortly) in the factory thus working out a fixed production overhead for each department; and

Estimate fixed overhead absorption rate based on usage of the resources in each department.

The rest of the chapter explains this in much more detail but first explains what cost centres are.

3.2 Cost centres



Definitions: Cost centre

Cost centre: a department or work group for which costs are established, in order to measure the cost of output produced by the centre.

For example, in a factory a group of machines might be a cost centre. The costs of operating the machines would be established, and a cost could then be calculated for each unit of product manufactured by the machines.



Example: Cost centre

A group of machines produces units of Product X. During one month, the costs of operating the machines were ₦36,000.

There are 4 machines which were each operated for 150 hours in the month. The machines produced 20,000 units of Product X.

The group of machines might be treated as a cost centre, and the costs of the cost centre in the month were ₦36,000.

The cost per unit of Product X produced by the cost centre was ₦1.80 (36,000 / 20,000).

The cost per machine hour could also be used = ₦60 ($\frac{₦36,000}{4 \times 150}$).

In a system of absorption costing, each item of overhead cost is charged either: to a cost centre; or

as a general expense.

The cost centres might be:

a cost centre in the production function (production overhead);

a cost centre in administration (administration overhead); and

a cost centre in sales and distribution (sales and distribution overhead).

The cost centres in the production function might be:

a department engaged directly in production work (a production department); or

a department or service section engaged in support activities, such as inventory management, production planning and control, quality control, repairs and maintenance, and so on (service departments).

In a system of absorption costing, overheads are charged to products or services on the basis of this structure of cost centres and general expenses.

3.3 Allocation, apportionment and absorption (recovery)

There are two main stages in absorption costing for charging overhead costs to the cost of production and cost units:

Allocation and apportionment

These are means of charging fixed production overheads to cost centres.

Allocation. Overheads are allocated to cost centres. If a cost centre is responsible for the entire cost of an item of expenditure, the entire cost is charged directly to the cost centre.

Apportionment. Many overhead costs are costs that cannot be allocated directly to one cost centre, because they are shared by two or more cost centres. These costs are apportioned between the cost centres. 'Apportionment' means sharing on a fair basis.

Absorption

Absorption (also called overhead recovery). When overheads have been allocated and apportioned to production cost centres, they are charged to the cost of products manufactured in the cost centre. The method of charging overheads to cost units is to establish a charging rate (an absorption rate or recovery rate) and to apply this rate to all items of production.



Illustration: Allocation, apportionment and absorption

Allocation	Overhead costs are recorded. Initially they are allocated to a cost centre or recorded as a general expense
Apportionment	Overhead costs are shared between the departments or activities that benefit from them
Absorption (Overhead recovery)	Overheads are added to the cost of cost units, using a fair basis for charging (absorption costing only)

3.4 Overhead cost allocation

Many items of indirect cost cannot be charged directly to a cost unit (a unit of product or service), but they can be charged directly to a cost centre (for example, a department or work group). Items of expense that can be identified with a specific cost centre should be charged in full as a cost to the cost centre. The process of charging costs directly to cost centres is called cost **allocation**.

Fixed production overheads may be allocated to:

production departments or production centres: these are cost centres that are directly engaged in manufacturing the products; or

service departments or service centres: These are cost centres that provide support to the production departments, but are not directly engaged in production, such as engineering, repairs and maintenance, the production stores and materials handling department (raw materials inventory), production planning and control, and so on.

Production overheads are the overhead costs of both the production departments and the service departments.

Overhead costs that cannot be directly allocated to a cost centre must be shared (apportioned) between two or more cost centres.



Examples: Allocation and apportionment

The salary of the manager of the production planning department can be allocated directly as a cost of the production planning cost centre (a service department cost centre within production).

The rental cost of equipment used by engineers in the maintenance department can be allocated directly as a cost of the maintenance department (a service department cost centre within production).

If the machining department has its own electricity power supply, electricity charges for the machining department can be allocated directly to the department, (a production department cost centre).

The salary of a supervisor in the finishing department can be allocated directly to the finishing department (a production department cost centre).

The cost of security guards for the manufacturing site cannot be allocated to any specific department or cost centre; therefore security guard services are likely to be recorded as a general production overhead expense, and the cost is allocated to 'security services'.

4 OVERHEAD APPORTIONMENT

Section overview

The apportionment of shared costs between cost centres

The basis of apportionment

4.1 The apportionment of shared costs between cost centres

Some costs cannot be allocated in full to a cost centre, because they are shared by two or more cost centres. These are divided between the cost centres on a fair basis. The process of dividing the shared costs is called **apportionment**.

Shared costs may be divided between administration cost centres and selling and distribution cost centres, as well as production centres and service centres.

The apportionment of production overhead costs might be in two stages:

sharing (or dividing) general costs between production centres and service centres; and then sharing the costs of the service centres between the production centres.

This is called secondary apportionment.

After this has been done, all the production overhead costs have been allocated or apportioned to the production centres. The total overhead costs of each production centre should be:

- (1) costs allocated directly to the production centre; plus
- (2) shared costs apportioned to the production centre; plus
- (3) a share of the costs of each service department, apportioned to the production centre.

4.2 The basis of apportionment

Shared overhead costs should be apportioned on a fair basis between cost centres. For each item of shared expense, a 'fair' basis for apportionment must be selected.

Choosing the basis of apportionment for each cost is a matter of judgement, but there is often an 'obvious' basis to choose. For example, the rental cost of a building and the insurance costs for the building will be apportioned between the cost centres that use the building. The basis of apportionment will probably be to share the costs in relation to the floor space used by each cost centre.

In some cases, however, it might not be clear what the most suitable basis of apportionment should be, and the choice is then simply a matter of judgement and preference.

At the end of the apportionment process, all overhead costs should be allocated or apportioned to a cost centre.



Example: apportionment of shared costs

A manufacturing company has two production departments, Machining and Assembly, and two service departments, Repairs and Quality Control. The following information is available about production overhead costs.

	Total	Machining	Assembly	Repairs	Quality control
	₦	₦	₦	₦	₦
Indirect labour cost	15,500	5,000	5,000	3,500	2,000
Indirect materials	5,300	1,500	2,400	1,000	400
Factory rental	14,400				
Power costs	4,800				
Depreciation (note 1)	14,000				
Building insurance	1,800				
Equipment insurance	4,200				
	<u>60,000</u>				

Note: Depreciation is a charge for the use of items of plant and equipment, such as machinery.

Indirect labour and indirect material costs have been allocated directly to these four cost centres. The other overhead costs are shared between the cost centres and so cannot be allocated directly.

Other information

	Total	Machining	Assembly	Repairs	Quality control
Cost of plant/equipment (₦)	70,000	40,000	15,000	5,000	10,000
Floor area (square metres)	1,800	500	900	100	300
Kilowatt hours (000s)	800	600	100	50	50

Required

How should overheads be allocated and apportioned between the four cost centres?



Answer

The indirect labour costs and indirect materials costs are allocated directly to the cost centres. The basis of apportionment chosen for each of the other shared costs will be as follows:

Item of cost	Basis of apportionment	Rate of apportionment	
Factory rental	Floor area	$\text{₦}14,400/1,800=$	₦8 per square metre
Power costs	Kilowatt hours	$\text{₦}4,800/800=$	₦6 per kilowatt hour
Depreciation	Cost of plant & equipment	$\text{₦}14,000/\text{₦}70,000=$	20% of cost
Building insurance	Floor area	$\text{₦}1,800/1,800=$	₦1 per square metre
Equipment insurance	Cost of plant and equipment	$\text{₦}4,200/70,000=$	6% of cost

These apportionment rates are used to establish the amount of overheads to apportion to each of the four departments.

	Total	Machining	Assembl y	Repairs	Quality control
	₦	₦	₦	₦	₦
Indirect labour cost	15,500	5,000	5,000	3,500	2,000
Indirect materials	5,300	1,500	2,400	1,000	400
Factory rental	14,400	4,000	7,200	800	2,400
Power costs	4,800	3,600	600	300	300
Depreciation (note 1)	14,000	8,000	3,000	1,000	2,000
Building insurance	1,800	500	900	100	300
Equipment insurance	4,200	2,400	900	300	600
	<u>60,000</u>	<u>25,000</u>	<u>20,000</u>	<u>7,000</u>	<u>8,000</u>

The workings for the machining department are shown below.

	Apportionment basis	Machining
		₦
Indirect labour cost: allocated		- 5,000
Indirect materials: allocated		- 1,500
Factory rental	₦8 per square metre × 500	4,000
Power costs	₦6 per kilowatt hour × 600	3,600
Depreciation (note 1)	20% of cost × 40,000	8,000
Building insurance	₦1 per square metre × 500	500
Equipment insurance	6% of cost × 40,000	2,400
Total overheads		<u>25,000</u>

Note: The same process is followed to arrive at the total overheads for the other departments.

5 APPORTIONMENT OF SERVICE DEPARTMENT COSTS

Section overview

Secondary apportionment

Secondary apportionment where one service department uses another service department

Secondary apportionment where service departments use each other: Reciprocal method

Reciprocal method: simultaneous equations technique

After production overheads have been allocated and apportioned to production departments and service departments, the costs of the service departments must then be apportioned to the production departments. When this has been done, all production overhead costs would have been allocated or apportioned to the production departments.

The purpose of doing this is to calculate an absorption rate for each production department. Absorption rates are used to add overhead costs to the costs of production (the cost of the units produced in the production department).

5.1 Secondary apportionment

The apportionment of fixed production overheads to service departments results in a total fixed production overhead for each service department. The total for each service department is then re-apportioned to the production department. This process is called secondary apportionment.

The basis of reapportionment of the overhead from each service department depends on how much of its service is used by other departments.



Example:

A manufacturing company has two production departments, Department 1 and Department 2. It also has two service departments, quality control and the repairs department.

Allocated overhead costs and apportioned general overhead costs for each cost centre are as follows:

Department 1:	₦100,000
Department 2:	₦200,000
Quality control	₦150,000
Repairs:	₦220,000

The repairs department does no work quality control: 75% of its time is spent on repair work for Department 1 and 25% of its time is spent on repair work for Department 2.

The quality control department does no work for repairs: 40% of its time is spent on Department 1 and 60% of its time is spent on Department 2.

The secondary apportionment of overheads will be as follows:

	Basis of apport.	Department 1 ₦	Department 2 ₦	Quality control ₦	Repairs ₦
Initial costs		100,000	200,000	150,000	220,000
Apportion quality control	(40:60)	60,000	90,000	(150,000)	
Apportion repairs	(75:25)	165,000	55,000	-	(220,000)
		<u>325,000</u>	<u>345,000</u>	nil	nil

5.2 Secondary apportionment where one service department uses another service department.

A service department might be used by production department and by another service department. In this case the secondary apportionment must proceed in two stages. The costs of the service department used by the other are apportioned first and then the new total for the second service department is apportioned.

**Example:**

A manufacturing company has two production departments, Department 1 and Department 2. It also has two service departments, the factory canteen and the repairs department.

Allocated overhead costs and apportioned general overhead costs for each cost centre are as follows:

Department 1:	₦100,000
Department 2:	₦200,000
Canteen:	₦150,000
Repairs:	₦220,000

The repairs department does no work for the canteen: 75% of its time is spent on repair work for Department 1 and 25% of its time is spent on repair work for Department 2.

There are 10 employees in Department 1, 20 employees in Department 2 and 20 employees in the repairs department.

Canteen costs are to be apportioned based on the number of employees in each department.

The apportionment of overheads will be as follows:

	Basis of apport.	Department 1 ₦	Department 2. ₦	Canteen ₦	Repairs ₦
Initial costs		100,000	200,000	150,000	220,000
Apportio n canteen	(10:20:20)	30,000	60,000	(150,000)	<u>60,000</u>
					280,000
Apportio n repairs	(75:25)	<u>210,000</u>	<u>70,000</u>	-	<u>(280,000)</u>
		<u>340,000</u>	<u>330,000</u>	nil	nil



Practice question

1

A manufacturing company has two production departments, P1 and P2 and two service departments, S1 and S2. The following information is available.

	P1	P2	S1	S2
Allocated and apportioned production overheads	₦ 200,000	₦ 250,000	₦ 195,000	₦ 180,000
Work done by service department for other departments				
S1	40%	60%	-	-
S2	50%	25%	25%	-

Apportion the overheads to the two production departments

5.3 Secondary apportionment where service departments use each other: reciprocal method

A situation may arise where both service departments do work for one another, as well as the production departments.

In this type of situation, the secondary apportionment is more complex. The process is now called reciprocal apportionment and can be done in either of two ways each of which gives the same result:

repeated distribution method; and
simultaneous equations method.

Repeated distribution method

Taking each service department in turn, the overheads of that department are apportioned to all departments that use its service i.e. to the other service department as well as to the production departments.

This leaves the first service department with no overheads. The overheads of the second service department are then apportioned to all departments that use its service i.e. to the first service department as well as to the production departments.



Example:

A manufacturing company has two production departments, Machining and Assembly, and two service departments, Repairs and Quality Control. The following information is available.

	Total	Machining	Assembly	Repairs	Quality control
Allocated/apportioned overhead costs	₦ 60,000	₦ 25,000	₦ 20,000	₦ 7,000	₦ 8,000
Work done by the service departments:					
Repairs	100%	60%	10%	-	30%
Quality Control	100%	30%	50%	20%	-

The apportionment proceeds as follows.

	Total	Machining	Assembly	Repairs	Quality control
	₦	₦	₦	₦	₦
Allocated/apportioned overhead costs	60,000	25,000	20,000	7,000	8,000
Repairs (60:10:30)		4,200	700	(7,000)	2,100
				0	10,100
Quality Control (30:50:20)		3,030	5,050	2,020	(10,100)
Now repeat:					
Repairs (60:10:30)		1,212	202	(2,020)	606
Quality Control (30:50:20)		182	303	121	(606)
Repeat again					
Repairs (60:10:30)		73	12	(121)	36
Quality Control (30:50:20)		11	18	7	(36)
Repeat again					
Repairs (60:10:30)		4	1	(7)	2
Quality Control (30:50:20)		1	1	0	(2)
	<u>60,000</u>	<u>33,713</u>	<u>26,287</u>	<u>0</u>	<u>0</u>

Comment

The total overhead costs of ₦60,000 have been apportioned. (₦33,713 + ₦26,287 = ₦60,000).

5.4 Reciprocal method: simultaneous equations technique

This technique is an alternative to the repeated distribution technique, and should produce exactly the same final apportionment of overhead costs between the production departments.

The method is to create two equations for the apportionment of service department overheads. These are simultaneous equations, which must then be solved. The solutions to the simultaneous equations can then be used to calculate the overhead apportionment to each production department.



Example:

The information is as follows:

	Total	Machining	Assembly	Repairs	Quality control
Allocated/apportioned overhead costs	₦60,000	₦25,000	₦20,000	₦7,000	₦8,000
Work done by the service departments:					
Repairs	100%	60%	10%	-	30%
Quality Control	100%	30%	50%	20%	-

Step 1: formulate the simultaneous equations

The first step is to establish two simultaneous equations. There should be one equation for each service department.

Each equation should state the total amount of overheads that will be apportioned from the service departments. This total overhead is the original overhead cost allocation/apportionment for the service department plus the proportion of the costs of the other service department that will be apportioned to it.

Using the example, the two equations are formulated as follows.

Let the total overheads apportioned from the Repairs department be X.

Let the total overheads apportioned from the Quality Control department be Y.

Then:

$X = \text{Original overheads of Repairs department} + 20\% \text{ of Quality Control costs.}$

$Y = \text{Original overheads of Quality Control department} + 30\% \text{ of Repair costs.}$

This gives us:

$$X = 7,000 + 0.20Y$$

$$Y = 8,000 + 0.30X$$



Example continued:

Step 2

The next step is to solve these simultaneous equations.

Re-arrange the two equations:

$$\begin{array}{r} X - 0.2Y = 7,000 \text{(1)} \\ - 0.3 X + Y = 8,000 \text{(2)} \end{array}$$

Solve to find values for X and Y.

In this example, the easiest method of solution is to multiply equation (1) by 5, so that the coefficient for Y is -1. This matches the coefficient of + 1 in equation (2). Add the two equations to obtain a value for X.

$$\begin{array}{r} 5X - Y = 35,000 \text{(1) } \times 5 = (3) \\ - 0.3 X + Y = 8,000 \text{ (2)} \\ \hline 4.7 X = 43,000 \text{(2) + (3)} \\ \\ X = 9,149 \text{ (= } 43,000/4.7) \end{array}$$

Now substitute this value for X in equation (2)

$$\begin{array}{r} - 0.3 X + Y = 8,000 \\ Y = 8,000 + 0.3 (9,149) \\ Y = 10,745 \end{array}$$

Step 3

Use the values for X and Y that you have calculated to establish the total costs to apportion from the service department to each production department.

In this example:

Of the total value of X, 60% is apportioned to Machining and 10% to Assembly

Of the total value of Y, 30% is apportioned to Machining and 50% to Assembly.

	Machining	Assembly
	₦	₦
Allocated/apportioned overhead costs	25,000	20,000
Apportion costs of service departments:		
Repairs (60% and 10% of X = 9,149)	5,489	915
Quality Control (30% and 50% of Y =10,745)	<u>3,224</u>	<u>5,372</u>
Final apportionment	<u>33,713</u>	<u>26,287</u>

This is the same as with the repeated distribution method.



Practice question

2



Nitrate Limited (NL), producing industrial chemicals, has three production and two service departments.

The annual overheads are as follows:

Production departments:

A	56,000
B	50,000
C	38,000

Service departments:

X	16,500
Y	10,600
	171,100

The service departments' costs are apportioned as follows:

	Production departments			Service departments	
	A	B	C	X	Y
Service department X	20%	40%	30%	-	10%
Service department Y	40%	20%	20%	20%	

Apportion costs of service departments using the simultaneous equation method

6 Overhead absorption

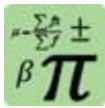
Section overview

- Overhead absorption rate (recovery rate)
 Departmental absorption rates or a factory-wide absorption rate?
 The treatment of non-production overheads

6.1 Overhead absorption rate (recovery rate)

When all production overheads have been allocated or apportioned to the production departments, a rate can be calculated for absorbing the overheads into the cost of the units manufactured in each department. This is the overhead absorption rate or overhead recovery rate.

The overhead absorption rate for a production department is calculated as follows:



Formula: Overhead absorption rate

$$\frac{\text{Total allocated and apportioned overheads}}{\text{Volume of activity in the period}}$$

The volume of activity can be any of the following:

Activity basis (volume of activity)	Absorption rate
Units produced in the period, but only if all units are identical	Absorption rate per unit. Not practical where units are not identical. However, used in standard costing.
Direct labour hours worked in the period	Absorption rate per direct labour hour. Commonly-used method.
Direct labour cost in the period	Overhead absorbed as a percentage of direct labour cost. Could be used when there are no records for direct labour hours worked.
Machine hours operated in the period	Absorption rate per machine hour. Commonly-used method in <i>machine-intensive</i> production departments.
Prime costs of production in the period (direct materials plus direct labour costs)	Overhead absorbed as a percentage of prime cost. This is uncommon.

The basis of activity selected for an absorption rate should be one that charges overhead costs to cost units on a fair basis. A rate per direct labour hour and a rate per machine hour are the most common methods, although a rate per unit is used in standard costing or where a single identical unit of product is manufactured.



Example: absorption rate

The allocated and apportioned overhead costs of Production Department X are ₦24,000 during a period when the department produces the following units of product:

	Product A	Product B	Product C
Units produced (quantity)	3,000	4,000	1,000
Prime cost per unit	₦3	₦4	₦5
Direct labour hours per unit	0.1	0.2	0.4
Direct labour cost	₦3,500	₦8,000	₦4,500
Machine hours per unit	0.2	0.1	0.2

It has been decided that production overheads will be absorbed on a direct labour hour basis.

The overhead absorption rate is calculated as follows.

Step 1: Calculate the total number of direct labour hours

	Direct labour hours
Product A: (3,000 units × 0.1 hours)	300
Product B: (4,000 units × 0.2 hours)	800
Product C: (1,000 units × 0.4 hours)	400
Total direct labour hours	<u>1,500</u>

Step 2: Calculate an absorption rate per direct labour hour

Production overhead expenditure	₦24,000
Number of labour hours	1,500
Absorption rate per direct labour hour	₦16

Step 3: Use this absorption rate to charge overhead costs to products

Overheads absorbed by each product:	₦
Product A: (300 hours × ₦16)	4,800
Product B: (800 hours × ₦16)	12,800
Product C: (400 hours × ₦16)	6,400
Total	<u>24,000</u>

	Product A	Product B	Product C
	₦	₦	₦
Prime cost per unit	3.00	4.00	5.00
Overhead at ₦16/direct labour hour	<u>1.60</u>	<u>3.20</u>	<u>6.40</u>
Full production cost/unit	<u>4.60</u>	<u>7.20</u>	<u>11.40</u>

The choice of the basis for absorbing overheads can have a significant effect on the overheads charged to each product or cost unit.

6.2 Departmental absorption rates or a factory-wide absorption rate?

An overhead absorption rate can be calculated for each production department separately.

Alternatively, a single overhead absorption rate might be used for all the production departments in the factory. Calculating a single factory-wide rate involves less time and effort than calculating separate absorption rates for each production department within the factory. However, it might be argued that a single-factory wide absorption rate is less 'exact' or less 'fair' in sharing overhead costs between products or cost units.

A factory wide rate is also called a blanket rate.



Example: absorption rate

A manufacturing company has two production departments. Each department is involved in making two products, X and Y. Information about costs and production volume in the year is shown below:

	Production departments		Products	
	Department P1	Department P2	Product X	Product Y
Overhead costs	₦60,000	₦90,000		
Direct labour hours/unit:				
Product X	0.5 hours	2 hours		
Product Y	3.5 hours	1.5 hours		
Units produced			2,000	4,000

Required

Calculate the total production overhead cost/unit for Product X and Product Y using:

- (1) separate departmental overhead rates for departments P1 and P2
- (2) a single absorption rate for the entire factory.



Answer

Separate departmental rates

	Department P1		Department P2	
Direct labour hours		hours		hours
Product X	(2,000 × 0.5)	1,000	(2,000 × 2)	4,000
Product Y	(4,000 × 3.5)	<u>14,000</u>	(4,000 × 1.5)	<u>6,000</u>
		<u>15,000</u>		<u>10,000</u>
Overhead expenditure		₦60,000		₦90,000
Absorption rate/direct labour hour		₦4		₦9
Production overhead cost/unit		Product X		Product Y
		₦		₦
Department P1 (at ₦4/hour)		2		14.00
Department P2 (at ₦9/hour)		<u>18</u>		<u>13.50</u>
Total production overhead cost/unit		<u>20</u>		<u>27.50</u>

Single departmental rate

$$\frac{(\text{₦}60,000 + \text{₦}90,000)}{(15,000 + 10,000)\text{hours}} = \text{₦}6 \text{ per direct labour hour}$$

Production overhead costs

Product X: (0.5 hours + 2 hours) × ₦6 = ₦15 per unit of Product X.

Product Y: (3.5 hours + 1.5 hours) × ₦6 = ₦30 per unit of Product Y.

if you are given a question about overhead absorption rates, with two production departments, you should normally assume that you are required to calculate separate overhead absorption rates for each department.

6.3 The treatment of non-production overheads

In many costing systems, administration overheads and sales and distribution overheads are not absorbed into product costs. Instead, they are treated in full as an expense in the financial period to which they relate.

Non-production overhead costs are never added to the value of inventory. The main reason for absorbing production overheads is normally to calculate a value for inventory, for the purpose of measuring profit.

However, it is possible to add non-production overheads to the full production cost of units produced, to obtain a full cost of sale. When this happens, the basis for absorbing the overhead costs should be 'fair'.

Administration overheads might be added as a percentage of production costs.

Sales and distribution overheads might also be added as a percentage of production costs. Alternatively, they might be added as a percentage of the value of sales.



Example: Non-production overheads

A company has budgeted to make and sell 100,000 units of Product X and 50,000 units of Product Y. Product X will sell for ₦5 per unit and Product Y will sell for ₦6 per unit.

The following costs have been budgeted.

	₦
Full production cost, Product X	200,000
Full production cost, Product Y	100,000
Administration overheads	120,000
Sales and distribution overheads	200,000

Administration overheads will be absorbed into product costs as a percentage of full production costs. Selling and distribution overheads will be absorbed as a percentage of sales revenue.

Required

Calculate the cost of sales for each product and the budgeted profit for each product.



Answer

Budgeted administration overheads = ₦120,000

Budgeted production costs (₦200,000 + ₦100,000) = ₦300,000.

Absorption rate for administration overheads = $(120,000/300,000) \times 100\% = 40\%$ of production cost.

	₦
Budgeted sales revenue, Product X (100,000 × ₦5)	500,000
Budgeted sales revenue, Product Y: (50,000 × ₦6)	300,000
Total budgeted sales revenue	<u>800,000</u>

Budgeted sales and distribution costs 200,000

Absorption rate for sales and distribution overheads
= $(200,000/800,000) \times 100\% = 25\%$ of budgeted sales revenue.

	Product X		Product Y	
	₦	₦	₦	₦
Sales		500,000		300,000
Production costs	200,000		100,000	
Administration costs (40% of production cost)	80,000		40,000	
Sales and distribution costs (25% of sales revenue)	<u>125,000</u>		<u>75,000</u>	
Full cost of sale		<u>405,000</u>		<u>215,000</u>
Profit		<u>95,000</u>		<u>85,000</u>

7 UNDER-ABSORBED AND OVER-ABSORBED OVERHEADS

Section overview

Predetermined overhead rate

Calculating a predetermined overhead rate

Under-absorption or over-absorption of overheads

The reasons for under- or over-absorption: expenditure and volume variances

7.1 Predetermined overhead rate

There is a problem with calculating production overhead absorption rates using actual overhead expenditure and actual activity levels (actual production volume).

Overhead rates are normally calculated for the entire financial year, and the same absorption rate is used throughout the year. If overhead rates are based on actual overhead expenditure and actual direct labour hours or machine hours, it would be necessary to wait until the end of the financial year to calculate any overhead absorption rates and product costs. This is unacceptable, because of the delay in providing management information about costs and profitability.

The cost accountant needs to know what the overhead absorption rate is in order to calculate product costs as soon as the products are manufactured. For this to be possible, the absorption rate must be decided in advance, for the entire financial year.

Predetermined absorption rates are therefore calculated and used. The absorption rates are calculated in advance using estimates for cost and production volume in the annual financial plan or budget.

7.2 Calculating a predetermined overhead rate

A predetermined overhead absorption rate is known by different names including the fixed overhead absorption rate, the fixed overhead recovery rate or the fixed overhead applied.

The predetermined overhead absorption rates are calculated from:

budgeted (planned) overhead expenditure; and

the budgeted volume or activity levels (for example, labour hours or machine hours).

The method of calculating a predetermined overhead rate, either for separate production departments or as a factory-wide rate, are the processes of allocation, apportionment and absorption that have already been described. Budgeted data is used, rather than data about actual costs and output.

7.3 Under-absorption or over-absorption of overheads

Actual overhead expenditure and actual production volume will almost certainly be different from the planned expenditure and production volume. This means that the production overheads absorbed into product costs will be higher or lower than the actual production overhead expenditure.

The difference is calculated as follows:



Illustration: Under of over-absorbed fixed overhead

		₦
Amount absorbed:		
Actual number of units made (or hours used)	×	Predetermined absorption rate
		X
Actual expenditure in the period		(X)
Over/(under) absorbed		X

Over-absorption.

Every time a unit of production is made, the accounting system posts fixed production overhead into the item. This transfers expense out of the fixed production overhead account as follows.



Illustration: Posting of fixed production overhead

	Debit	Credit
Finished goods	X	
Fixed production overhead		X

If the amount of production overheads absorbed into product costs is more than the actual production overhead expenditure, there is over-absorbed overhead. Too much overhead cost has been charged to finished goods.

This means that too much has been transferred out of the fixed production overhead account.

Finished goods are charged to cost of sales. The fact that fixed production overhead has been over absorbed means that the expense in the statement of comprehensive income is overstated.

These problems are corrected by the following journal:



Illustration: Accounting for over-absorption of fixed overhead

	Debit	Credit
Fixed production overhead	X	
Cost of sales		X

The over-absorbed overhead is accounted for as an adjustment to the profit in the period, and is added to profit in the cost accounting income statement.

Under-absorption

If the amount of production overheads absorbed into product costs is less than the actual production overhead expenditure, there is under-absorbed overhead. Not enough overhead cost has been charged to production costs, because actual costs were higher. Under-absorbed overhead is accounted for as an adjustment to the profit in the period, and is deducted from profit.



Illustration: Accounting for under-absorption of fixed overhead

	Debit	Credit
Cost of sales	X	
Fixed production overhead		X

There is no adjustment to the value of closing inventory to allow for any over-absorption or under-absorption of overhead in the cost accounting income statement.



Example:

A company manufactures and sells a range of products in a single factory. Its budgeted production overheads for Year 6 were ₦150,000, and budgeted direct labour hours were 50,000 hours.

Actual results in Year 6 were as follows:

	₦	
Sales	630,000	
Direct materials costs	130,000	
Direct labour costs	160,000	
Production overhead	140,000	(40,000 hours)
Administration overhead	70,000	
Selling and distribution overhead	90,000	

There was no opening or closing inventory at the beginning or end of Year 6.

The company uses an absorption costing system, and production overhead is absorbed using a direct labour hour rate.

Required

- Calculate the production overhead absorption rate.
- Calculate the over or under absorption of fixed overhead.
- Calculate the full production cost.
- Show how the profit or loss for the year will be reported.



Answer

a. The predetermined absorption rate is $\text{₦}150,000/50,000 \text{ hours} = \text{₦}3$ per direct labour hour.

b Under absorption	₦
Overhead absorbed (40,000 hours @ ₦3 per hour)	120,000
Overhead incurred (actual cost)	<u>(140,000)</u>
Under absorption	<u>(20,000)</u>

c The full production cost:	₦
Direct materials costs	130,000
Direct labour costs	160,000
Production overhead absorbed (40,000 hours × ₦3)	<u>120,000</u>
Full production cost (= cost of sales in this example)	<u>410,000</u>

The profit for the year is reported as follows. Notice that under-absorbed overhead is an adjustment that reduces the reported profit. Over-absorbed overhead would be an adjustment that increases profit.

	₦	₦
d Sales		630,000
Full production cost of sales		410,000
Under-absorbed overhead		<u>20,000</u>
		<u>(430,000)</u>
		200,000
Administration overhead	70,000	
Selling and distribution overhead	<u>90,000</u>	
		<u>(160,000)</u>
Profit for Year 6		<u>40,000</u>

7.4 The reasons for under or over-absorption: expenditure and volume variances

Under or over-absorption is caused by the actual fixed overhead and production volume being different from those figures used to calculate the predetermined rate.

There are two reasons for over-absorbed or under-absorbed overheads. These can be measured as:

an overhead expenditure variance; and

an overhead volume variance.

The predetermined overhead absorption rate is based on budgeted overhead expenditure and budgeted production volume. What was expected in the budget might not actually happen. When there are differences between actual and budgeted fixed overhead expenditure, and actual and budgeted activity volume, an under- or over-absorption of overheads occurs.

An overhead variance is reported as either favourable (F) or adverse (A).

When an overhead variance causes **over-absorption of overhead**, it is a **favourable variance**. The over-absorption is an adjustment that increases profit.

When an overhead variance causes **under-absorption of overhead**, it is an **adverse variance**. The under-absorption is an adjustment that reduces profit.

Expenditure variance

Actual overhead expenditure might be different from the expected (budgeted) expenditure. Therefore there will be some under-absorbed or over-absorbed overheads because actual overhead expenditure differs from the budgeted expenditure.



Illustration: Expenditure variance

	₦	
Expected overhead expenditure	E	
Actual overhead expenditure	A	
Expenditure variance	<u>(E – A)</u>	(favourable or adverse)

When actual fixed overhead expenditure exceeds the budget, there is an ‘adverse’ variance, and this will result in some under-absorption of fixed overheads. When actual fixed overhead expenditure is less than budgeted, there is a ‘favourable’ variance and this will result in over-absorption of fixed overhead.

The reasons for an expenditure variance might be either: excessive spending on overhead items or under-estimating fixed overhead expenditure in the budget.

Volume variance

The second reason for under- or over-absorption of fixed overhead is the difference between the actual and budgeted volume of activity (i.e. the volume of activity on which the pre-determined overhead absorption rate was calculated).



Illustration: Volume variance

	Units or hours	
Expected production volume	E	
Actual production volume	A	
Volume variance (units or hours)	<u>(E – A)</u>	(favourable or adverse)
× Absorption rate per unit or hour (₦)	X	
Volume variance (in ₦)	<u>X(E – A)</u>	

When actual activity volume exceeds the budget, there will be over-absorption of fixed overheads, which is a ‘favourable’ variance. When actual activity volume is less than budget, there will be under-absorption of fixed overhead, which is an ‘adverse’ variance.

When overheads are absorbed on the basis of direct labour hours or machine hours, the actual hours worked might be higher or lower than budgeted. The reasons for a favourable or an adverse volume variance might therefore be any of the following. Working more hours than budgeted might be caused by working overtime, or taking on additional direct labour employees.

Working fewer hours than budgeted might be caused by staff shortages (due to employees leaving or absence from work), hold-ups in production or lack of customer orders.



Example:

In its annual financial plan for Year 1, a manufacturing company budgets that production overhead expenditure will be ₦800,000 and that there will be 100,000 direct labour hours of work. It uses a single absorption rate, which is a rate per direct labour hour.

Actual production overhead during Year 1 was ₦805,000 and 105,000 direct labour hours were worked.



Answer

The total under- or over-absorbed overhead

The production overhead absorption rate for the year is ₦800,000/100,000 = ₦8 per direct labour hour. All cost units produced during the year are charged with production overheads at the rate of ₦8 for each direct labour hour.

	₦
Overheads absorbed (105,000 hours × ₦8) (Overheads included in product costs)	840,000
Actual overhead expenditure	<u>805,000</u>
Over-absorbed overheads	<u><u>35,000</u></u>

This is added to profit when calculating the actual profit for Year 1.

Explaining the over-absorbed overhead

The over-absorbed overhead of ₦35,000 can be explained by a combination of an expenditure variance and a volume variance.

	₦	
Budgeted overhead expenditure	800,000	
Actual overhead expenditure	<u>805,000</u>	
Expenditure variance	<u><u>5,000</u></u>	Adverse

The expenditure **variance is** adverse because actual expenditure was more than planned expenditure, and this has resulted in some **under-absorption** of overhead.

	Hours	
Budgeted volume (direct labour hours)	100,000	
Actual volume (direct labour hours)	<u>105,000</u>	
Volume variance (direct labour hours)	5,000	Favourable
Absorption rate/direct labour hour	₦8	
Volume variance in ₦	<u><u>₦40,000</u></u>	Favourable

The volume **variance is favourable** because actual hours worked exceeded the planned hours, and this has resulted in some **over-absorption** of overhead.

Summary	₦	
Expenditure variance	5,000	Adverse
Volume variance	<u>40,000</u>	Favourable
Total over-absorbed overhead	<u><u>35,000</u></u>	Favourable

8 FIXED AND VARIABLE OVERHEADS

Section overview

Definition of fixed and variable overheads

Absorption rates for fixed and variable production overheads

Calculating under- or over-absorbed overhead with fixed and variable overheads

8.1 Definition of fixed and variable overheads

Most overhead is usually fixed, but some overhead might be a variable cost.

Fixed overhead is overhead expenditure that should be a fixed amount in total during a given period of time, and will not change if more or less production work is done.

Variable overhead is overhead that increases as more production work is done or decreases as less production work is done. Total variable overhead expenditure therefore depends on the volume of production. Variable overhead is usually calculated as an amount for each direct labour hour worked.

8.2 Absorption rates for fixed and variable production overheads

When an absorption costing system identifies fixed and variable overhead costs separately, there will be separate absorption rates for fixed overheads and variable overheads.



Example:

The budgeted production overhead expenditure for Year 1 is ₦2,400,000 of fixed overheads plus variable overheads of ₦3 per direct labour hour. The budgeted direct labour hours are 100,000 for the year.

	₦
Budgeted fixed overhead	2,400,000
Budgeted variable overhead (100,000 × ₦3)	<u>300,000</u>
Total budgeted overhead expenditure	<u><u>2,700,000</u></u>

The overhead absorption rate per direct labour hour is calculated as a separate rate for fixed and variable overheads:

	₦
Fixed overhead absorption rate (₦2,400,000/100,000)	24
Variable overhead absorption rate	<u>3</u>
Total absorption rate per direct labour hour	<u><u>27</u></u>

Total overhead expenditure

The total fixed overhead **expenditure** is unaffected by changes in production volume. However, total variable overhead expenditure increases or falls with increases or falls in production volume.

Unit overhead cost and overhead absorption rate

The budgeted fixed overhead cost per unit or per direct labour hour decreases as the planned production volume increases. The variable overhead absorption rate and spending rate is the same, regardless of the volume of production.



Example:

Suppose that in the previous example, the budget is amended, and the new plan is to work 120,000 direct labour hours, rather than 100,000 hours. The new budget for overhead expenditure will be as follows:

	₦
Budgeted fixed overhead	2,400,000
Budgeted variable overhead (120,000 × ₦3)	<u>360,000</u>
Total budgeted overhead expenditure	<u>2,760,000</u>

The overhead absorption rate per direct labour hour would be calculated as follows, with the fixed overhead absorption rate lower due to the higher budgeted direct labour hours, but the variable overhead absorption rate unchanged.

	₦
Fixed overhead absorption rate (₦2,400,000/120,000)	20
Variable overhead absorption rate	<u>3</u>
Total absorption rate/direct labour hour	<u>23</u>

8.3 Calculating under- or over-absorbed overhead with fixed and variable overheads

When there are some variable overheads, the method of calculating under- or over-absorbed overhead is slightly different from the calculation when all overheads are fixed. This is because variable overhead expenditure is expected to vary with the actual volume of activity.



Example:

A company has budgeted fixed production overheads of ₦600,000 for Year 3, and a variable overhead cost of ₦2 per direct labour hour. The budgeted production volume is 60,000 direct labour hours of work. Actual production in Year 3 was 62,000 direct labour hours, and actual overhead expenditure (fixed and variable) was ₦790,000 in total.

Required

Calculate the under- or over-absorbed overhead in the year, and analyse this into an expenditure and a volume variance.



Answer

Absorbed overheads	₦
Fixed overheads (62,000 hours × ₦10)	620,000
Variable overheads (62,000 hours × ₦2)	<u>124,000</u>
Total absorbed overheads	744,000
Actual overhead expenditure	<u>790,000</u>
Under-absorbed overheads	<u><u>46,000</u></u>

Explaining the under-absorbed overhead

This under-absorbed overhead of ₦46,000 can be analysed into an expenditure and a volume variance. There are two important points to note.

The expected overhead expenditure is the budgeted fixed overhead expenditure plus the expected variable overhead expenditure for the hours actually worked.

The volume variance affects fixed overheads only, not variable overheads.



Example: Summary

Expected overhead expenditure	₦	
Expected fixed overheads (= Budgeted fixed overhead)	600,000	
Expected variable overheads (62,000 × ₦2)	<u>124,000</u>	
Total expected overhead expenditure	724,000	
Actual overhead expenditure	<u>790,000</u>	
Expenditure variance	<u>66,000</u>	Adverse
	Hours	
Budgeted volume (direct labour hours)	60,000	
Actual volume (direct labour hours)	<u>62,000</u>	
Volume variance (direct labour hours)	2,000	Favourable
Fixed overhead absorption rate/hour	<u>₦10</u>	
Volume variance in ₦ (fixed overhead only)	<u><u>₦20,000</u></u>	Favourable
Summary	₦	
Expenditure variance	66,000	Adverse
Volume variance	<u>20,000</u>	Favourable
Total under-absorbed overhead	<u><u>46,000</u></u>	Adverse

9 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the meaning of overheads;

Identify manufacturing and non-manufacturing overheads;

Explain allocation and apportionment and apply the techniques to identify the total overhead costs associated with different departments (including techniques of secondary apportionment);

Explain absorption;

Calculate departmental overhead absorption rates from data supplied;

Calculate the overhead costs absorbed by applying overhead absorption rate in an appropriate manner; and

Calculate and account for over and under absorption of overhead.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1

The service centre costs should be apportioned by apportioning the costs of S2 first. This is because S2 does work for S1 as well as the production departments

	Basis of apportionment	P1	P2	S1	S2
		₦	₦	₦	₦
Initial costs		200,000	250,000	195,000	180,000
Apportion S2	(50:25:25)	90,000	45,000	45,000	(180,000)
				240,000	
Apportion S1	(40:60)	96,000	144,000	(240,000)	
		<u>386,000</u>	<u>439,000</u>	<u>nil</u>	<u>nil</u>

Solution

2

Let X represent total overheads of department X

Let Y total overheads of department Y

Since X received 20% of Y's services

Thus $X = 16,500 + 0.2 Y$

Likewise $Y = 10,600 + 0.1X$

Using substitution method of simultaneous equation

$X = 16,500 + 0.2 (10,600 + 0.1X)$

$X = 16,500 + 2,120 + 0.02X$

$X - 0.02X = 18,620$

$0.98X = 18,620$

$X = 19,000$

$Y = 10,600 + (0.1 \times 19,000)$

$Y = 12,500$

Overheads charged to production:

	A	B	C
Allocated overheads	56,000	50,000	38,000
Share of X's service (₦19,000 × % served)	3,800	7,600	5,700
Share of Y's service (₦12,500 × % served)	5,000	2,500	2,500
	<u>64,800</u>	<u>60,100</u>	<u>46,200</u>

Marginal costing and absorption costing

Contents

- 1 Marginal cost and marginal costing
- 2 Reporting profit with marginal costing
- 3 Reporting profit with absorption costing
- 4 Marginal costing and absorption costing compared
- 5 Advantages and disadvantages of absorption and marginal costing
- 6 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

A	Cost accounting	
	3	Accounting for cost elements (continued)
	c	Accounting for overheads
	vi	Explain and calculate under - and over - absorption of overheads.
	5	Costing techniques
	a	Explain the various types of costing techniques.
	b	Prepare an income statement and determine the profit or loss under absorption and marginal costing.
	c	Describe the advantages and disadvantages of absorption and marginal costing.
	d	Reconcile the profits or losses computed under absorption and marginal costing.

Exam context

This chapter explains the distinction between marginal and absorption costing.

Marginal costing is useful for decision-making as it focuses only on those costs which change with a decision.

Absorption costing is useful for inventory valuation for reporting purposes as it focuses on the total cost of bringing an item of inventory to its present location and condition.

By the end of this chapter you should be able to:

- Explain the concept of marginal costing;
- Calculate the marginal cost of an item from given data;
- Explain how marginal cost and the concept of contribution are important in decision-making;
- Describe absorption costing using examples;
- Calculate the absorption cost of an item from given data;
- Compare marginal costing and absorption costing; and
- Reconcile absorption costing and marginal costing profit figures.

1 MARGINAL COST AND MARGINAL COSTING

Section overview

Marginal cost
Marginal costing and its uses
Assumptions in marginal costing
Contribution

1.1 Marginal cost

The marginal cost of an item is its variable cost.

Marginal production cost = Direct materials + Direct labour + Direct expenses + Variable production overhead.

Marginal cost of sale for a product = Direct materials + Direct labour + Direct expenses + Variable production overhead + Other variable overhead (for example, variable selling and distribution overhead).

Marginal cost of sale for a service = Direct materials + Direct labour + Direct expenses + Variable overhead.

It is usually assumed that **direct labour costs** are variable (marginal) costs, but often direct labour costs might be fixed costs, and so would not be included in marginal cost.

Variable overhead costs might be difficult to identify. In practice, variable overheads might be measured using a technique such as high/low analysis or linear regression analysis, to separate total overhead costs into fixed costs and variable cost per unit of activity.

For variable production overheads, the unit of activity is often either direct labour hours or machine hours, although another measure of activity might be used.

For variable selling and distribution costs, the unit of activity might be sales volume or sales revenue.

Administration overheads are usually considered to be fixed costs, and it is very unusual to come across variable administration overheads.

1.2 Marginal costing and its uses

Marginal costing is an alternative to absorption costing as a method of costing. In marginal costing, fixed production overheads are not absorbed into product costs. Marginal costing only includes those production costs which change with the number of units produced (i.e. the variable or marginal production costs).

There are several reasons for using marginal costing:

To measure profit (or loss), as an alternative to absorption costing;

To forecast what future profits will be; and

To calculate what the minimum sales volume must be in order to make a profit.

It can also be used to provide management with information for decision making.

Its main uses, however, are for planning (for example, budgeting), forecasting and decision-making.

1.3 Assumptions in marginal costing

For the purpose of marginal costing, the following assumptions are normally made: Every additional unit of output or sale, or every additional unit of activity, has the same variable cost as every other unit. In other words, the variable cost per unit is a constant value;

Fixed costs are costs that remain the same in total in each period, regardless of how many units are produced and sold;

Costs are either fixed or variable, or a mixture of fixed and variable costs. Mixed costs can be separated into a variable cost per unit and a fixed cost per period; and

The marginal cost of an item is therefore the extra cost that would be incurred by making and selling one extra unit of the item. Therefore, marginal costing is particularly important for decision-making as it focuses on what changes as a result of a decision.

This is explored in detail in later chapters.

1.4 Contribution

Contribution is a key concept in marginal costing.

Contribution = Sales – Variable costs

Fixed costs are constant in each period. To make a profit, an entity must first make enough contribution to cover its fixed costs. Contribution therefore means: 'contribution towards covering fixed costs and making a profit'.

Total contribution – Fixed costs = Profit

When fixed costs have been covered, any additional contribution represents a profit. If total contribution fails to cover fixed costs, there is a loss.

2 REPORTING PROFIT WITH MARGINAL COSTING

Section overview

Total contribution minus fixed costs

A marginal costing income statement with opening and closing inventory

Calculation of marginal cost profit

2.1 Total contribution minus fixed costs

Profit is measured by comparing revenue to the cost of goods sold in the period and then deducting other expenses.

The cost of goods sold is the total cost of all production costs in the period adjusted for the inventory movement.

In a marginal cost system, the opening and closing inventories are measured at their marginal costs. The cost per unit includes only the variable costs of production (direct materials + direct labour + direct expenses + variable production overhead).

When measuring profits using marginal costing, it is usual to identify contribution, and then to subtract fixed costs from the total contribution, in order to get to the profit figure.



Illustration:

	₦	₦
Sales		360,000
Direct costs	105,000	
Variable production costs	15,000	
Variable sales and distribution costs	10,000	
Total marginal costs		<u>(130,000)</u>
Total contribution		230,000
Total fixed costs		<u>(150,000)</u>
Profit		<u><u>80,000</u></u>

Total contribution and contribution per unit

In marginal costing, it is assumed that the variable cost per unit of product (or per unit of service) is constant. If the selling price per unit is also constant, this means that the contribution earned from selling each unit of product is the same.

Total contribution can therefore be calculated as: Units of sale × Contribution per unit.



Example:

A company manufactures and sells two products, A and B.

Product A has a variable cost of ~~₦6~~ and sells for ~~₦10~~, and product B has a variable cost of ~~₦8~~ and sells for ~~₦15~~.

During the period, 20,000 units of Product A and 30,000 units of Product B were sold.

Fixed costs were ~~₦260,000~~. What was the profit or loss for the period?



Answer

Contribution per unit:

Product A: ~~₦10~~ – ~~₦6~~ = ~~₦4~~

Product B: ~~₦15~~ – ~~₦8~~ = ~~₦7~~

	₦
Contribution from Product A: (20,000 × ₦4)	80,000
Contribution from Product B: (30,000 × ₦7)	210,000
Total contribution for the period	<u>290,000</u>
Fixed costs for the period	<u>(260,000)</u>
Profit for the period	<u><u>30,000</u></u>

2.2 A marginal costing income statement with opening and closing inventory

The explanation of marginal costing has so far ignored opening and closing inventory.

In absorption costing, the production cost of sales is calculated as 'opening inventory value + production costs incurred in the period – closing inventory value'.

The same principle applies in marginal costing. The variable production cost of sales is calculated as 'opening inventory value + variable production costs incurred in the period – closing inventory value'.

When marginal costing is used, inventory is valued at its **marginal cost of production** (variable production cost), without any absorbed fixed production overheads.

If an income statement is prepared using marginal costing, the opening and closing inventory might be shown, as follows:



Illustration: Marginal costing income statement for the period

	₦	₦
Sales		440,000
Opening inventory at variable production cost	5,000	
Variable production costs		
Direct materials	60,000	
Direct labour	30,000	
Variable production overheads	15,000	
	110,000	
Closing inventory at variable production cost	(8,000)	
Variable production cost of sales	102,000	
Variable selling and distribution costs	18,000	
Variable cost of sales		(120,000)
Contribution		320,000
Fixed costs:		
Production fixed costs	120,000	
Administration costs (usually 100% fixed costs)	70,000	
Selling and distribution fixed costs	90,000	
Total fixed costs		(280,000)
Profit		40,000

If the variable production cost per unit is constant (i.e. it was the same last year and this year), there is no need to show the opening and closing inventory valuations, and the income statement could be presented more simply as follows:



Illustration: Marginal costing income statement for the period

	₦	₦
Sales		440,000
Variable production cost of sales	102,000	
Variable selling and distribution costs	18,000	
Variable cost of sales		(120,000)
Contribution		320,000
Fixed costs:		
Production fixed costs	120,000	
Administration costs (usually 100% fixed costs)	70,000	
Selling and distribution fixed costs	90,000	
Total fixed costs		(280,000)
Profit		40,000

2.3 Calculation of marginal cost profit

The following example illustrates the calculation of marginal cost profit.

In the next section the same scenario will be used to show the difference between marginal cost profit and total absorption profit.



Example:

Makurdi Manufacturing makes and sells a single product:

	₦
Selling price per unit	150
Variable costs:	
Direct material per unit	35
Direct labour per unit	25
Variable production overhead per unit	10
Marginal cost per unit (used in inventory valuation)	<u>70</u>

Budgeted fixed production overhead ₦110,000 per month

The following actual data relates to July and August:

	July	August
Fixed production costs	₦110,000	₦110,000
Production	2,000 units	2,500 units
Sales	1,500 units	3,000 units

There was no opening inventory in July.

This means that there is no closing inventory at the end of August as production in the two months (2,000 + 2,500 units = 4,500 units) is the same as the sales (1,500 + 3,000 units = 4,500 units)

The profit statements for each month are shown on the next page. Work through these carefully one month at a time.



Example: Marginal cost profit statement

	July	August
Sales:		
1,500 units × ₦150	225,000	
3,000 units × ₦150		450,000
Opening inventory	nil	35,000
Variable production costs		
Direct material: 2,000 units × ₦35	70,000	
Direct labour: 2,000 units × ₦25	50,000	
Variable overhead 2,000 units × ₦10	20,000	
		87,500
Direct material: 2,500 units × ₦35		87,500
Direct labour: 2,500 units × ₦25		62,500
Variable overhead 2,500 units × ₦10		25,000
Closing inventory		
500 units @ (70)	(35,000)	
Zero closing inventory		nil
Cost of sale	(105,000)	(210,000)
Contribution	120,000	240,000
Fixed production costs (expensed)	(110,000)	(110,000)
Profit for the period	10,000	130,000

3 REPORTING PROFIT WITH ABSORPTION COSTING

Section overview

Reporting profit with absorption costing
Calculation of total absorption costing profit

3.1 Reporting profit with absorption costing

Absorption costing is the 'traditional' way of measuring profit in a manufacturing company. Inventory is valued at the full cost of production, which consists of direct materials, direct labour and direct costs plus absorbed production overheads (fixed and variable production overheads).

Fixed production overhead may be under- or over- absorbed because the absorption rate is a predetermined rate. This was covered in chapter 6.

The full presentation of an absorption costing income statement might therefore be as follows (illustrative figures included):



Illustration: Total absorption costing income statement for the period

	₦	₦
Sales		430,000
Opening inventory at full production cost	8,000	
Production costs		
Direct materials	60,000	
Direct labour	30,000	
Production overheads absorbed	100,000	
	<u>198,000</u>	
Closing inventory at full production cost	<u>(14,000)</u>	
Full production cost of sales		<u>(184,000)</u>
		246,000
(Under)/over-absorption		
Production overheads absorbed	100,000	
Production overheads incurred	<u>(95,000)</u>	
Over-absorbed overheads		<u>5,000</u>
		251,000
Administration, selling and distribution costs		<u>(178,000)</u>
Profit		<u><u>73,000</u></u>

3.2 Calculation of total absorption costing profit

The following example uses the same base scenario as that used to illustrate marginal costing. This means that you can compare the difference between absorption and marginal costing profits.



Example:

Makurdi Manufacturing makes and sells a single product:

	₦
Selling price per unit	150
Variable costs:	
Direct material per unit	35
Direct labour per unit	25
Variable production overhead per unit	10
	70
Fixed overhead per unit (see below)	50
Total absorption cost per unit (used in inventory valuation)	120

Normal production 2,200 units per month

Budgeted fixed production overhead ₦110,000 per month

Fixed overhead absorption rate $\text{₦}110,000/2,200 \text{ units} = \text{₦}50 \text{ per unit}$

The following data relates to July and August:

	July	August
Fixed production costs	₦110,000	₦110,000
Production	2,000 units	2,500 units
Sales	1,500 units	3,000 units

There was no opening inventory in July.

This means that there is no closing inventory at the end of August as production in the two months (2,000 + 2,500 units = 4,500 units) is the same as the sales (1,500 + 3,000 units = 4,500 units)



Example: Total absorption cost profit statement

	July	August
Sales:		
1,500 units × ₦150	225,000	
3,000 units × ₦150		450,000
Opening inventory	nil	60,000
Variable production costs		
Direct material: 2,000 units × ₦35	70,000	
Direct labour: 2,000 units × ₦25	50,000	
Variable overhead 2,000 units × ₦10	20,000	
Direct material: 2,500 units × ₦35		87,500
Direct labour: 2,500 units × ₦25		62,500
Variable overhead 2,500 units × ₦10		25,000
Fixed production costs (absorbed)		
2,000 units × ₦50	100,000	
2,500 units × ₦50		125,000
Under (over) absorption		
200 units @ ₦50	10,000	
300 units @ ₦50		(15,000)
Closing inventory		
500 units @ (70 + 50)	(60,000)	
Zero closing inventory		nil
Cost of sale	<u>(190,000)</u>	<u>(345,000)</u>
Profit for the period	<u>35,000</u>	<u>105,000</u>

4 MARGINAL COSTING AND ABSORPTION COSTING COMPARED

Section overview

The difference in profit between marginal costing and absorption costing
 Summary: comparing marginal and absorption costing profit

4.1 The difference in profit between marginal costing and absorption costing

The profit for an accounting period calculated with marginal costing is different from the profit calculated with absorption costing.

The difference in profit is **entirely** due to the differences in inventory valuation. The main difference between absorption costing and marginal costing is that in absorption costing, inventory cost includes a share of fixed production overhead costs. The opening inventory contains fixed production overhead that was incurred last period. Opening inventory is written off against profit in the current period. Therefore, part of the previous period's costs are written off in the current period income statement.

The closing inventory contains fixed production overhead that was incurred in this period. Therefore, this amount is not written off in the current period income statement but carried forward to be written off in the next period income statement.

The implication of this is as follows (assume costs per unit remain constant):

When there is no change in the opening or closing inventory, exactly the same profit will be reported using marginal costing and absorption costing;

If inventory increases in the period (closing inventory is greater than opening inventory),

the increase is a credit to the income statement reducing the cost of sales and increasing profit;

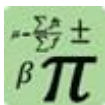
the increase will be higher under total absorption valuation than under marginal costing valuation (because the absorption costing inventory includes fixed production overhead); therefore the total absorption profit will be higher.

If inventory decreases in the period (closing inventory is less than opening inventory), the decrease is a debit to the income statement;

the decrease will be higher under total absorption valuation than under marginal costing valuation (because the absorption costing inventory includes fixed production overhead); therefore

the total absorption profit will be lower.

The difference in the two profit figures is calculated as follows:



Formula: Profit difference under absorption costing (TAC = total absorption costing) and marginal costing (MC)

Assuming cost per unit is constant across all periods under consideration.

Number of units' increase or decrease × Fixed production overhead per unit

Returning to the previous example:



Example: Profit difference

	July	August	Over the two months
	₦	₦	₦
Absorption costing profit	35,000	105,000	140,000
Marginal costing profit	10,000	130,000	140,000
Profit difference	25,000	(25,000)	nil

This profit can be explained based on how the inventory movement is valued under each system:

	Units	Units	Units
Closing inventory		nil	nil
2,000 units made less 1,500 sold	500		
Opening inventory	nil	500	nil
	500	(500)	nil
Absorbed fixed production overhead per unit (₦)	50	50	50
Profit difference (₦)	25,000	(25,000)	nil

Note that the difference is entirely due to the movement in inventory value:



Example: Profit difference – due to inventory movement

TAC inventory movement:	July	August	Over the two months
	₦	₦	₦
Closing inventory	60,000	nil	nil
Opening inventory	nil	(60,000)	nil
	60,000	(60,000)	nil
MC inventory movement			
Closing inventory	35,000	nil	nil
Opening inventory	nil	(35,000)	nil
	35,000	(35,000)	nil
Profit difference	25,000	(25,000)	nil

4.2 Summary: comparing marginal and absorption costing profit

An examination might test your ability to calculate the difference between the reported profit using marginal costing and the reported profit using absorption costing. To calculate the difference, you might need to make the following simple calculations:
 Calculate the increase or decrease in inventory during the period, in units;
 Calculate the fixed production overhead cost per unit;
 The difference in profit is the increase or decrease in inventory quantity multiplied by the fixed production overhead cost per unit; and
 If there has been an increase in inventory, the absorption costing profit is higher. If there has been a reduction in inventory, the absorption costing profit is lower.
 Ignore fixed selling overhead or fixed administration overhead. These are written off in full as a period cost in both absorption costing and marginal costing, and only fixed production overheads are included in inventory values.



Practice question

1



A company uses marginal costing. In the financial period that has just ended, opening inventory was ₦8,000 and closing inventory was ₦15,000. The reported profit for the year was ₦96,000.

If the company had used absorption costing, opening inventory would have been ₦15,000 and closing inventory would have been ₦34,000.

Required

What would have been the profit for the year if absorption costing had been used?

**Practice question****2**

A company uses absorption costing. In the financial period that has just ended, opening inventory was ₦76,000 and closing inventory was ₦49,000. The reported profit for the year was ₦183,000.

If the company had used marginal costing, opening inventory would have been ₦40,000 and closing inventory would have been ₦28,000.

Required

What would have been the profit for the year if marginal costing had been used?

**Practice question****3**

The following information relates to a manufacturing company for a period.

Production	16,000 units	Fixed production costs	₦80,000
Sales	14,000 units	Fixed selling costs	₦28,000

Using absorption costing, the profit for this period would be ₦60,000

Required

What would have been the profit for the year if marginal costing had been used?

**Practice question****4**

1 Red Company is a manufacturing company that makes and sells a single product. The following information relates to the company's manufacturing operations in the next financial year.

Opening and closing stock:	Nil
Production:	18,000 units
Sales:	15,000 units
Fixed production overheads:	₦117,000
Fixed sales overheads:	₦72,000

Using absorption costing, the company has calculated that the budgeted profit for the year will be ₦43,000.

Required

What would be the budgeted profit if marginal costing is used, instead of absorption costing?

5 ADVANTAGES AND DISADVANTAGES OF ABSORPTION AND MARGINAL COSTING

Section overview

Advantages and disadvantages of absorption costing

Advantages and disadvantages of marginal costing

The previous sections of this chapter have explained the differences between marginal costing and absorption costing as methods of measuring profit in a period. Some conclusions can be made from these differences.

The amount of profit reported in the cost accounts for a financial period will depend on the method of costing used.

Since the reported profit differs according to the method of costing used, there are presumably reasons why one method of costing might be used in preference to the other. In other words, there must be some advantages (and disadvantages) of using either method.

5.1 Advantages and disadvantages of absorption costing

Absorption costing has a number of advantages and disadvantages.

Advantages of absorption costing

Inventory values include an element of fixed production overheads. This is consistent with the requirement in financial accounting that (for the purpose of financial reporting) inventory should include production overhead costs.

Calculating under/over absorption of overheads may be useful in controlling fixed overhead expenditure.

By calculating the full cost of sale of a product and comparing it with the selling price, it should be possible to identify which products are profitable and which are being sold at a loss.

Disadvantages of absorption costing

Absorption costing is a more complex costing system than marginal costing.

Absorption costing does not provide information that is useful for decision making (like marginal costing does).

5.2 Advantages and disadvantages of marginal costing

Marginal costing has a number of advantages and disadvantages.

Advantages of marginal costing

It is easy to account for fixed overheads using marginal costing. Instead of being apportioned they are treated as period costs and written off in full as an expense in the income statement for the period when they occur.

There is no under/over-absorption of overheads with marginal costing, and therefore, no adjustment is necessary in the income statement at the end of the accounting period.

Marginal costing provides useful information for decision making.

Contribution per unit is constant, unlike profit per unit which varies as the volume of activity varies.

Disadvantages of marginal costing

Marginal costing does not value inventory in accordance with the requirements of financial reporting. (However, for the purpose of cost accounting and providing management information, there is no reason why inventory values should include fixed production overhead, other than consistency with the financial accounts.)

Marginal costing can be used to measure the contribution per unit of product, or the total contribution earned by a product, but this is not sufficient to decide whether the product is profitable or not. Total contribution has to be sufficient to cover fixed costs and make a profit.

6 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the concept of marginal costing;

Calculate the marginal cost of an item from given data;

Explain how marginal cost and the concept of contribution are important in decision making;

Describe absorption costing using examples;

Calculate the absorption cost of an item from given data;

Compare marginal costing and absorption costing; and

Reconcile absorption costing and marginal costing profit figures.

SOLUTIONS TO PRACTICE QUESTIONS

Solution

1

There was an increase in inventory. It was ₦7,000 using marginal costing (= ₦15,000 – ₦8,000). It would have been ₦19,000 using absorption costing.

	₦
Increase in inventory, marginal costing	7,000
Increase in inventory, absorption costing	<u>19,000</u>
Difference (profit higher with absorption costing)	12,000
Profit with marginal costing	<u>96,000</u>
Profit with absorption costing	<u>108,000</u>

The profit is higher with absorption costing because there has been an increase in inventory (production volume has been more than sales volume.)

Solution

2

There was a reduction in inventory. It was ₦27,000 using absorption costing (= ₦76,000 – ₦49,000). It would have been ₦12,000 using marginal costing.

	₦
Reduction in inventory, absorption costing	27,000
Reduction in inventory, marginal costing	<u>12,000</u>
Difference (profit higher with marginal costing)	15,000
Profit with absorption costing	<u>183,000</u>
Profit with marginal costing	<u>198,000</u>

Profit is higher with marginal costing because there has been a reduction in inventory during the period.

Solution

3

Ignore the fixed selling overheads. These are irrelevant since they do not affect the difference in profit between marginal and absorption costing.

There is an increase in inventory by 2,000 units, since production volume (16,000 units) is higher than sales volume (14,000 units).

If absorption costing is used, the fixed production overhead cost per unit is ₦5 (= ₦80,000/16,000 units).

The difference between the absorption costing profit and marginal costing profit is therefore ₦10,000 (= 2,000 units × ₦5).

Absorption costing profit is higher, because there has been an increase in inventory.

Marginal costing profit would therefore be ₦60,000 – ₦10,000 = ₦50,000.

Solution**4**

Production overhead per unit, with absorption costing:

= ₦117,000/18,000 units

= ₦6.50 per unit.

The budgeted increase in inventory = 3,000 units (18,000 – 15,000).

Production overheads in the increase in inventory = 3,000 × ₦6.50 = ₦19,500.

With marginal costing, profit will be lower than with absorption costing, because there is an increase in inventory levels.

Marginal costing profit = ₦43,000 - ₦19,500 = ₦23,500.

Activity-based costing

Contents

- 1 Traditional costing system
- 2 Activity-based costing (ABC)
- 3 Chapter overview

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A	Cost accounting (continued)			
	3	Accounting for cost elements (continued)		
		c	Accounting for overheads	
			Explain activity based costing.	

Exam context

This chapter explains activity-based costing.

By the end of this chapter, you should be able to:

- Explain the difference between traditional volume based absorption methods and activity-based costing;
- Apportion overheads using activity-based costing; and
- Estimate unit cost using activity-based costing.

1 TRADITIONAL COSTING SYSTEM

Section overview

- Absorption costing
- Under- and over-absorption
- Criticisms of absorption costing

1.1 Absorption costing

Absorption costing is a form of costing in which the costs of products are calculated by adding an amount for indirect production costs (production overheads) to the direct costs of production.

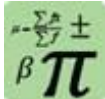
This was covered in an earlier chapter but a brief revision is provided here for your convenience.

Production overheads are indirect costs. This means that the costs (unlike direct costs) cannot be attributed directly to specific items (products) for which a cost is calculated. A 'fair' share of overhead costs is added to the direct costs of the product, using an absorption rate.

A suitable absorption rate is selected. This is usually a rate per direct labour hour, a rate per machine hour, a rate per amount of material or possibly a rate per unit of product.

Production overheads may be calculated for the factory as a whole; alternatively, separate absorption rates may be calculated for each different production department. (However, it is much more likely that a question involving absorption costing will give a factory-wide absorption rate rather than separate departmental absorption rates.)

The overhead absorption rate (or rates) is determined in advance for the financial year. It is calculated as follows:



Formula: Overhead absorption rate

$$\frac{\text{Total allocated and apportioned overheads}}{\text{Volume of activity in the period}}$$

Which is:

$$\frac{\text{Budgeted production overhead expenditure for the period}}{\text{Budgeted activity in the period}}$$

The 'activity' is the number of labour hours in the year, the number of machine hours or the number of units produced, depending on the basis of absorption (labour hour rate, machine hour rate or rate per unit) that is selected.



Practice question

1

A manufacturing company makes two products, X and Y. Budget information about these products is as follows.

	Product X	Product Y
Direct cost per unit	₦10	₦7
Direct labour time to make each unit (minutes)	15	20
Budgeted production for the year (units)	8,000	9,000

The budgeted production overheads for the year are ₦120,000. The company uses an absorption costing system and a direct labour hour absorption rate.

Required

- Calculate the overhead absorption rate.
- Calculate the budgeted cost per unit of X and unit of Y?

1.2 Under- and over-absorption

Overhead absorption rates are decided in advance (before the period under review).

Actual overhead expenditure and actual production volume might differ from the estimates used in the budget to work out the absorption rate.

As a consequence, the amount of overheads added to the cost of products manufactured is likely to be different from actual overhead expenditure in the period. The difference is under- or over-absorbed overheads.



Illustration: Under or over-absorbed fixed overhead

		₦
Amount absorbed:		
Actual number of units made (or hours used)	×	Predetermined absorption rate
		X
Actual expenditure in the period		(X)
Over/(under) absorbed		<u>X</u>

Overheads are under-absorbed when the amount of overheads absorbed into production costs is less than the actual amount of overhead expenditure.

Overheads are over-absorbed when the amount of overheads absorbed into production costs is more than the actual amount of overhead expenditure.

The amount of under- or over-absorbed overheads is written to profit or loss for the year as an adjusting figure.

If overhead is under-absorbed overhead the profit is adjusted down (because production costs have been understated)

If overhead is over-absorbed the profit is adjusted upwards.

1.3 Criticisms of absorption costing

Traditional absorption costing has many weaknesses, especially in a 'modern' manufacturing environment.

Production overhead costs are often high relative to direct production costs. Therefore, a system of adding overhead costs to product costs by using time spent in production (direct labour hours or machine hours) is difficult to justify.

A full cost of production has only restricted value for many types of management decision.

However, traditional absorption costing is still in use in some companies.

It provides a rational method of charging overhead costs to production costs, so that a full cost of production can be calculated for closing inventories.

It is also argued that absorption costing is useful for some pricing decisions. (Pricing is covered in a later paper).

A number of alternative costing methods have been developed with a view to replacing the traditional methods. One such method is activity-based costing.

2 ACTIVITY-BASED COSTING (ABC)

Section overview

- Introduction to activity-based costing
- Activities
- Cost drivers and cost pools
- When the use of ABC might be appropriate
- Advantages and disadvantages of ABC

2.1 Introduction to activity-based costing

Activity-based costing (ABC) is a form of absorption costing that takes a different approach to the apportionment and absorption of production overhead costs.

Activity-based costing is based on the following ideas:

In a modern manufacturing environment, a large proportion of total costs are overhead costs, and direct labour costs are relatively small;

It is appropriate to trace these costs as accurately as possible to the products that create the cost because overhead costs are large; and

The traditional methods of absorbing production overhead costs on the basis of direct labour hours or machine hours have no rational justification as many production overhead costs are not directly related to the production work that is carried out. For example:

The costs of quality control and inspection depend on the quality standards and inspection methods that are used: these do not necessarily relate to the number of hours worked in production;

The costs of processing and chasing customer orders through the factory relate more to the volume of customer orders rather than the hours worked on each job in production;

Costs of managing the raw materials inventories (storage costs) relate more to the volume of materials handled rather than hours worked on the material in production; and
The costs of production relate more to the volume and complexity of customer orders or the number of batch production runs, rather than hours worked in production.

2.2 Activities

Activity-based costing (ABC) takes the view that many production overhead costs can be associated with particular activities other than direct production work.

If such activities can be identified and costs linked to them overhead costs can then be added to product costs by using a separate absorption rate for each activity.

ABC costing of overheads and estimate of full production costs is therefore based on activities, rather than hours worked in production.

Identifying activities

A problem with introducing activity-based costing is deciding which activities create or 'drive' overhead costs.

There are many different activities within a manufacturing company, and it is not always clear which activities should be used for costing.

Activities might include, for example:

materials handling and storage;

customer order processing and chasing;

purchasing;

quality control and inspection;

production planning; and

repairs and maintenance.

These activities are not necessarily confined to single functional departments within production departments.

Although ABC is often concerned with production costs, it can also be applied to activities outside production, such as sales and distribution. Sales and distribution activities might include:

selling activities;

warehousing and despatch; and

after-sales service.

In a system of activity-based costing, it is preferable to select a fairly small number of activities. If a large number of activities are selected, the costing system could become too complex and time-consuming to operate.

The activities are selected on the basis of management judgement and experience, and their knowledge of the activities within the manufacturing environment.

2.3 Cost drivers and cost pools

Cost drivers

For each activity, there should be a cost driver. A cost driver is the factor that determines the cost of the activity. It is something that will cause the costs for an activity to increase as more of the activity is performed.

Overhead costs are therefore caused by activities, and the costs of activities are driven by factors other than production volume.

Each cost driver must be a factor that can be measured so that the number of units of the cost driver that have occurred during each period can be established.

Possible examples include:

Activity	Possible cost driver	Information needed for ABC
Customer order processing	Number of customer orders	Number of orders for each product
Materials purchasing	Number of purchase orders	Number of orders for materials for each finished product
Quality control and inspection	Number of inspections	Number of inspections of output of each product
Production planning	Number of production runs or batches	Number of runs or batches of each product
Repairs and maintenance	Number of machines, or machine hours operated	Number of machines or machine hours worked for each product
Selling	Number of sales orders	Number of orders for each product
Warehousing and despatch	Number of deliveries made	Number of deliveries for each product

Cost pools

A cost pool is simply the overhead expenditure allocated and apportioned to an activity. Overhead costs are allocated (or allocated and apportioned) to each activity, and for each activity there is a 'cost pool'.

ABC absorbs overheads into the cost of products (or services) at a separate rate for each cost pool (each activity).

The total production cost for each product or service is therefore direct production costs plus absorbed overheads for each activity.

The cost absorbed under ABC might be very different to that absorbed using a traditional, volume-based approach.



Example: ABC vs traditional, volume based absorption

A manufacturing company makes four products and incurs estimated material handling costs of ₦250,000 per month. (This is the cost pool for material handling cost).

The company produces 160,000 units per month and absorbs material handling cost on the number of units. This gives a material handling cost of ₦1.5625 (₦250,000 ÷ 160,000 units)

The material handling cost is absorbed as follows:

Product	Units produced	Unit cost (₦)	Cost absorbed (₦)
W	60,000	₦1.5625	93,750
X	33,000	₦1.5625	51,563
Y	40,000	₦1.5625	62,500
Z	27,000	₦1.5625	42,187
	<u>160,000</u>	<u>₦1.5625</u>	<u>250,000</u>

The company has instigated a project to see if ABC costing would be appropriate.

The project has identified that a large part of the material handling costs are incurred in receiving material orders and that the same effort goes into receiving orders regardless of the size of the order. Order sizes differ substantially.

The company has identified the following number of orders in respect of material for each type of product.

Product	Number of orders
W	15
X	22
Y	4
Z	9
	<u>50</u>

An ABC cost per order (hence cost per unit) can be estimated as follows:

If the cost driver for order handling is the number of orders handled, the budgeted order handling cost will be ₦5,000 per order (₦250,000/50).

Overhead costs will be charged to products as follows:

Product	Number of orders	Cost per order	Apportione d cost	Units produced	Unit cost
W	15	₦5,000	75,000	60,000	1.25
X	22	₦5,000	110,000	33,000	3.33
Y	4	₦5,000	20,000	40,000	0.50
Z	9	₦5,000	45,000	27,000	1.67
	<u>50</u>	<u>₦5,000</u>	<u>250,000</u>	<u>160,000</u>	

The above example shows that the material handling overhead absorbed to each type of product is very different under the two approaches.

For example, only 33,000 units of product X are made (out of a total of 160,000 units). However, product X requires 22 orders out of a total of 50 and it is the number of orders that drive this cost.

The traditional approach recognised ₦51,563 as relating to product X but ABC, using the number of orders as the driver results in ₦110,000 being absorbed by product X.

The above example shows the difference between traditional absorption and ABC using a single cost. In reality there would be more than one activity used as a basis for absorption leading to a series of absorption rates (per activity).

Also note that one of the absorption methods might be a volume-based method. The point is that traditional absorption methods treat all costs as varying according to a volume measure whereas ABC splits the total and treats each part of the total cost according to what drives it.



Example: ABC

A company makes three products, X, Y and Z using the same direct labour employees and the same machine for production.

Production details for the three products for a typical period are as follows:

	Labour hours per unit	Machine hours per unit	Material cost per unit (₦)	Number of units produced
Product X	0.25	0.75	100	1,500
Product Y	0.75	0.50	60	2,500
Product Z	0.50	1.50	120	14,000

Direct labour costs ₦160 per hour.

Total production overheads are ₦1,309,000 and further analysis shows that the total production overheads can be divided as follows:

	₦
Costs relating to machinery	196,350
Costs relating to inspection	458,150
Costs relating to set-ups	392,700
Costs relating to materials handling	261,800
Total production overhead	1,309,000

The following total activity volumes are associated with each product for the period:

	Number of inspections	Number of set-ups	Number of movements of materials	Machine hours
Product X	360	80	40	1,125
Product Y	80	120	80	1,250
Product Z	960	500	280	21,000
	<u>1,400</u>	<u>700</u>	<u>400</u>	<u>23,375</u>

Machine costs are absorbed on a machine hour basis.



Example (continued): ABC

The costs per unit for each product may be estimated as follows using ABC principles.

Step 1: Cost per activity

Activity	Cost allocated (₦)	Cost driver	Activity per period	Overhead absorption rate
Inspection	458,150	Inspections	1,400	₦327.25 per inspection
Set-ups	392,700	Set-ups	700	₦561 per set-up
Materials handling	261,800	Movements	400	₦654.50 per movement
Machinery operations	196,350	Machine hrs	23,375	₦8.40 per machine hour
Total	<u>1,309,000</u>			

Step 2: Allocate overheads to product types based on cost per activity and cost drivers

	X ₦	Y ₦	Z ₦
Set-ups			
80 set ups × ₦561	44,880		
120 set ups × ₦561		67,320	
500 set ups × ₦561			280,500
Inspection			
360 set ups × ₦327.25	117,810		
80 set ups × ₦327.25		26,180	
960 set ups × ₦327.25			314,160
Materials handling			
40 movements × ₦654.50	26,180		
80 movements × ₦654.50		52,360	
280 movements × ₦654.50			183,260
Machinery operations			
1,125 hours × ₦8.40	9,450		
1,250 hours × ₦8.40		10,500	
21,000 hours × ₦8.40			176,400
Overhead costs per product	<u>198,320</u>	<u>156,360</u>	<u>954,320</u>



Example (continued): ABC

Step 3: Calculate overhead per unit (if required)

	X	Y	Z
Overhead costs per product (from step 2)	₦198,320	₦156,360	₦954,320
Number of units	1,500	2,500	14,000
Overhead cost per unit	<u>₦132.21</u>	<u>₦62.54</u>	<u>₦68.17</u>

Step 4: Calculate total production cost per unit (if required)

Production cost per unit: ABC	X	Y	Z
	₦	₦	₦
Direct materials	100.00	60.00	120.00
Direct labour	40.00	120.00	80.00
Production overhead (from step 3)	<u>132.21</u>	<u>62.54</u>	<u>68.17</u>
Full production cost per unit	<u>272.21</u>	<u>242.50</u>	<u>268.17</u>

Although ABC is a form of absorption costing, the effect of ABC could be to allocate overheads in a completely different way between products. Product costs and product profitability will therefore be very different with ABC compared with traditional absorption costing.



Practice question

2

A company makes and sells two products, X and Y.

Data for production and sales each month are as follows:

	Product X	Product Y
Sales demand (units)	4,000	8,000
Direct material cost/unit (₦)	20	10
Direct labour hours/unit (hours)	0.1	0.2
Direct labour cost/unit	₦2	₦4

Production overheads are ₦500,000 each month.

An analysis of overhead costs suggests that there are four main activities that cause overhead expenditure.

Activity	Total cost ₦	Cost driver	Total number	Product X	Product Y
Batch set-up	100,000	Number of set-ups	20	10	10
Order handling	200,000	Number of orders	40	24	16
Machining	120,000	Machine hours	15,000	6,000	9,000
Quality control	80,000	Number of checks	32	18	14
	<u>500,000</u>				

Required

Calculate the full production costs for Product X and Product Y, using:

- traditional absorption costing (absorbing production overhead on a direct labour hour basis.
- activity-based costing.

2.4 When the use of ABC might be appropriate

Activity-based costing could be suitable as a method of costing in the following circumstances:

In a manufacturing environment, where absorption costing is required for inventory valuation;

Where a large proportion of production costs are overhead costs, and direct labour costs are relatively small;

Where products are complex; and

Where products are provided to customer specifications.

Where order sizes differ substantially, and order handling and despatch activity costs are significant.

2.5 Advantages and disadvantages of ABC

Advantages

ABC provides useful information about the activities that drive overhead costs.

Traditional absorption costing and marginal costing do not do this.

ABC therefore provides information that could be relevant to long-term cost control and long-term product selection or product pricing.

With ABC, overheads are charged to products on the basis of the activities that are required to provide the product. Each product should therefore be charged with a 'fair share' of overhead cost that represents the activities that go into making and selling it.

It might be argued that full product costs obtained with ABC are more 'realistic', although it can also be argued that full product cost information is actually of little practical use or meaning for management.

There is also an argument that in the long-run, all overhead costs are variable (even though they are fixed in the short-term). Measuring costs with ABC might therefore provide management with useful information for controlling activities and long-term costs.

Disadvantages

ABC systems are costly to design and use. The costs might not justify the benefits. The analysis of costs in an ABC system may be based on unreliable data and weak assumptions. In particular, ABC systems may be based on inappropriate activities and cost pools, and incorrect assumptions about cost drivers.

ABC provides an analysis of historical costs. Decision-making by management should be based on expectations of future cash flows.

Within ABC systems, there is still a large amount of overhead cost apportionment. General overhead costs such as rental costs, insurance costs and heating and lighting costs may be apportioned between cost pools. This reduces the causal link between the cost driver and the activity cost.

Many ABC systems are based on just a small number of cost pools and cost drivers. More complex systems are difficult to justify, on grounds of cost.

Identifying the most suitable cost driver for a cost pool/activity is often difficult. Many activities and cost pools have more than one cost driver.

Traditional cost accounting systems may be more appropriate for the purpose of inventory valuation and financial reporting.

3 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the difference between traditional volume based absorption methods and activity-based costing;

Apportion overheads using activity-based costing; and

Estimate unit cost using activity-based costing.

SOLUTIONS TO PRACTICE QUESTIONS

Solution		1
Overhead absorption rate		
		Hours
Budgeted labour hours: Product X: $8,000 \times 15/60$		2,000
Budgeted labour hours: Product Y: $9,000 \times 20/60$		<u>3,000</u>
Total budgeted hours for the year		<u>5,000</u>
Budgeted production overheads		N120,000
Absorption rate per direct labour hour		N24
Budgeted cost per unit		
Direct cost	10	7
Production overheads: $N24 \times 15/60$	<u>6</u>	$N24 \times 20/60$
		<u>8</u>
Full production cost	<u>16</u>	<u>15</u>

Solution**2****a) Traditional absorption costing**

The overhead absorption rate = $\frac{\text{₦}500,000}{(4,000 \times 0.1) + (8,000 \times 0.2)} = \text{₦}250$

	Product X	Product Y
	₦	₦
Direct materials	20	10
Direct labour	2	4
Overhead (at ₦250 per hour)	25	50
Cost per unit	47	64
Number of units (×)	4,000	8,000
Total cost (₦)	188,000	512,000
	+ = 700,000	

b) Activity-based costing

Activity	Total cost (₦)	Cost driver	Rate (₦)	Product X (₦)	Product Y (₦)
Batch setup	100,000	No. of set-ups	5,000	50,000	50,000
Order handling	200,000	No. of orders	5,000	120,000	80,000
Machining	120,000	Machine hours	8	48,000	72,000
Quality control	80,000	No. of checks	2,500	45,000	35,000
	500,000			263,000	237,000

Unit cost under ABC	Product X	Product Y
	₦	₦
Direct materials	80,000	80,000
Direct labour	8,000	32,000
Overheads	263,000	237,000
Total cost	351,000	349,000
Number of units	4,000	8,000
Cost per unit (₦)	87.75	43.625

Tutorial note:

Using ABC in this situation, the cost per unit of Product X is much higher than with traditional absorption costing and for Product Y the unit cost is much less.

The difference is caused by the fact that Product X uses only 20% of total direct labour hours worked, but much larger proportions of set-up resources, order handling resources, machining time and quality control resources. As a result, the overheads charged to each product are substantially different.

This is an important feature of activity-based costing. The overheads charged to products, and so the overhead cost per unit of product, can be significantly different from the overhead cost per unit that would be obtained from traditional absorption costing.

Specific order costing

Contents

- 1 Job costing
- 2 Batch costing
- 3 Contract costing
- 4 Service costing
- 5 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A		Cost accounting (continued)	
	4	Costing methods	
	a	Explain the types of costing methods and compile cost using:	
		i	Specific order costing of:
			• Job costing;
			• Batch costing; and
			• Contract costing.
		lii	Service costing
			• Identify situations where the use of service/operation costing is appropriate.
			• Illustrate suitable unit cost measures that may be used in different service/operation situations.
			• Carry out service cost analysis in simple service industry situations.

Exam context

This chapter explains job, batch and service costing.

By the end of this chapter you should be able to:

- Explain the nature of job costing;
- Calculate job cost from given data;
- Explain the nature of batch costing;
- Calculate batch cost from given data;
- Explain the nature of contract costing;
- Calculate contract cost from given data;
- Explain the nature of service costing; and
- Calculate cost of services rendered by a service organisation.

1 JOB COSTING

Section overview

Introduction to specific order costing
The nature of job costing
The cost of a job
Cost records and accounts for job costing

1.1 Introduction to specific order costing

Job, batch and contract costing methods are used when goods or services are supplied to meet the specific requirements of the customer (in the case of batch costing, the “customer” may well be internal to the business – e.g. stores). They are often referred to collectively as specific order costing methods.

Costing systems are used to record total costs and to spread these into cost units as appropriate.

The method used to measure the cost of units depends on the production system and how the products are made.

1.2 The nature of job costing

Job costing is used when the cost unit is a single item. The time taken to complete the job is relatively short, with the organisation completing many such jobs during one financial year.

Job costing is used when a business entity carries out tasks or jobs to meet specific customer orders. Although each job might involve similar work, they are all different and are carried out to the customer’s specific instructions or requirements.

Examples of jobs include work done for customers by builders or electricians, audit work done for clients by a firm of auditors, and repair work on motor vehicles by a repair firm.

Job costing is similar to contract costing, in the sense that each job is usually different and carried out to the customer’s specification or particular requirements. However, jobs are short-term and the work is usually carried out in a fairly short period of time. Contracts are usually long-term and might take several months or even years to complete.

1.3 The cost of a job

Actual costs incurred on each job are recorded on job cost card – materials, labour, overheads etc. – and thus all documentation relating to such expenses (stores issue notes, timesheets, etc.) must be coded with the job number(s) to which they relate. (Job cost cards are usually a computerised record). Normally, every job is assigned a unique job number or code.

Job costing differs from most other types of costing system because each cost unit is a job, and no two jobs are exactly the same. Each job is costed separately.

The expected cost of a job has to be estimated so that a price for the job can be quoted to a customer.

A costing system should also calculate the actual cost of each job that has been carried out.

A cost is calculated for each individual job, and this cost can be used to establish the profit or loss from doing the job.

A job costing system is usually based on absorption costing principles, and in addition a share of non-production overheads is included, as follows.



Illustration: Job cost

	₦
Direct materials	500
Direct labour	300
Direct expenses	200
Prime cost	<u>1,000</u>
Production overhead absorbed	750
Production cost of the job	<u>1,750</u>
Non-production overheads	400
Total job cost	<u>2,150</u>

In many cases, job costs include not just direct materials costs and direct labour costs, but also **direct expenses**, such as:

the rental cost of equipment hired for the job;

the cost of work done for the job by sub-contractors; and

the depreciation cost of equipment used exclusively on the job.

Production overheads might be absorbed on a direct labour hour basis, or on any other suitable basis.

Non-production overheads might be added to the cost of the job:

as a percentage of the prime cost of the job; or

as a percentage of the production cost of the job.



Example: Job costing

The following cost information has been gathered about Job number 453.

The direct materials cost is ₦100, the direct labour cost is ₦60 and direct expenses are ₦40. Direct labour costs ₦20 per hour. Production overheads are charged at the rate of ₦30 per direct labour hour and non-production overheads are charged at the rate of 40% of prime cost.

The job cost for Job 453 is calculated as follows:

Job cost: Job 453

	₦
Direct materials	100
Direct labour (3 hours at ₦20)	60
Direct expenses	40
Prime cost	<u>200</u>
Production overhead (3 hours at ₦30)	90
Production cost of the job	<u>290</u>
Non-production overheads (40% of prime cost)	80
Total job cost	<u>370</u>

1.4 Cost records and accounts for job costing

In order to establish the cost of each individual job in a costing system, it is necessary to have procedures for recording direct costs in such a way that they can be allocated to specific jobs. Production overheads and non-production overheads can be charged using overhead absorption rates within a system of absorption costing.

Each job is given a unique identity number, or job number. The costs for individual jobs are recorded as follows:

The direct materials for a job are issued directly from stores to the job. The materials requisition note should specify the job number and the costs of the materials are charged to the job;

The labour time spent on a job is recorded on time sheets or job sheets. The time sheet for each individual employee indicates the jobs he has worked on and the time that he spent on each job. These can be converted into a cost for the job at the employee's hourly rate;

A system is needed for recording direct expenses to specific jobs. Costs might be obtained from purchase invoices from suppliers, and recorded in the job cost record (the 'job sheet') for the job;

Production overheads are charged to the job (absorbed, in an absorption costing system) at the appropriate absorption rate, when the job has been completed; and Similarly, non-production overheads can be charged when the job has been finished by charging them at the appropriate absorption rate.

Direct costs and overheads are recorded on a job sheet or job card for the job. At one time, a job card used to be an actual card or sheet of paper, although job costing systems are now likely to be computerised.

In a costing system, a job account is similar to a work-in-progress account, except that it is for one job only. In a company that specialises in jobbing work, the work-in-progress account is the total of all the individual job accounts.



Illustration: Job cost account

Job 12345			
	₦		₦
Direct materials	1,800	Cost of sales	7,300
Direct wages	2,500		
Direct expenses			
Production overhead	3,000		
	7,300		7,300

When the job is finished, the total cost of the job is transferred to the cost of sales account.



Example: Job costing

There is a comprehensive example on the following pages.

The information will be used to complete the following tasks:

1. Prepare a schedule to show the resources used in the month.
2. Prepare journal entries to account for the utilisation of resources and to collect costs into the job accounts.
3. Prepare job cost accounts for each individual job in the costing ledger.
4. Prepare job cost cards showing the resources allocated to the jobs and the allocation of administration and marketing expenses for the jobs completed in the period. Also, incorporate the revenue for the period and show the profit or loss on those jobs completed.
5. Assuming that the company operates a system using a control account in its general ledger for jobs, show the double entry (as T-accounts) to account for job activity in the period.

(Note: The system suggested is similar to that for the receivables control account backed up by the receivables ledger. In this case there is a WIP control account backed up by the job costing ledger).



Example: Job Costing

The following information relates to job activity in the month of June.

	Job 0503	Job 0402	Job 0607
Contract price	₦500,000	₦980,000	₦600,000
Commenced	3 May	2 April	7 June
Completed	25 June	Not completed	19 June

Opening WIP comprised:

Direct materials (all material X)	₦5,000	₦10,000	na
Direct labour (all grade A)	₦10,000	₦18,000	
	<u>₦15,000</u>	<u>₦28,000</u>	

Material issues from stores:

Material X	200 kgs	800 kgs	900 kgs
Material Y	400 kgs	600 kgs	
Labour			
Grade A	60 hours	120 hours	150 hours
Grade B	25 hours	100 hours	20 hours

Costs:

Material X	₦220 per kg
Material Y	₦500 per kg
Grade A	₦250 per hour
Grade B	₦400 per hour

Variable overhead recovery rate ₦300 per hour

Fixed production overhead is absorbed using direct labour hours

Budgeted fixed production overhead ₦160,000

Budgeted labour hours 500 hours

Actual fixed production overhead expenditure in the period ₦161,000

The company needed to hire a special machine for job 0402 at a cost of ₦5,000 in the current month.

20 kgs of raw material were returned to stores on completion of job 0607.

For internal profit reporting purposes administration and marketing expenses are added to cost of sales at 20% at the time of completion of the job. Actual administration and marketing expense in the period was ₦130,000.



Example: Task 1 – Schedule of resources used in month

Material X	Kgs	Cost per kg	₦
Job 0503:	200	220	44,000
Job 0402	800	220	176,000
Job 0607	900	220	198,000
Returns	(20)	220	(4,400)
	<u>880</u>	220	<u>193,600</u>
	<u>1,880</u>	220	<u>413,600</u>

Material Y	Kgs	Cost per kg	₦
Job 0503:	400	500	200,000
Job 0402	600	500	300,000
	<u>1,000</u>	500	<u>500,000</u>

Labour grade A	Hours	Cost per hour	₦
Job 0503:	60	250	15,000
Job 0402:	120	250	30,000
Job 0607:	150	250	37,500
	<u>330</u>	250	<u>82,500</u>

Labour grade B	Hours	Cost per hour	₦
Job 0503:	25	400	10,000
Job 0402:	100	400	40,000
Job 0607:	20	400	8,000
	<u>145</u>	400	<u>58,000</u>

Variable overhead	Hours	Cost per hour	₦
Job 0503:	60 + 25 = 85	300	25,500
Job 0402:	120 + 100 = 220	300	66,000
Job 0607:	150 + 20 = 170	300	51,000
	<u>475</u>	300	<u>142,500</u>

Fixed overhead	Hours	Cost per hour	₦
Job 0503:	85	320	27,200
Job 0402:	220	320	70,400
Job 0607:	170	320	54,400
	<u>475</u>	320	<u>152,000</u>



Example: Task 2 – Journal entries to record costs in the job accounts

	Debit	Credit
Issues of Material X		
Job 0503 account	44,000	
Job 0402 account	176,000	
Job 0607 account	198,000	
Material X inventory account		418,000
Returns of Material X		
Material X inventory account	4,400	
Job 0607 account		4,400
Issues of Material Y		
Job 0503 account	200,000	
Job 0402 account	300,000	
Material Y inventory account		500,000
Grade A labour		
Job 0503 account	15,000	
Job 0402 account	30,000	
Job 0607 account	37,500	
Grade A labour account		82,500
Grade B labour		
Job 0503 account	10,000	
Job 0402 account	40,000	
Job 0607 account	8,000	
Grade B labour account		58,000
Variable overhead		
Job 0503 account	25,500	
Job 0402 account	66,000	
Job 0607 account	51,000	
Variable overhead account		142,500
Fixed overhead		
Job 0503 account	27,200	
Job 0402 account	70,400	
Job 0607 account	54,400	
Fixed production overhead account		152,000
Hire cost		
Job 0402 account	5,000	
Cash		5,000



Example: Task 3 – Job cost accounts

Job 0503		
	₦	₦
Balance b/d	15,000	
Issues from stores:		
Material X	44,000	
Material Y	200,000	
Labour:		
Grade A	15,000	
Grade B	10,000	
Variable overhead	25,500	
Fixed overhead	27,200	
	<u>336,700</u>	
		Cost of sales
		<u>336,700</u>

Job 0402		
	₦	₦
Balance b/d	28,000	
Issues from stores:		
Material X	176,000	
Material Y	300,000	
Labour:		
Grade A	30,000	
Grade B	40,000	
Variable overhead	66,000	
Fixed overhead	70,400	
Machine hire	5,000	
	<u>715,400</u>	
		Balance c/d
		<u>715,400</u>

**Example: Task 3 – Job cost accounts (continued)**

Job 0607			
	₦		₦
Issues from stores:		Returns to stores	
Material X	198,000	Material X	4,400
Labour:			
Grade A	37,500		
Grade B	8,000		
Variable overhead	51,000		
Fixed overhead	54,400	Cost of sales	344,500
	<u>348,900</u>		<u>348,900</u>

**Example: Task 4– Job cost cards**

	Job 0503	Job 0402	Job 0607
	₦	₦	₦
Material X			
In opening WIP	5,000	10,000	na
In period	44,000	176,000	193,600
	49,000	186,000	193,600
Material Y (in period)	200,000	300,000	
Grade A labour			
In opening WIP	10,000	18,000	na
In period	15,000	30,000	37,500
	25,000	48,000	
Grade B labour	10,000	40,000	8,000
Variable overhead	25,500	66,000	51,000
Fixed overhead	27,200	70,400	54,400
Machine hire		5,000	
Factory cost	336,700	<u>715,400</u>	344,500
Administration and marketing @ 20%	67,340		68,900
Cost of sale	404,040		413,400
Contract price	500,000		600,000
Profit	<u>95,960</u>		<u>186,600</u>

The following journals were not asked for but they are included to help you to understand the double entry in the general ledger.



Example: Task 5– Journal entries to record costs in the general ledger

	Debit	Credit
a Issues of Material X		
WIP control account	418,000	
Inventory control account		418,000
b Returns of Material X		
Inventory control account	4,400	
WIP control account		4,400
c Issues of Material Y		
WIP control account	500,000	
Inventory control account		500,000
d Grade A labour		
WIP control account	82,500	
Payroll control account		82,500
e Grade B labour		
WIP control account	58,000	
Payroll control account		58,000
f Variable overhead		
WIP control account	142,500	
Variable overhead account		142,500
g Fixed overhead		
WIP control account	152,000	
Fixed production overhead account		152,000
h Hire cost		
WIP control account	5,000	
Cash		5,000
i Transfer of costs on completed sales		
Cost of sales account (336,700 for job 0503 and 344,500 for job 0607)	681,200	
WIP control account		681,200



Example: Task 5 – WIP control account

WIP control			
₦		₦	
Balance b/d	43,000		
a) Inventory control	418,000	b) Inventory control	4,400
c) Inventory control	500,000		
d) Payroll control	82,500		
e) Payroll control	58,000		
f) Var. overhead	142,500		
g) Fixed overhead	152,000		
h) Hire cost	5,000	i) Cost of sales	681,200
	<u>1,401,000</u>	Balance c/d	<u>715,400</u>
Balance b/d	715,400		<u>1,401,000</u>
Cost of sales			
₦		₦	
i) WIP control a/c	681,200		
Fixed production overhead			
₦		₦	
Balance b/d (Actual spend)	161,000	g) WIP control a/c	152,000

We now need to recognise the following entries. Once again journals are provided for your convenience.



Example: Task 5 – Further journal entries

	Debit	Credit
j Administration and marketing mark-up (20% of cost of sales figure)		
Cost of sales account (20% of 681,200)	136,240	
Administration and marketing control a/c		136,240
Note that this is the same sum of the two figures shown on the job cost card in task 4 (67,340 + 68,900)		
k Transfer of balance on cost of sales to the income statement		
Income statement	817,440	
Cost of sales account		817,440
l Under recovery of fixed production overhead		
Income statement (161,000 – 152,000)	9,000	
Fixed production overhead account		9,000
m Over recovery of administration and marketing overhead		
Administration and marketing control a/c	6,240	
Income statement (136,240 – 130,000)		6,240
n Recognition of revenue on finished jobs		
Receivables (500,000 + 600,000)	1,100,000	
Income statement		1,100,000



Example: Task 5 – WIP control account

WIP control			
		₦	₦
Balance b/d		715,400	
Cost of sales			
		₦	₦
i) WIP control a/c		681,200	
j) Admin and marketing		136,240	
	k) Income statement		817,440
			<u>817,440</u>
Fixed production overhead			
		₦	₦
Balance b/d (actual)		161,000	
	g) WIP control a/c		152,000
	i) Income statement		9,000
		<u>161,000</u>	<u>161,000</u>
Administration and marketing			
		₦	₦
Balance b/d (actual)		130,000	
m) Income statement		6,240	
	j) Cost of sales		136,240
		<u>136,240</u>	<u>136,240</u>
Balance b/d			
Income statement			
		₦	₦
k) Cost of sales		817,440	
i) Fixed prod. O'hd		9,000	
Profit		279,800	
	j) Cost of sales		817,440
	m) Admin and mkt.		6,240
	n) Receivables		1,100,000
		<u>1,106,240</u>	<u>1,106,240</u>
Balance b/d			

2 BATCH COSTING

Section overview

The nature of batch production
The nature of batch costing
Cost records and accounts for batch costing

2.1 The nature of batch production

As the name might suggest, batch costing is a system of costing for items that are produced in batches rather than individually. A batch might also be called a 'production run'.

Batch costing is used when production units are manufactured in batches or production runs.

Batch production is used in manufacturing in the following circumstances:

The capacity of a factory to make a product exceeds the sales demand for the product. The factory is therefore not required to make the product continuously. Instead, it makes the product in occasional 'production runs' or batches;

The factory makes several different products using the same equipment or machinery. The machinery must therefore switch between making the different products, which means that the products will not be manufactured continuously. Instead, the products are made in occasional 'production runs' or batches. For example, a company might manufacture a range of wooden furniture items on the same machinery. It might manufacture a batch of 100 tables, followed by a batch of 400 chairs, followed by a batch of 200 bookshelves, and so on; and

In some industries, it might be impractical to manufacture items except by making them several units at a time, in batches. An example is the manufacture of bread rolls and other products in a bakery. Several bread rolls are put into the baking oven on the same tray and they are made at the same time, all in the same batch.

The products are therefore made in batches, several units at a time. The finished units are transferred to finished goods inventory. The product is not manufactured again until the finished goods inventory is sold and more units are required. Another batch of the product is then manufactured.

2.2 The nature of batch costing

Batch costing is similar to job costing in all respects except that the costs are attributed to a group of identical items produced together, as it is not cost efficient to treat each item in the batch as a single cost unit.

In **batch costing**, the total cost is established for each individual batch, where each batch consists of a large number of similar units or items. (Unlike job costing, however, it is less common to include non-production overhead costs within the total batch cost, although it is certainly possible to do so).

The total batch cost is divided by the number of units produced in the batch to establish the cost per unit.

In all other respects, batch costing is very similar to job costing.



Illustration: Batch number 123t

	₦
Direct materials	55,000
Direct labour	30,000
Production overhead absorbed	<u>75,000</u>
Total production cost, batch 123	160,000
Number of units made in the batch	<u>÷2,000</u>
Production cost per unit	<u><u>₦80</u></u>

To prepare for the next batch production run, there might be set-up costs. If so, set-up costs can be charged directly to the cost of the batch.

2.3 Cost records and accounts for batch costing

In job costing, it is necessary to record the direct costs of each job. In the same way, in a system of batch costing there must be a system for charging costs directly to individual batches or production runs.

Each batch or production run should be given a unique identity code. When direct materials are issued from store, the materials requisition note should specify the batch for which the materials will be used.

Direct labour time spent on each production run or batch can be recorded on time sheets within each production cost centre.



Example: Batch costing

The following information relates to the production of a batch of 1,000 units in October.

	Batch XYZ
Contract price	₦400,000
Materials	
Material 1	250 kgs
Material 2	350 kgs
Labour	
Grade A	100 hours
Grade B	50 hours
Costs:	
Material 1	₦300 per kg
Material 2	₦400 per kg
Grade A	₦275 per hour
Grade B	₦375 per hour
Variable overhead recovery rate	₦200 per hour
Fixed overhead recovery rate	₦250 per hour

Fixed production overhead is absorbed using direct labour hours

The cost of the batch (and hence the cost per unit) can be calculated as follows:

	Kgs	Cost per kg	₦
Material 1	250 kgs	₦300 per kg	75,000
Material 2	350 kgs	₦400 per kg	140,000
Labour grade A	100 hrs	₦275 per hr	27,500
Labour grade B	50 hrs	₦375 per hr	18,750
Variable overhead	150 hrs	₦200 per hr	30,000
Fixed overhead	150 hrs	₦250 per hr	37,500
Total batch cost			328,750
Number of units			÷1,000
Cost per unit			328.75



Example: Batch costing

The batch cost account is as follows:

Batch XYZ		
	₦	₦
Issues from stores:		
Material 1	75,000	
Material 2	140,000	
Labour:		
Grade A	27,500	
Grade B	18,750	
Variable overhead	30,000	
Fixed overhead	37,500	
	328,750	
		Cost of sales/inventory (1,000 units @ 328.75)
		328,750
		328,750

For completeness the journal entries to record costs in the batch account are as follows:

	Debit	Credit
Issues of Material 1		
Batch XYZ account	75,000	
Material 1 inventory account		75,000
Issues of Material 2		
Batch XYZ account	140,000	
Material 2 inventory account		140,000
Grade A labour		
Batch XYZ account	27,500	
Grade A labour account		27,500
Grade B labour		
Batch XYZ account	18,750	
Grade B labour account		18,750
Variable overhead		
Batch XYZ account	30,000	
Variable overhead account		30,000
Fixed overhead		
Batch XYZ account	37,500	
Fixed production overhead account		37,500

3 CONTRACT COSTING

Section overview

The nature of contract costing

Contract costing

Recognition of revenue and cost of sales as contract activity progresses

3.1 The nature of contract costing

Contract costing is a specialised type of job costing. It is used for large scale contracts where the time taken to complete the contract might fall into several accounting periods. Contract costing is used extensively by businesses involved in industries, such as civil engineering and ship building but the same principles would apply to a contract to generate bespoke software or similar jobs.

Note that a contract does not have to have a duration exceeding one year for contract costing to be appropriate. However, this is often the case.

3.2 Contract costing

Costs attributable to a contract are collected and recorded in a very similar way to job and batch costing with all costs relating to a contract being charged to a contract account for that contract. These would include, materials, labour, machine hire, sub-contractor cost, professional and legal fees, overheads, etc.

Whilst it is very similar to job costing, contract costing does involve further complications resulting from the fact that the activity to fulfil a contract often falls into several accounting periods.

A company might transfer costs in relation to assets to a contract account but not actually use that asset in a period. Such costs must be carried down into the next period.

Materials



Example: Materials not used in a period

Company A entered into a contract to construct a new building for a customer.

It took delivery of 100,000 bricks to the site.

Only 80,000 bricks had been used by the end of the period.

The remaining 20,000 bricks will be used in the next period.

This could be achieved by carrying the bricks down in the contract account or by transferring the bricks into inventory at the year-end and then transferring them back into the contract account at the start of the next year.

Plant and equipment



Example: Machine not used in a period

Company A entered into a contract to construct a new building for a customer.

It bought a machine to use on the contract for ₦200,000.

The machine had a useful life of 5 years (giving an annual depreciation of ₦40,000).

The cost of the machine relating to the contract could be accounted for in one of two ways.

Method 1

The whole cost of the machine could be debited to the contract account and the carrying amount (after depreciation) carried down on that account at the end of the period.

Method 2

The machine could be capitalised as a non-current asset in the usual way and the depreciation charged to the contract account rather than the statement of profit or loss.

Transfer of cost out of the contract account

Costs accumulated in the contract account must be transferred to profit or loss as the contract activity progresses.

The amount transferred is the cost incurred in bringing the asset under construction to its stage of completion at the year-end.

This is discussed in more detail later in this chapter.



Example: Contract costing

Company X (a company with a December year-end) entered into a contract (Contract X) on 31 March.

The following costs were incurred on the contract during the year.

	₦
Materials issued to the contract	150,000
Direct labour	150,000
Other costs	60,000
Plant (carrying amount of asset transferred to the contract)	40,000

Further information:

Unused materials at the year-end	20,000
Carrying amount of plant and equipment at the year-end	30,000

All other costs incurred in the period are to be transferred to profit or loss.

The contract account can be completed as follows

Contract X			
	₦		₦
Materials	150,000	Materials c/d	20,000
Direct labour	150,000		
Other costs	60,000		
Plant and equipment	40,000	Plant c/d	30,000
		Transfer to profit or loss	350,000
	<u>400,000</u>		<u>400,000</u>
Materials b/d	20,000		
Plant b/d	30,000		

3.3 Recognition of revenue and cost of sales as contract activity progresses

Revenue and cost of sales from long-term contracts are recognised each year over the life of the contract (subject to certain conditions).

Revenue is recognised to reflect the percentage of the contract that has been completed by the reporting date (its stage of completion). The percentage completed can be measured in a number of ways.

Cost of sale is recognised to reflect the work done in reaching the stage of completion.

Measuring stage of completion

The stage of completion of a contract refers to how much of the contract has been completed by a given date. This can then be used to measure how much revenue should be recognised by that date.

There are different ways of estimating the stage of completion including:

Cost based: The costs incurred to date as a percentage of the total costs expected by the end of the contract; or

Sales based: An independent third party is engaged to examine the progress of the contract and assess how much of the total contract value has been earned by the year-end. This amount is known as the work certified (by the independent expert).



Example: Cost based approach

The following are figures in relation to a construction contract undertaken by Entity P.

The figures are for the year ended 31 December, Year 2.

	N000
Contract price	1,500
Costs to date	1,000
Expected total costs	1,200

Contract revenue and contract costs recognised on the cost basis for the year ended 31 December, Year 2 are calculated as follows:

	N000
Revenue (1,500 × 83.3% W)	1,250
Cost of sale (1,200 × 83.3% W)	1,000
Profit	250

Working: Percentage of work completed to date.

$$= \text{Costs to date} / \text{Total costs} = 1,000 / 1,200 = 83.3\%$$

Note, that in the above example the costs recognised were the same as the costs incurred by the year-end. This should always be the case when a cost based approach is used to measure stage of completion.



Example: Sales based approach

The following are figures in relation to a construction contract undertaken by Entity Q.

The figures are for the year ended 31 December Year 2.

	N000
Contract price	1,500
Work certified to date	1,100
Costs to date	1,000
Expected total costs	1,200

Contract revenue and contract costs recognised on the revenue basis for the year ended 31 December Year 2 are calculated as follows:

	N000
Revenue (1,500 × 73.3%W)	1,100
Cost of sale (1,200 × 73.3%W)	<u>880</u>
Profit	<u>220</u>

Working: Percentage of work completed to date.

$$= \text{Work certified to date} / \text{Total sales value} = 1,100 / 1,500 = 73.3\%$$

Note, that in the above example the recognised is the work certified. The costs recognised may not be the same as the costs incurred by the end of the period.

4 SERVICE COSTING

Section overview

The nature of services and operations
 Service costing, product costing and job costing compared
 Cost units in service costing: composite cost units
 Calculating the cost per unit of service (or operation)

4.1 The nature of services and operations

It is usual to explain costing in terms of how to calculate and record the costs of manufactured products. However, many business entities do not make and sell products; they provide services.

Services are any activity carried out by a party to the benefit of another that is essentially intangible and does not result in the ownership of anything.

Examples include hotel services, consultancy services, legal and accounting services, providers of telephone services (telecommunications companies), providers of television and radio channels, entertainment services, postal services, medical services, and so on.

Characteristics of services

There are five major characteristics of services:

Intangibility: They do not have a physical substance unlike goods. They cannot be held or seen;

Inseparability: Consumption and creation of a service cannot be separated. Services are consumed as they are created. A service does not exist until it is consumed by the person being served;

Variability: Services face the problem of maintaining consistency in the standard of output. Goods can usually be supplied to a standard specification. This is more difficult to achieve for services;

Perishability: Services cannot be stored; and

Lack of ownership: Services do not result in the transfer of property in anything. The purchase of a service only confers on the customer a temporary benefit.

Operations

Operations are activities. Like services, they do not result in a finished product to sell to customers. Examples of operations include a customer service centre taking telephone calls and e-mails from customers, and the staff canteen providing meals to employees.

4.2 Service costing, product costing and job costing compared

Costs can be established for services, such as hotel accommodation, telephone calls, auditing work, holidays and travel, and so on. The costs of a service are the sum of direct materials, direct labour, direct expenses (if any) and a share of operational overheads.

Costs can also be established for operations, in a similar way.

Service costing differs from costing in manufacturing industries in several ways.

There is no production system; therefore there are no production overheads.

Direct materials costs are often a fairly small proportion of total costs (for example, the direct materials costs to a telecommunications company of providing telephone services are very small).

In some service industries, direct labour costs are high (for example, in the film-making industry, accountancy and investment banking).

General overhead costs can be a very high proportion of total costs.

Inventory is usually very small; therefore absorption costing is usually of little or no value for management information purposes.

Not all entities that provide services will use service costing. The purpose of service costing is to provide information to management about the costs of different services that the entity provides, and the profitability of each of the different services. Each service should be fairly standard. If they are not standard services, it is more sensible to use job costing to calculate the cost of each 'job' of service. For example:

Service costing might be used by a hospital to record or calculate the cost of each of the different services provided by the hospital, such as the cost of treating a patient for a particular condition; and

Job costing might be used by a professional firm such as a firm of accountants or solicitors, where the cost of each job depends largely on the amount of time spent on each job by the professional staff.

4.3 Cost units in service costing: composite cost units

One of the main problems with service costing is that it can be difficult to identify a suitable cost unit for the service. It is often appropriate to use a composite cost unit in service costing. This is a cost that is made up from two variables, such as a cost per man per day (a cost per 'man/day'). Here, the two variables are 'men' (the number of employees) and 'days'.

Examples of composite **cost units used in service costing** are as follows:

The cost per room per day. This is a useful unit cost in the hotel services industry;

The cost per passenger per mile or the cost per passenger per kilometre (= the average cost of transporting a passenger for one mile or one kilometre). This unit/measure of cost is used by transport companies that provide bus or train services;

The cost per tonne per mile delivered (= the average cost of transporting one tonne of goods for one mile). This unit cost is commonly used for costing freight services and delivery operations;

The cost per patient/day (= the average cost of treating one patient for one day) or the cost per hospital bed/day (= the cost of maintaining one hospital bed in a hospital for one day). These costs are used by health service providers; and

The cost per man per day. This unit cost is widely used in professional services, such as auditing, legal services and consultancy services.

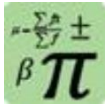
Composite cost units can be used in addition to a 'job costing' type of service costing system. For example, a firm of accountants might calculate the cost of each job performed for a client. In addition, it might calculate the average cost per man per day for the professional services that it provides.

The cost of each service 'job' enables management to monitor costs and profits on individual jobs for a customer.

The composite cost, which is an average cost for all 'jobs' allows management to monitor the general level of costs.

4.4 Calculating the cost per unit of service (or operation)

The cost of a service unit (or composite cost unit) is calculated as follows.



Formula: Cost per unit of service

$$\frac{\text{Total costs of the service}}{\text{Number of units of service}}$$

Total costs are the costs of direct materials, direct labour and direct expenses, plus a charge for overheads (unless marginal costing is used to cost the services).

The total number of service units might be a bit more difficult to calculate. Here are a few examples.



Example:

A hotel has 80 standard twin-bedded rooms. The hotel is fully-occupied for each of the 350 days in each year that it is open. The total costs of running the hotel each year are ₦3,360,000.

What would be a useful measure of the cost of providing the hotel services?



Answer

A useful unit cost is the cost per room/day. This is the average cost of maintaining one room in the hotel for one day.

Room/days per year = 80 rooms × 350 days = 28,000

Cost per room/day = ₦3,360,000/28,000 = ₦120.

**Example:**

A train company operates a service between two cities, Southtown and Northtown. The distance between the cities is 400 miles. During the previous year, the company transported 200,000 passengers from Southtown to Northtown and 175,000 passengers from Northtown to Southtown. The total costs of operating the service were ₦60 million.

What would be a useful measure of the cost of providing the train service between the two cities?

**Answer**

A useful unit cost is the cost per passenger/mile. This is the average cost of transporting one passenger for one mile.

Passenger/miles per year = $(200,000 \times 400) + (175,000 \times 400) = 150$ million.

Cost per passenger/mile = $\text{₦}60,000,000 / 150,000,000 = \text{₦}0.40$.

5 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the nature of job costing;

Calculate job cost from given data;

Explain the nature of batch costing;

Calculate batch cost from given data;

Explain the nature of contract costing;

Calculate contract cost from given data;

Explain the nature of service costing; and

Calculate cost of services rendered by a service organisation.

Process costing

Contents

- 1 Introduction to process costing
- 2 Normal loss
- 3 Abnormal loss
- 4 Abnormal gain
- 5 Process costing with closing work-in-progress
- 6 Opening work-in-progress: weighted average cost method
- 7 Opening work-in-progress: FIFO method
- 8 Work-in-progress and losses
- 9 Process costing: joint products and by-products
- 10 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

A	Cost accounting		
	4	Costing methods	
		a	Explain the types of costing methods and compile cost using:
			ii Process costing
			<ul style="list-style-type: none">• Determine the cost of a unit of output where there is normal loss, abnormal loss and abnormal gain.
			<ul style="list-style-type: none">• Prepare process accounts (including accounting for normal loss, abnormal loss and abnormal gain).
			<ul style="list-style-type: none">• Explain the concept of equivalent units.
			<ul style="list-style-type: none">• Determine the value of complete units and work-in-progress (WIP) using weighted average and FIFO methods.
			<ul style="list-style-type: none">• Differentiate between by-products and joint products.
			<ul style="list-style-type: none">• Estimate the value of by-products and joint products at split-off point (the point of separation).

Exam context

This chapter explains process costing.

By the end of this chapter you should be able to:

- Explain process costing;
- Explain when process costing is appropriate;
- Calculate the cost of output from a process including losses and opening and closing WIP;
- Differentiate between joint products and by-products; and
- Calculate the cost of joint products and by-products.

1 INTRODUCTION TO PROCESS COSTING

Section overview

Process costing

Situations where process costing might be appropriate

Process costing issues introduced

1.1 Process costing

Process costing provides a system of costing where any or all of these characteristics occur.

Output is continually produced from the manufacturing process and is normally measured in total quantities, such as tonnes or litres produced, or in very large quantities of small units (such as the number of cans or tins).

In the production process, materials might be added in full at the start of a process, or might be added gradually throughout the process. The materials are processed to produce the final output. In a process costing system, it is usual to distinguish between: direct materials; and conversion costs, which are direct labour costs and production overheads.

There might be losses in the process, due to evaporation or chemical reaction and the quantity of output might therefore be less than the quantity of materials input. Process costing provides a system of costing that allows for expected losses in the manufacturing process.

When there is a continuous production process, it is difficult to measure the quantity of work-in-process (incomplete production) at the end of a financial period. Process costing provides a method of measuring and costing incomplete production (WIP).

In some processes, more than one product might be output from the same process. When more than one product is output, they might be called joint products or a by-product. Process costing offers methods of costing each of the different products. In some process manufacturing systems, there are a series of sequential processes. For example, a manufacturing system might consist of three consecutive processes: raw materials are input to Process 1, then the output from Process 1 goes onto the next process (Process 2) and the output from Process 2 then goes into a final process, Process 3. The output from Process 3 is the final product.

Each process is different and all these characteristics do not occur in all processes.

1.2 Situations where process costing might be appropriate

Process costing is used when output is produced in a continuous process system, and it is difficult to separate individual units of output.

Examples of manufacturing where process costing is used are:

chemicals manufacture;

the manufacture of liquids; and

the continuous manufacture of high volumes of low-cost food items such as tins of

peas or beans, or bottles of tomato ketchup.

In these types of production process, losses in process might occur and there are often problems in measuring exactly the amount of unfinished production (work-in-process) at the end of a period.

The basic principle of costing is the same as for other types of costing. The cost of a unit of output from a process is measured as the total cost of resources input to the process divided by the total units produced.

1.3 Process costing issues introduced

Process costing can be quite tricky at first. It is often helpful to draw a process account as this helps to focus one's mind on the main issue which is that costs are collected on the debit side of the account and they must be allocated to whatever passes out of the account. This is more complex than it sounds.

We will proceed to give an overview of the issues before starting to look at the detailed calculations.

Consider the following:



Example: Simple process account

		Process			
	Units	₦		Units	₦
Materials	100	1,000	Output	100	1,500
Conversion cost		500		100	1,500
	<u>100</u>	<u>1,500</u>		<u>100</u>	<u>1,500</u>

This is very straight forward. The total costs input to the process are ₦1,500. This represents 100 units of raw material at a cost of ₦1,000 and the cost of work that has been carried out on the raw materials. This cost ₦500 so the total costs input are ₦1,500. 100 units are transferred out of the process and these must have cost ₦1,500 or ₦15 per unit.

It might seem strange to labour this point but this is what process costing is always trying to do. It collects costs of input and then allocates them to the output from the process.

Now let's add a complication.



Example: Process account – losses

Process					
	Units	₦		Units	₦
Materials	100	1,000	Output	90	
Conversion cost		500	Loss	10	
	<u>100</u>	<u>1,500</u>		<u>100</u>	<u>1,500</u>

The input costs are still the same but now there are two lines on the credit side of the account to which we could allocate cost, the good output and the loss. A decision needs to be made. Should some of the cost relate to the loss or should all of it relate to the good output? The answer to this question depends on whether the loss is considered to be normal or abnormal. This will be explained shortly. Now let's add another complication.



Example: Process account – closing WIP

Process					
	Units	₦		Units	₦
Materials	100	1,000	Output	90	
Conversion cost		500	Closing WIP	10	
	<u>100</u>	<u>1,500</u>		<u>100</u>	<u>1,500</u>

Again the input costs are still the same but now there are two types of output from the process, the good output and the closing WIP.

We must decide how to allocate the input costs to the good output which is complete and the closing WIP (incomplete units). How we do this is explained later in the chapter.

Now let's add yet another complication.



Example: Process account – opening WIP

Process					
	Units	₦		Units	₦
Opening WIP	10	100			
Materials	100	1,000	Output	95	
Conversion cost		500	Closing WIP	15	
	<u>110</u>	<u>1,600</u>		<u>110</u>	<u>1,600</u>

The opening WIP is a cost that was input in the previous period. We still face the same basic problem. The total costs on the debit side have to be allocated to output. However, the existence of opening WIP means that we must have a policy for dealing

with it. Do we treat it just like any other costs and average all of the input costs out or do we operate a FIFO system and simply allocate the cost of opening WIP to the first units produced? This will be answered later.

The following proforma process account is provided as a reference:



Example: Proforma process account

Process					
	Units	₦		Units	₦
Opening WIP	X	X	Good output	X	X
Direct material	X	X	Normal loss	X	X-
Direct labour		X			
Direct expense		X			
Overheads		X			
Abnormal gain	X	X	Abnormal loss	X	X
			Closing WIP	X	X
	<u>X</u>	<u>X</u>		<u>X</u>	<u>X</u>

Note that it is not possible to have abnormal loss and gain on the same account in the same period.

Whatever the complications, the task that sits at the heart of process costing is always to allocate the costs collected on the debit side of the account to the possible outputs (good output, closing WIP and lost units) on the credit side.

In all questions you will need to:

Identify the losses and output;

Calculate the cost of good output, losses and WIP;

Use the costs you have calculated to assign values to the good output, losses and WIP; and

Complete the process account.

2 NORMAL LOSS

Section overview

Normal loss

Normal loss with no recovery value

Normal loss with recovery value

Normal loss with cost of disposal

2.1 Normal loss

A feature of process manufacturing is that there is often some loss or wastage in production and output quantities are less than input quantities of materials.

Losses might be normal or abnormal.

Normal loss is the expected loss in processing.



Formula: Normal loss

Normal loss = Quantity of material input – Expected output
or

Quantity of material input = Normal loss + Expected output
or

Expected output = Quantity of material input – Normal loss

Normal loss is usually expressed as a percentage of the input units of materials.



Example: Normal loss

Normal loss of a process is 10%.

A company puts 5,000 litres into the process.

Normal loss is 10% of 5,000 = 500.

Expected output from the process would be 90% of 5,000 litres = 4,500 litres

Normal loss is unavoidable in the normal course of events. It is inherent in the physical and chemical reactions that take place in a process.



Example:

A person buys a litre of soup.

The soup must be heated but heating will cause evaporation.

When the soup is ready to eat there will be less than a litre left.

Normal loss is how much evaporation would normally be expected.

2.2 Normal loss with no recovery value



Example:

Returning to the soup example.

A person buys one litre of soup for ₦500.

Normal evaporation during cooking is 10%.

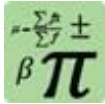
When the soup is ready to eat there is 0.9 litres left.

The person has paid ₦500 for 0.9 litres and this is unavoidable.

The implication of this simple example is as follows. The normal loss is something that is unavoidable in order to get the good output. The cost of the lost units is part of the cost of obtaining the good output.

All of the cost should be assigned to the good output and none to the normal loss.

If the normal loss has no scrap value it is given a nil value. This means that all of the costs of input must be recognised as part of good output.



Formula: Cost of good output

$$\text{Cost of good output per unit} = \frac{\text{Total process costs}}{\text{Expected units of output}}$$



Example: Normal loss– no scrap recovery value

The following information relates to a production process:

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,800 litres

Direct materials cost	₦3,600
Direct labour cost	₦300
Production overhead absorbed	₦600

The cost per unit produced can be calculated as follows: ₦

Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	<u>₦2.50</u>

Process account in the cost ledger

The process cost account (shown below) is a work-in-progress account for the process. The debit side of the account records direct materials and direct labour costs, and production overheads absorbed. The credit side of the WIP account records the cost of the finished output.

The account also includes memorandum columns for the quantities of direct materials input and the quantities of output and loss. Normal loss is shown so that the quantities columns add up to the same amount on the debit or credit sides, but the normal loss has no cost.

**Example: Process account with normal loss (no scrap recovery)**

The following information relates to a production process X.

The process account can be completed as follows

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output (actual) at ₦2.5 each	1,800	4,500
Direct labour		300			
Prod. Overhead		600	Normal loss	200	–
	<u>2,000</u>	<u>4,500</u>		<u>2,000</u>	<u>4,500</u>

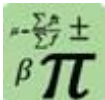
Note that it is always useful to draft a process account at the start of an answer as it focuses the mind on what needs to be done.

2.3 Normal loss with recovery value

In some cases, losses in a process have a scrap value. The normal loss quantity might not be physically lost but is changed in some way, so that it is not the same as good output. For example, there might be some kind of chemical separation with a substance scraped off the top of the liquid in the process and whatever is scraped off might have a scrap value.

If normal loss has a scrap value the company is able to recover some of the input costs to the process. The scrap value reduces the cost of the process.

To reflect this in the process account the normal loss is measured at its scrap value and the calculation of the cost of good output becomes:

**Formula: Cost of good output**

$$\text{Cost of good output per unit} = \frac{\text{Total process costs} - \text{Scrap value of the normal loss}}{\text{Expected units of output}}$$



Example: Normal loss– with scrap recovery value

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,800 litres
Scrap value of normal loss (₦)	0.9 per litre

Direct materials cost (₦)	3,600
Direct labour cost (₦)	300
Production overhead absorbed (₦)	600

The cost per unit produced can be calculated as follows:

Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Less scrap value of normal loss (200 litres × 0,9)	(180)
	4,320
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	<u>₦2.40</u>

The process account can be completed as follows:

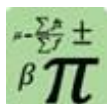
Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output (actual) at ₦2.4 each	1,800	4,320
Direct labour		300			
Prod. Overhead		600	Normal loss	200	180
	<u>2,000</u>	<u>4,500</u>		<u>2,000</u>	<u>4,500</u>

2.4 Normal loss with cost of disposal

In other cases a company might have to pay to dispose of losses in a process. The substance scraped off the top of the liquid in the process might be poisonous and might have to be disposed of safely.

The cost of disposal represents an additional cost to the process.

To reflect this in the process account the normal loss is measured at zero but the expected costs of disposal are debited to the process account.



Formula: Cost of good output

$$\text{Cost of good output per unit} = \frac{\text{Total process costs} + \text{Disposal costs of the normal loss}}{\text{Expected units of output}}$$



Example: Normal loss– no scrap disposal cost

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,800 litres
Disposal cost of normal loss	₦1 per litre

The cost per unit produced can be calculated as follows:

	₦
Direct materials	3,600
Direct labour	300
Production overheads	600
Total production cost	4,500
Disposal costs of normal loss (200 litres × ₦1)	200
	4,700
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	<u>₦2.6111</u>

The process account can be completed as follows:

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output (actual) at ₦2.6111 each	1,800	4,700
Direct labour		300			
Prod. Overhead		600			
Disposal cost of normal loss		200	Normal loss	200	–
	<u>2,000</u>	<u>4,700</u>		<u>2,000</u>	<u>4,700</u>

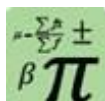
3 ABNORMAL LOSS

Section overview

Introduction to abnormal loss
Accounting for abnormal loss
Abnormal loss with recovery value

3.1 Introduction to abnormal loss

Normal loss is the expected amount of loss in a process. Actual loss might be more than the expected or normal loss. When actual loss exceeds normal loss, there is abnormal loss. The excess of the total actual loss over the normal loss is abnormal loss.



Formula: Abnormal loss

$$\text{Abnormal loss} = \text{Actual loss} - \text{Expected (normal) loss}$$

From earlier:

$$\text{Quantity of material input} = \text{Normal loss} + \text{Expected output}$$

But:

$$\text{Expected output} = \text{Actual output} + \text{Abnormal loss}$$

Therefore:

$$\text{Quantity of material input} = \text{Normal loss} + \text{Actual output} + \text{Abnormal loss}$$

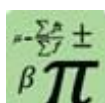
$$\text{Total loss} = \text{Normal loss} + \text{Abnormal loss.}$$

Abnormal loss is not expected and should not happen. It therefore, makes sense to give it a cost. By giving a cost to abnormal loss, management information about the loss can be provided, and management can be made aware of the extent of any problem that might exist with excessive losses in process.

3.2 Accounting for abnormal loss

If it is assumed that all losses in process occur at the end of the process, units of abnormal loss are costed in exactly the same way as units of finished output. This might seem a little strange but the idea is to highlight the impact of the loss.

The cost per unit of abnormal loss is therefore the same as the cost of units of good output. This is exactly the same as before.



Formula: Cost of good output

$$\text{Cost of good output per unit} = \frac{\text{Total process costs} - \text{Scrap value of the normal loss}}{\text{Expected units of output}}$$

The cost of units of abnormal loss is treated as an expense for the period, and charged as an expense in the income statement for the period.



Example: Abnormal loss

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,700 litres
Therefore abnormal loss	100 litres

The cost per unit produced can be calculated as follows:

	₦
Direct materials	3,600
Direct labour	300
Production overheads	600
	<hr/>
Total production cost	4,500
Expected output (90% of 2,000)	<hr/> ÷1,800 litres
Cost per litre	<hr/> ₦2.5

Costing:

Cost of finished output = 1,700 units × ₦2.50 = ₦4,250.

Cost of abnormal loss = 100 units × ₦2.50 = ₦250.

The process account can be completed as follows

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output (actual) at ₦2.5 each	1,700	4,250
Direct labour		300	Abnormal loss	100	250
Prod. Overhead		600	Normal loss	200	–
	<hr/>			<hr/>	
	2,000	4,500		2,000	4,500
				<hr/>	

Note that the abnormal loss is included in the credit side of the account, in the same way that normal loss is shown on the credit side. However, whereas normal loss has no value/cost, abnormal loss has a cost.

The appropriate double entry in the cost ledger is:



Illustration: Abnormal loss double entry

	Debit	Credit
Abnormal loss account	X	
Process account		X



Example: Abnormal loss account

Continuing from the example above.

Abnormal loss account					
	Litres	₦		Litres	₦
Process X account	100	250	Income statement	100	250

At the end of the financial period, the balance on the abnormal loss account is written off as a cost in the costing income statement.

3.3 Abnormal loss with recovery value

When loss has a scrap value, the scrap value of **normal loss** is deducted from the process cost, as explained earlier.

Abnormal loss will also have a scrap value but this is treated differently to the scrap value of normal loss.

The cost of expected units of output is calculated in the usual way.

The scrap value of normal loss is normal loss units × scrap value per unit (as usual).

In the process account the cost of abnormal loss is measured at the cost of expected units (just as before).

Periodically the units in the normal loss account are transferred to a scrap account at scrap value.

The balance on the abnormal loss account is an expense for the period (measured at the cost of the units less the scrap value).

This means that scrap value of abnormal loss is set off against the cost of abnormal loss in the abnormal loss account, not the process account.



Illustration: Abnormal loss scrap value double entry

	Debit	Credit
Cash (money from the sale of scrapped units)	X	
Abnormal loss account		X

The net cost of abnormal loss (cost of abnormal loss minus its scrap value) is then transferred as a cost to the cost accounting income statement at the end of the accounting period.



Example: Abnormal loss

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,700 litres
Therefore, abnormal loss	100 litres

Scrap value of loss ₦0.9 per litre

The cost per unit produced can be calculated as follows: ₦

Direct materials	3,600
Direct labour	300
Production overheads	600
Scrap value of normal loss (200 × ₦0.90)	(180)
Total production cost	<u>4,320</u>
Expected output (90% of 2,000)	<u>÷1,800 litres</u>
Cost per litre	<u>₦2.4</u>

Costing:

Cost of finished output = 1,700 units × ₦2.40 = ₦4,080.

Cost of abnormal loss = 100 units × ₦2.40 = ₦240.

Normal loss = 200 units × ₦0.9 = ₦180

The process account can be completed as follows

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output	1,700	4,080
Direct labour		300	Abnormal loss	100	240
Prod. Overhead		600	Normal loss	200	180
	<u>2,000</u>	<u>4,500</u>		<u>2,000</u>	<u>4,500</u>



Example: Accounting for the losses

The double entry to account for the losses can be completed as follows

Abnormal loss account					
Litres			₦		
Process X account	100	240	Scrap account	100	90
			Income statement		150
	100	240		100	240

Scrap account					
Litres			₦		
Process X account (normal loss)	200	180	Cash	300	270
Abnormal loss account	100	90			
	300	270		300	270

4 ABNORMAL GAIN

Section overview

Abnormal gain

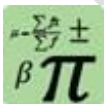
Accounting for abnormal gain: no scrap value for loss

Abnormal gain where loss has a scrap value

4.1 Abnormal gain

Abnormal loss occurs when actual loss is more than the expected (normal) loss.

Abnormal gain occurs when the actual loss is less than normal loss. Abnormal gain is the difference between the normal loss (expected loss) and the actual loss.



Formula: Abnormal gain

$$\text{Abnormal gain} = \text{Expected (normal) loss} - \text{Actual loss}$$

From earlier:

$$\text{Expected output} = \text{Actual output} + \text{Abnormal loss}$$

Gain is opposite in sign so goes to the other side of the expression:

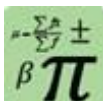
$$\text{Expected output} + \text{Abnormal gain} = \text{Actual output}$$

$$\text{Actual loss} = \text{Normal loss} - \text{Abnormal gain}$$

4.2 Accounting for abnormal gain: no scrap value for loss

The method of costing for abnormal gain is the same in principle as for abnormal loss. If it is assumed that all losses occur at the end of the process, the cost per unit of finished output and the value/cost of abnormal gain are calculated as the cost per expected unit of output. (i.e., the cost of good output)

The cost per unit of abnormal loss is therefore, the same as the cost of units of good output. This is exactly the same as before.



Formula: Cost of good output

$$\text{Cost of good output per unit} = \frac{\text{Total process costs} - \text{Scrap value of the normal loss}}{\text{Expected units of output}}$$

The differences between costing for abnormal loss and costing for abnormal gain are that:

Abnormal gain is a benefit rather than a cost. Whereas abnormal loss is written off as a cost at the end of the financial period, abnormal gain is an adjustment that increases the profit for the period;

Abnormal gain is recorded as a debit entry in the process account, because it is a benefit; and

The other half of the double entry is recorded in an abnormal gain account. At the end of the period, the balance on the abnormal gain account is then transferred to the income statement as a benefit for the period, adding to profit.



Example: Abnormal gain

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,850 litres
Therefore, abnormal gain	50 litres

The cost per unit produced can be calculated as follows:

Direct materials	3,600
Conversion costs (direct labour + production overheads)	900
Total production cost	<u>4,500</u>
Expected output (90% of 2,000)	<u>÷1,800 litres</u>
Cost per litre	<u>₦2.5</u>

Costing:

Cost of finished output = 1,850 units × ₦2.50 = ₦4,625.

Cost of abnormal gain = 50 units × ₦2.50 = ₦125.

Normal loss = zero (as there is no scrap value).

The process account can be completed as follows

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output	1,850	4,625
Conversion cost		900			
Abnormal gain	50	125	Normal loss	200	nil
	<u>2,050</u>	<u>4,625</u>		<u>2,050</u>	<u>4,625</u>

Accounting for abnormal gain: ledger entries

The abnormal gain is shown on the debit side of the account, and the total number of units in the memorandum column for quantities (2,050) is larger than the actual quantity of units input to the process (2,000).

The appropriate double entry in the cost ledger is:

**Illustration: Abnormal gain double entry**

	Debit	Credit
Process account	X	
Abnormal gain account		X

**Example: Abnormal gain account**

Continuing from the example above.

Abnormal gain account					
	Litres	₦		Litres	₦
Income statement		125	Process X account	50	125

The balance on this account is taken to the costing income statement at the end of the period, and added to the reported profit.

4.3 Abnormal gain where loss has a scrap value

When loss has a scrap value, the value of abnormal gain is actually less than the amount shown in the process account. The process has been more efficient and produced more good output but there are less normal loss units so the scrap recovery is less than expected.

Accounting for the scrap value of abnormal gain is similar to accounting for the scrap value of abnormal loss.

In the process account (WIP), abnormal gain is valued at the cost per expected unit of output.

The scrap value of normal loss is normal loss units \times scrap value per unit (as usual). The scrap value of abnormal gain is recorded as a debit entry in the abnormal gain account (in a similar way to recoding the scrap value of abnormal loss as a credit entry in the abnormal loss account).

The scrap value of the abnormal gain is set-off against the value of the abnormal gain in the abnormal gain account, not the process account.

The balance on the abnormal gain account is the net value of abnormal gain (value of abnormal gain minus the scrap value not earned from the normal loss). This balance is transferred as a net benefit to the cost accounting income statement at the end of the accounting period.



Example: Abnormal gain where loss has recovery value

The following information relates to a production process X.

Input quantities	2,000 litres
Normal loss	10%
Therefore, expected output	1,800 litres
Actual output	1,850 litres
Therefore, abnormal gain	50 litres

Scrap value of normal loss	₦0.9 per litre
----------------------------	----------------

The cost per unit produced can be calculated as follows:

Direct materials	3,600
Direct labour	300
Production overheads	600
Scrap value of normal loss (200 \times ₦0.90)	(180)
Total production cost	<u>4,320</u>
Expected output (90% of 2,000)	\div 1,800 litres
Cost per litre	<u>₦2.4</u>

Costing:

Cost of finished output = 1,850 units \times ₦2.40 = ₦4,440.

Cost of abnormal gain = 50 units \times ₦2.40 = ₦120.

Normal loss = 200 units \times ₦0.90 = ₦180.

The process account can be completed as follows

Process X					
	Litres	₦		Litres	₦
Materials	2,000	3,600	Output	1,850	4,440
Conversion cost		900			
Abnormal gain	50	120	Normal loss	200	180
	<u>2,050</u>	<u>4,620</u>		<u>2,050</u>	<u>4,620</u>



Example: Accounting for the abnormal gain and the normal loss

The double entry to account for the losses can be completed as follows

Abnormal gain account					
	Litres	₦		Litres	₦
Scrap account	50	45	Process X account	50	120
Income statement		75			
	<u>50</u>	<u>120</u>		<u>50</u>	<u>120</u>

The balance on this account is ₦75. This is treated as an addition to profit in the cost accounting income statement for the period.

Scrap account					
	Litres	₦		Litres	₦
Process X a/c (normal loss)	200	180	Abnormal gain account	50	45
			Cash	150	135
	<u>200</u>	<u>180</u>		<u>200</u>	<u>180</u>

The company expected to be able to sell 200 litres of scrap product. The abnormal gain means that they only have 150 litres to sell.

5 PROCESS COSTING WITH CLOSING WORK-IN-PROGRESS

Section overview

Sharing out process costs between finished units and unfinished inventory

Equivalent units

A three-stage calculation

Introduction to opening work-in-progress

5.1 Sharing out process costs between finished units and unfinished inventory

When manufacturing is a continuous process, there may be unfinished units (work-in-progress (WIP)) at the start and end of a period. This section looks at closing WIP. In all the examples in this section it is assumed that there is no opening WIP. Also note that the examples in this section assume that there are no losses.

This means that some units have been started and finished in the year and others have been started but not finished.

It stands to reason that the cost or value of an unfinished unit is less than the cost of a completed unit. The costs of the process must be shared between finished output and work-in-process on a fair basis.

Previous sections have explained that costs are allocated to output by calculating a cost per unit. This involves dividing a cost figure by the number of units of expected output.

In order to do this when there is closing work-in-progress we use the concept of equivalent units.

5.2 Equivalent units

An equivalent unit means 'equal to one finished unit of output'. This is quite a simple idea. A number of partially complete units is the equivalent of a number of complete units depending on their degree of completion.



Illustration:

200 units that are 50% complete are equivalent to 100 (50% × 200) complete units

400 units that are 20% complete are equivalent to 80 (20% × 400) complete units

Costs are shared between finished units and unfinished units by calculating a cost per equivalent unit.

Complication

In all of the previous examples a cost per unit was calculated by dividing the total process costs (perhaps adjusting for expected normal loss or cost of disposal) by the expected number of units.

The existence of work-in-progress complicates this because the work-in-progress might be complete to different degrees in respect of different cost inputs. For example a unit in the closing work-in-progress might be 80% complete with respect to material but only 50% complete with respect to labour.

In this case, the number of equivalent units of direct materials cost in a period will therefore differ from the number of equivalent units of labour.

A cost per unit is calculated for each type of cost using the equivalent units for that cost. The cost of output is then based on these individual costs.

Costs for finished output and work in progress can be calculated from the number of equivalent units and the cost per equivalent unit.

5.3 A three-stage calculation

We recommend a three-stage calculation:

Prepare a statement of equivalent units to calculate the equivalent units for each type of cost in the output from the process and for closing WIP;

Next, prepare a statement of cost per equivalent unit for each type of cost; and

Third, prepare a statement to calculate the cost of finished output and closing WIP from the statement of equivalent units and statement of cost per equivalent unit.

**Example: Closing work-in-progress**

The following information relates to a production process X.

Input quantities	4,000 units
Completed output	3,500 units
Closing WIP	500 units

All the direct materials are added to production at the beginning of the process.

Closing inventory of 500 units is therefore 100% complete for materials but is only 40% complete for conversion.

The costs incurred in the period were:

	₦
Direct materials	24,000
Conversion costs:	7,400

**Answer****Statement of equivalent units**

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Finished output	3,500	100%	3,500	3,500
Closing WIP:				
Materials	500	100%	500	
Conversion		40%		200
	<u>4,000</u>		<u>4,000</u>	<u>3,700</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs (₦)	24,000	7,400
Equivalent units	÷ 4,000	÷ 3,700
Cost per equivalent unit (₦)	<u>6</u>	<u>2</u>

Statement of evaluation

	₦
Cost of finished goods (3,500 × (₦6 + ₦2))	<u>28,000</u>
Cost of closing WIP	
Materials (500 units × ₦6)	3,000
Conversion (200 units × ₦2)	400
Cost per equivalent unit	<u>3,400</u>

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Direct materials	4,000	24,000	Finished goods	3,500	28,000
Conversion costs	-	7,400	Closing WIP	500	3,400
	<u>4,000</u>	<u>31,400</u>		<u>4,000</u>	<u>31,400</u>

5.4 Introduction to opening work-in-progress

Opening work-in-progress adds another level of complexity.

When there is opening work-in-progress there are two types of cost on the debit side of the account. These are the costs that were incurred last period and brought forward as work-in-progress and the costs that were incurred in the current period. The issue is whether they should be treated together or separately. This question is addressed in the accounting policy adopted for opening work-in-progress.

weighted average cost method treats all costs on the debit side of the account in the same way.

first-in, first-out (FIFO) method allocates the costs in opening WIP to the finished goods and then spreads the remaining costs elsewhere.

6 OPENING WORK-IN-PROGRESS: WEIGHTED AVERAGE COST METHOD

Section overview

The underlying principle

The three-stage calculation

Weighted average cost method: summary

6.1 The underlying principle

When the weighted average cost method is used, the assumption is that all units produced during the period and all units of closing inventory should be valued at the same cost per equivalent unit for materials and the same cost per equivalent unit for conversion costs.

An average cost per equivalent unit is calculated for all units of output and closing inventory. This includes the units that were partly-completed at the beginning of the period (and which were therefore valued as closing WIP at the end of the previous period).

The calculation of equivalent units is based on the number of units finished in the period (it does not matter when they were started) and the number of units in closing WIP.

6.2 The three-stage calculation

The costs are worked out in a similar way to the previous example (where there was no opening WIP).

Statement of equivalent units. Prepare a statement of equivalent units for finished output and for closing WIP.

Statement of cost per equivalent unit. Calculate the cost per equivalent unit for direct materials and the cost per equivalent unit for conversion costs. However, remember to include the cost of the opening WIP. The materials cost of the opening WIP should be included in the total direct materials cost, and the conversion costs in the opening WIP should be added to the conversion costs for the current period.

You will normally have to calculate a separate cost per equivalent units for materials and for conversion costs. This is because the equivalent units of closing inventory will be different for materials and conversion costs.

Statement of evaluation. Having calculated the equivalent units and a cost per equivalent unit, prepare a statement of evaluation.



Example: Opening work-in-progress – Weighted average method

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete)	₦12,600
Conversion costs in opening WIP (30% complete)	₦970

During the month

Input quantities	7,000 units
Completed output	8,000 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Closing inventory of 2,000 units is therefore 100% complete for materials but is only 60% complete for conversion.

The costs incurred in the period were:	₦
Direct materials	28,000
Conversion costs:	17,430



Answer

Statement of equivalent units

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Finished output	8,000	100%	8,000	8,000
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
	<u>10,000</u>		<u>10,000</u>	<u>9,200</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs	₦	₦
Costs in opening WIP	12,600	970
Costs in the period	28,000	17,430
	<u>40,600</u>	<u>18,400</u>
Equivalent units	÷ 10,000	÷ 9,200
Cost per equivalent unit (₦)	<u>4.06</u>	<u>2</u>

Statement of evaluation

Cost of finished goods (8,000 × (₦4.06 + ₦2))	<u>₦ 48,480</u>
Cost of closing WIP	
Materials (2,000 units × ₦4.06)	8,120
Conversion (1,200 units × ₦2)	<u>2,400</u>
Cost per equivalent unit	<u>10,520</u>

These costs would be recorded in the process account as follows.

Process (WIP) account

		units	₦			units	₦
Opening WIP	3,000	13,570	Finished goods	8,000	48,480		
Direct materials	7,000	28,000	Closing WIP	2,000	10,520		
Conversion costs	-	17,430					
	<u>10,000</u>	<u>59,000</u>		<u>10,000</u>	<u>59,000</u>		

6.3 Weighted average cost method: summary

The weighted average cost method for process costing with opening WIP can be summarised as follows.

All output and closing inventory is valued at the same cost per equivalent unit

Cost of opening inventory + Costs in the period = Total costs

Units of closing inventory + Units of output in the period = Total equivalent units

Cost per equivalent unit = Total costs/Total equivalent units



Illustration: Summary of weighted average calculation of cost per unit

	Direct materials	Conversion costs
Cost of opening inventory	X	X
Costs incurred in the period	X	X
Total costs	X_m	X_{cc}
Number of units output	Y	Y
Equivalent units of closing inventory	Y	Y
Total equivalent units	Y_m	Y_{cc}
Cost per equivalent unit	<u>(X_m/Y_m)</u>	<u>(X_{cc}/Y_{cc})</u>

7 OPENING WORK-IN-PROGRESS: FIFO METHOD

Section overview

FIFO method in process costing
The three-stage calculation
FIFO method: summary

7.1 FIFO method in process costing

The first-in, first-out (FIFO) method of process costing is based on the assumption that the opening units of work-in-process at the beginning of the month will be the first units completed. The cost of these units is their value at the beginning of the period plus the cost to complete them in the current period.

It is necessary to calculate the number of equivalent units of work done in the period. This consists of:

The equivalent units of direct materials and conversion costs required to complete the opening WIP. These are the first units completed in the period;

The equivalent units of finished output in the period that was started as well as finished in the period. These have one equivalent unit of direct materials and one equivalent unit of conversion costs. The total number of these units is:

the total finished output in the period; and

minus the quantity of opening WIP (which are completed first)

The equivalent units of closing WIP (calculated in the normal way).

7.2 The three-stage calculation

The three-stage calculation with the FIFO method is similar to the calculation method previously described, with the exception that in the statement of evaluation, the cost of finished output consists of:

The finished cost of opening WIP which is the sum of:

the costs in the opening WIP value at the start of the period; plus

the costs in the current period to complete these units; plus

the cost of finished output started as well as finished in the period.

Study the following example carefully.



Example: Opening work-in-progress – FIFO method

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete – therefore 0% is needed in this period)	₦12,600
Conversion costs in opening WIP (30% complete – therefore 70% is needed in this period)	₦970
	<hr/>
	₦13,570
	<hr/>
During the month	
Input quantities	7,000 units
Completed output	8,000 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units
 All the direct materials are added to production at the beginning of the process.	
Closing inventory of 2,000 units is therefore 100% complete for materials but is only 60% complete for conversion.	
The costs incurred in the period were:	₦
Direct materials	28,000
Conversion costs:	17,430



Answer

Statement of equivalent units

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Started last period				
Opening WIP	3,000			
Materials		0%	nil	
Conversion		70%		2,100
Started and finished in the period	5,000	100%	5,000	5,000
Finished in period	8,000		5,000	7,100
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
	<u>10,000</u>		<u>7,000</u>	<u>8,300</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs in current period	₦28,000	₦17,430
Equivalent units	÷ 7,000	÷ 8,300
Cost per equivalent unit	<u>₦4</u>	<u>₦2.1</u>

Statement of evaluation

	₦
Cost of goods finished in the period (8,000 units)	
Started in previous period but finished in this period	
Opening WIP (3,000 units)	13,570
Conversion cost to finish opening WIP (2,100 × ₦2.1)	4,410
	<u>17,980</u>
Started and finished in this period (5,000 × ₦4 + ₦2.1)	30,500
	<u>48,480</u>
Cost of closing WIP	
Materials (2,000 units × ₦4)	8,000
Conversion (1,200 units × ₦2.1)	2,520
	<u>10,520</u>

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Opening WIP	3,000	13,570	Finished goods	8,000	48,480
Direct materials	7,000	28,000	Closing WIP	2,000	10,520
Conversion costs	-	17,430			
	<u>10,000</u>	<u>59,000</u>		<u>10,000</u>	<u>59,000</u>

(**Tutorial note:** If you compare this example using FIFO with the previous example using the weighted average cost method, you will see that the cost of finished output and value of closing WIP is the same in each case. This is a coincidence. Normally, the two methods provide different costs for finished output and different closing WIP valuations.)

7.3 FIFO method: summary

The first-in, first-out method for process costing with opening WIP can be summarised as follows.

The cost of the opening units completed in the current period is calculated separately from the cost of the units that are started and finished in the current period.

A cost per equivalent unit is calculated **for the current period**, as follows:



Illustration: Summary of weighted average calculation of cost per unit

	Direct materials TC _m	Conversion costs TC _c
Costs incurred in the current period	TC _m	TC _c
Equivalent units of work in the current period:		
to complete opening WIP	X	Y
to start and finish units	X	Y
to make closing WIP	X	Y
Total equivalent units of work in this period	<u>X_m</u>	<u>Y_{cc}</u>
Cost per equivalent unit in the current period	<u>TC_m / X_m</u>	<u>TC_c / Y_{cc}</u>

These costs are used to apportion the process costs in the current period between:

- the cost of completing the opening WIP;
- the cost of units started and finished in the current period; and
- the value of closing inventory.

Having calculated costs for the current period, the valuation of output from the process is calculated as follows:



Illustration: Summary of evaluation of outputs under the FIFO method

	₦
Cost of Items started in the previous period and finished in this period	
Opening WIP	X
Cost of finishing the opening WIP	
To complete material	X
To complete other costs	X
	X
Cost of items started and finished in this period	X
Cost of items finished in the period	X
Cost of items started in this period	
Material	X
Other costs	X
	X
Total process costs	X

8 WORK-IN-PROGRESS AND LOSSES

Section overview

Introduction

Opening WIP and losses (Weighted average)

Opening WIP and losses (FIFO)

8.1 Introduction

Questions might combine WIP and losses.

Earlier in the chapter, we explained that normal loss is measured at zero or its scrap value if it has one. This recognised that the scrap recovery reduces the overall cost of the process.

When a question requires the calculation of cost per unit by components of cost, the question arises as to what cost the expected scrap recovery should be set off against. After all the value of the scrapped unit would lay partly in its material cost but also partly in its conversion cost. The usual approach is to employ a convention that ignores the complication, and offset the expected scrap recovery against the material cost only.

We saw that abnormal loss is measured in the same way as good production. The abnormal loss units are included in the expected good output used in the cost per unit calculation.

The same principles are followed when a question requires the calculation of cost per unit by component through the calculation of equivalent units. The number of equivalent units taken to build the abnormal loss must be included in the total number of equivalent units.



Example: Closing work-in-progress and losses

The following information relates to a production process X.

Input quantities	4,000 units
Normal loss (all units having a scrap recovery of ₦1 per unit)	10% of input
Completed output	3,000 units
Closing WIP	500 units

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 500 units is therefore 100% complete for materials but is 60% complete for conversion.

The costs incurred in the period were:	₦
Direct materials	24,000
Conversion costs:	7,400

It is useful to construct an extra working with these questions to show the physical number of units.



Example: Closing work-in-progress and losses – Preliminary working:

	Units
Opening WIP	0
Input	4,000
Total possible units	<u>4,000</u>
Normal loss (10% of input)	<u>(400)</u>
Expected good output	3,600
Actual good output	(3,000)
Closing WIP	<u>(500)</u>
Abnormal loss	<u>100</u>



Example: Closing work-in-progress and losses

Statement of equivalent units

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Finished output	3,000	100%	3,000	3,000
Closing WIP:				
Materials	500	100%	500	
Conversion		60%		300
Abnormal loss				
Materials	100	100%	100	
Conversion		50%		50
	<u>3,600</u>		<u>3,600</u>	<u>3,350</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs	₦24,000	₦7,400
Expected scrap recovery of normal loss (10% × 4,000 units × ₦1)	₦(400)	
	<u>₦23,600</u>	<u>₦7,400</u>
Equivalent units	÷ 3,600	÷ 3,350
Cost per equivalent unit	<u>₦6.56</u>	<u>₦2.21</u>

Statement of evaluation

Note that the costs per unit above have been rounded to two decimal places. However, the calculations below are based on unrounded figures ($\frac{23,600}{3,600}$ and $\frac{7,400}{3,350}$)

	₦
Cost of finished goods (3,000 × (₦6.56 + ₦2.21))	<u>26,294</u>
Cost of closing WIP	
Materials (500 units × ₦6.56)	3,278
Conversion (300 units × ₦2.21)	662
Cost per equivalent unit	<u>3,940</u>
Cost of closing abnormal loss	
Materials (100 units × ₦6.56)	656
Conversion (50 units × ₦2.21)	110
Cost per equivalent unit	<u>766</u>

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Direct materials	4,000	24,000	Finished goods	3,000	26,294
			Normal loss	400	400
Conversion costs	-	7,400	Abnormal loss	100	766
			Closing WIP	500	3,940
	<u>4,000</u>	<u>31,400</u>		<u>3,600</u>	<u>31,400</u>

8.2 Opening WIP and losses (Weighted average)



Example: Opening work-in-progress and losses – Weighted average method

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete)	₦12,600
Conversion costs in opening WIP (30% complete)	₦970

During the month

Input quantities (units)	7,000
Normal loss (all units having a scrap recovery of ₦1)	5% of input
Completed output (units)	7,500
Closing WIP (100% complete for direct materials and 60% complete for conversion costs) (units)	2,000

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 500 units is therefore 100% complete for materials but is 60% complete for conversion.

The costs incurred in the period were:	₦
Direct materials	28,000
Conversion costs:	17,430



Example: Opening work-in-progress and losses – Weighted average method – Preliminary working:

	Units
Opening WIP	3,000
Input	7,000
Total possible units	10,000
Normal loss (5% of input)	(350)
Expected good output	9,650
Actual good output	(7,500)
Closing WIP	(2,000)
Abnormal loss	150

Example: Opening work-in-progress and losses – Weighted average method

Statement of equivalent units

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Finished output	7,500	100%	7,500	7,500
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
Abnormal loss				
Materials	150	100%	150	
Conversion		50%		75
	<u>9,650</u>		<u>9,650</u>	<u>8,775</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
Total costs	₦	₦
Costs in opening WIP	12,600	970
Costs in the period	28,000	17,430
Expected scrap recovery of normal loss (5% × 7,000 units × ₦1)	(350)	
	<u>40,250</u>	<u>18,400</u>
Equivalent units	÷ 9,650	÷ 8,775
Cost per equivalent unit	<u>4.17</u>	<u>2.10</u>

Statement of evaluation

Note that the costs per unit above have been rounded to two decimal places. However, the calculations below are based on unrounded figures ($\frac{40,250}{9,650}$ and $\frac{18,400}{8,775}$)

Cost of finished goods (7,500 × (₦4.17 + ₦2.1))	<u>47,009</u>
Cost of closing WIP	
Materials (2,000 units × ₦4.17)	8,342
Conversion (1,200 units × ₦2.1)	<u>2,516</u>
	<u>10,858</u>
Abnormal loss	
Materials (150 units × ₦4.17)	626
Conversion (75 units × ₦2.1)	<u>157</u>
	<u>783</u>

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Opening WIP	3,000	13,570	Finished goods	7,500	47,009
Direct materials	7,000	28,000	Normal loss	350	350
Conversion costs	-	17,430	Abnormal loss	150	783
			Closing WIP	2,000	10,858
	<u>10,000</u>	<u>59,000</u>		<u>10,000</u>	<u>59,000</u>

8.3 Opening WIP and losses (FIFO)



Example: Opening work-in-progress and losses – FIFO method

The following information relates to a production process X.

Opening inventory	3,000 units
Material cost in opening WIP (100% complete – therefore 0% is needed in this period)	₦12,600
Conversion costs in opening WIP (30% complete – therefore 70% is needed in this period)	₦970
	₦13,570

During the month

Input quantities	7,000 units
Normal loss (all units having a scrap recovery of ₦1)	5% of input
Completed output	7,500 units
Closing WIP (100% complete for direct materials and 60% complete for conversion costs).	2,000 units

All the direct materials are added to production at the beginning of the process.

Inspection of the units occurs when they are 50% complete. (Note that this must relate to conversion as they are 100% complete for material).

Closing inventory of 500 units is therefore 100% complete for materials but is 60% complete for conversion.

The costs incurred in the period were:	₦
Direct materials	28,000
Conversion costs:	17,430



Example: Opening work-in-progress and losses – FIFO method – Preliminary working:

	Units
Opening WIP	3,000
Input	7,000
Total possible units	10,000
Normal loss (5% of input)	(350)
Expected good output	9,650
Actual good output:	
Started in the previous period but finished in this period	(3,000)
Started and finished in this period	(4,500)
Output in this period	(7,500)
Closing WIP	(2,000)
Abnormal loss	150



Example: Opening work-in-progress and losses – FIFO method

Statement of equivalent units

Output	Total units	Percentage complete	Equivalent units	
			Direct materials	Conversion costs
Started last period				
Opening WIP	3,000			
Materials		0%	nil	
Conversion		70%		2,100
Started and finished in the period	4,500	100%	4,500	4,500
Finished in period	7,500		4,500	6,600
Closing WIP:				
Materials	2,000	100%	2,000	
Conversion		60%		1,200
Abnormal loss				
Materials	150	100%	150	
Conversion		50%		75
	<u>9,650</u>		<u>6,650</u>	<u>7,875</u>

Statement of cost per equivalent unit

	Direct materials	Conversion costs
	₦	₦
Total costs in current period	28,000	17,430
Expected scrap recovery of normal loss (5% × 7,000 units × ₦1)	(350)	
	<u>27,650</u>	<u>17,430</u>
Equivalent units	÷ 6,650	÷ 7,875
Cost per equivalent unit	<u>₦4.16</u>	<u>₦2.21</u>



Example: Opening work-in-progress and losses – FIFO method

Statement of evaluation

Note that the costs per unit above have been rounded to two decimal places. However, the calculations below are based on unrounded figures ($\frac{27,650}{6,650}$ and $\frac{17,430}{7,875}$)

	₦
Cost of goods finished in the period (8,000 units)	
Started in previous period but finished in this period	
Opening WIP (3,000 units)	13,570
Conversion cost to finish opening WIP (2,100 × ₦2.21)	4,648
	18,218
Started and finished in this period (4,500 × (₦4.16 + ₦2.21))	28,671
	46,889
Cost of closing WIP	
Materials (2,000 units × ₦4.16)	8,316
Conversion (1,200 units × ₦2.21)	2,655
	10,971
Cost of abnormal loss	
Materials (150 units × ₦4.16)	624
Conversion (75 units × ₦2.21)	166
	790

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Opening WIP	3,000	13,570	Finished goods	7,500	46,889
Direct materials	7,000	28,000	Normal loss	350	350
Conversion costs	-	17,430	Abnormal loss	150	790
			Closing WIP	2,000	10,971
	10,000	59,000		10,000	59,000

9 PROCESS COSTING: JOINT PRODUCTS AND BY-PRODUCTS

Section overview

Definition of joint products

Apportioning common processing costs between joint products

By-products

9.1 Definition of joint products

In some process manufacturing systems, two or more different products are produced.



Definition: Joint products

Joint products are two or more products generated simultaneously, by a single manufacturing process using common input, and being substantially equal in value.

Until the joint products are produced in the manufacturing process, they cannot be distinguished from each other. The same input materials and processing operation produces all the joint products together.

Each joint product has a substantial sale value relative to each other joint product.



Example: Joint products

The refining of crude oil produces a series of products fuel oil, gasoline, and kerosene.

Domestic animals are grown for food and their hides are turned into leather.

9.2 Apportioning common processing costs between joint products

The costs of the common process that produces the joint products are common costs. In order to calculate a cost for each joint product, these common costs must be shared (apportioned) between the joint products. The common costs of the process must be apportioned between the joint products on a fair basis, in much the same way that overhead costs are apportioned between cost centres.

One of the following three methods of apportionment is normally used:

Units basis: Common costs are apportioned on the basis of the total number of units produced. The cost per unit is the same for all the joint products. (This is also described as the physical quantities basis).

Sales value at the split-off point basis: Common costs are apportioned on the basis of the sales value of the joint products produced, at the point where they are separated in the process (the 'split-off point').

Net realisable value (sales value less further processing costs basis): Common costs are apportioned on the basis of their eventual sales value after they have gone through further processing to get them ready for sale.



Example: Joint products

Two joint products JP1 and JP2, are produced from a common process.

During March, 8,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were ₦135,880.

Output was 5,000 units of JP1 and 3,000 units of JP2.

JP1 has a sales value of ₦40 per unit when it is output from the process and can be sold for ₦120 per unit after further processing costs of ₦25 per unit.

JP2 has a sales value of ₦55 per unit when it is output from the process and can be sold for ₦80 per unit after further processing costs of ₦15 per unit.

Joint costs can be apportioned in one of the following ways.



Answer: Units basis

Output	Units
JP1	5,000
JP2	3,000
	8,000
Costs:	₦
JP1: $\frac{5,000 \text{ units}}{8,000 \text{ units}} \times \text{₦}135,880$.	84,925
JP2: $\frac{3,000 \text{ units}}{8,000 \text{ units}} \times \text{₦}135,880$.	50,955
	135,880

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	₦		units	₦
Direct materials	8,000	135,880	JP1	5,000	84,925
	8,000	135,880	JP2	3,000	50,955
				8,000	135,880

**Answer: Sales value at point of split-off**

Sales value	₦
JP1 (5,000 units × ₦40)	200,000
JP2 (3,000 units × ₦55)	165,000
	<u>365,000</u>
 Costs:	 ₦
JP1: ₦200,000 / ₦365,000 × ₦135,880 .	74,455
JP2: ₦165,000 / ₦365,000 × ₦135,880 .	61,425
	<u>135,880</u>

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	₦		units	₦
Direct materials	8,000	135,880	JP1	5,000	74,455
	8,000	135,880	JP2	3,000	61,425
				<u>8,000</u>	<u>135,880</u>

**Answer: Net realisable value at the point of split-off**

NRV value	₦
JP1 (5,000 units × ₦120 – ₦25)	475,000
JP2 (3,000 units × ₦80 – ₦15)	195,000
	<u>670,000</u>
 Costs:	 ₦
JP1: ₦475,000 / ₦670,000 × ₦135,880 .	96,333
JP2: ₦195,000 / ₦670,000 × ₦135,880 .	39,547
	<u>135,880</u>

These costs would be recorded in the process account as follows.

Process account					
	units	₦		units	₦
Direct materials	8,000	135,880	JP1	5,000	96,333
	8,000	135,880	JP2	3,000	39,547
				<u>8,000</u>	<u>135,880</u>

9.3 By-products

When two or more different products are produced, any product that does not have a substantial sales value is called a by-product.



Definition: By-products

By-products are outputs from a joint process that are relatively minor in quantity and/or value.

A by-product has a small value relative to the joint products but it may have some value.

The proceeds of sale of the by-product can be treated in a number of ways and the method chosen has an implication on how the by-product is measured in the joint process account.

Possible methods include:

Treatment of proceeds of sale	Measurement of by-product in joint process account
As revenue (adding it to the revenue from sales of other products).	No cost is allocated to the by product.
As other income	No cost is allocated to the by product.
As a deduction from joint process costs (this is the most commonly used method).	By-product is measured at scrap value (the accounting treatment is very similar to that used for normal loss).

Since a by-product does not have any substantial value, there is no sense in charging it with a share of the common processing costs.

Instead, the sales value of the by-product is usually deducted from the common processing costs (just as for normal loss). If there are joint products, the common processing costs are apportioned after deducting the sales value of the by-product from the total costs of the process.



Example: By-product and joint products

Two joint products JP1 and JP2, are produced from a common process.

During March, 9,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were ₦135,880.

Output was 5,000 units of JP1 and 3,000 units of JP2 and 1,000 units of by-product BP3.

JP1 has a sales value of ₦40 per unit when it is output from the process and can be sold for ₦120 per unit after further processing costs of ₦25 per unit.

JP2 has a sales value of ₦55 per unit when it is output from the process and can be sold for ₦80 per unit after further processing costs of ₦15 per unit.

BP3 has a sales value of ₦1.58 per unit

The company's policy is to treat the proceeds of sale of a by-product as a reduction of joint process costs

Apportion the process costs between the joint products on the basis of net realisable sales value at the split-off point.

**Answer: Net realisable value at the point of split-off**

Common process costs	₦
Total process costs	135,880
Deduct: Sales value of by-product (1,000 × ₦1.58)	<u>(1,580)</u>
	<u>134,300</u>

Answer: Net realisable value at the point of split-off

NRV value	₦
JP1 (5,000 units × ₦120 – ₦25)	475,000
JP2 (3,000 units × ₦80 – ₦15)	<u>195,000</u>
	<u>670,000</u>
Costs:	₦
JP1: $\frac{₦475,000}{₦670,000} \times ₦134,300$	95,213
JP2: $\frac{₦195,000}{₦670,000} \times ₦134,300$	<u>39,087</u>
	<u>134,300</u>

These costs would be recorded in the process account as follows.

Process account					
	units	₦		units	₦
Direct materials	8,000	135,880	JP1	5,000	95,213
			JP2	3,000	39,087
			By product	1,000	1,580
	<u>8,000</u>	<u>135,880</u>		<u>8,000</u>	<u>135,880</u>

**Example: By-product and joint products**

Two joint products XX and YY, are produced from a common process. During July, 11,000 units of materials were input to the process. Total costs of processing (direct materials and conversion costs) were ₦100,000. Output was 6,000 units of XX and 4,000 units of YY and 1,000 units of by-product Q.

XX has a sales value of ₦24 per unit when it is output from the process.

YY has a sales value of ₦12 per unit when it is output from the process.

Q has a sales value of ₦1 per unit

The company's policy is to apportion joint costs based on sales value at the point of split-off.

80% of the output of both XX and YY was sold by the month end.

The proceeds of sale of the by-product could be treated in one of the following ways.



Answer: Sales value at point of split-off deducting proceeds of sale of the by-product from the joint process cost (as before)

Sales value	₦
XX (6,000 units × ₦24)	144,000
YY (4,000 units × ₦12)	48,000
	<u>192,000</u>

1 By-product deducted from costs

Costs:	₦
XX: $\frac{₦144,000}{₦192,000} \times (₦100,000 - ₦1,000)$	74,250
YY: $\frac{₦48,000}{₦192,000} \times (₦100,000 - ₦1,000)$	24,750
	<u>99,000</u>

These costs would be recorded in the process account as follows.

Process (WIP) account					
	units	₦		units	₦
Direct materials	11,000	100,000	XX	6,000	74,250
			YY	4,000	24,750
			Q	1,000	1,000
	<u>11,000</u>	<u>100,000</u>		<u>11,000</u>	<u>100,000</u>

The income statement would show the following:

	₦
Revenue:	
Sales of XX (80% × 6,000 units × ₦24)	115,200
Sales of YY (80% × 4,000 units × ₦12)	38,400
	153,600
Cost of sales:	
Production costs	99,000
Less: Closing inventory (20% × 99,000)	(19,800)
	<u>(79,200)</u>
Profit	<u>74,400</u>



Answer: Sales value at point of split-off (treating proceeds of sale of the by-product as other income)

Sales value	₦
XX (6,000 units × ₦24)	144,000
YY (4,000 units × ₦12)	48,000
	<u>192,000</u>

1 By-product deducted from costs

Costs:	₦
XX: $\frac{₦144,000}{₦192,000} \times ₦100,000$	75,000
YY: $\frac{₦48,000}{₦192,000} \times ₦100,000$	25,000
	<u>100,000</u>

These costs would be recorded in the process account as follows.

Process (WIP) account						
		units	₦		units	₦
Direct materials		11,000	100,000	XX	6,000	75,000
				YY	4,000	25,000
				Q	1,000	nil
		<u>11,000</u>	<u>100,000</u>		<u>8,000</u>	<u>100,000</u>

The income statement would show the following:

	₦
Revenue:	
Sales of XX (80% × 6,000 units × ₦24)	115,200
Sales of YY (80% × 4,000 units × ₦12)	38,400
	153,600
Cost of sales:	
Production costs	100,000
Less: Closing inventory (20% × 100,000)	(20,000)
	<u>(80,000)</u>
Gross profit	73,600
Other income	1,000
Profit	<u>74,600</u>

The profit in the above example is higher than the profit in the previous example by ₦200.

This is because the whole sales proceeds from the sale of the by-product has been recognised as other income.

When the sales proceeds from the sale of the by-product are deducted from the joint process cost part of that deduction is carried forward to the next period in the valuation of closing inventory. The deduction in joint process costs was ₦1,000 and 80% of the inventory to which it relates has been sold leaving 20% (₦200) to be carried forward to the next period.

10 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain process costing;

Explain when process costing is appropriate;

Calculate the cost of output from a process including losses and opening and closing WIP;

Differentiate between joint products and by-products; and

Calculate the cost of joint products and by-products.

Forecasting

Contents

- 1 Trend lines
- 2 Seasonal variations
- 3 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B Forecasting, budgeting and decision making			
	1	Forecasting techniques	
		a	Explain the principles of time series analysis (cyclical, trend, seasonal variation and random elements).
		b	Explain the advantages and disadvantages of time series analysis.
		c	Calculate moving averages; use trend and seasonal variation (additive and multiplicative) to make budget forecasts.
A Cost accounting			
	2	Cost classifications, codification, segregation and estimation	
		b	Cost segregation and estimation
		iii	Demonstrate the use of the following cost segregation techniques:
			<ul style="list-style-type: none">• Regression analyses.

Exam context

This chapter explains forecasting techniques used in business. The chapter covers time series analysis. This chapter also explains how a trend line might be derived using least squares linear regression analysis and illustrates the different results produced by each from the same set of data.

By the end of this chapter you should be able to:

- Construct a time series;
- Identify and draw the trend line;
- Derive the line of best fit using centred moving averages or least squares linear regression analysis;
- Use the additive model to make forecasts; and
- Use the proportional model to make forecasts.

1 TREND LINES

Section overview

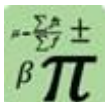
The nature of a time series
Analysing a time series
Moving averages
Centred moving averages
Line of best fit (high-low method)
Line of best fit (least squares linear regression analysis)
Lines of best fit compared

1.1 The nature of a time series

A time series is a record of data over a period of time for example, sales revenue per month or revenue per quarter. The time series is a convenient way of representing historical information but more importantly, it might be used to make predictions about the future. This is done by continuing the series forward in time. In order to do this, the time series must be analysed into its component parts.

Components of a time series

A change in value of an observed variable in a time series might be due to a combination of factors. These are described as the components of the time series. There are two models of a time series which differ in how these components are linked together.



Formula: Time series models

Additive model:

$$TS = T + S + C + R$$

Proportional (multiplicative model)

$$TS = T \times S \times C \times R$$

Where:

T = Trend – the overall direction of change in the data.

S = Seasonal variation – differences between the actual data observed for a time period and the amount predicted by the trend for that period.

C = Cyclical variation – Longer term variations which might cause changes over longer periods.

R = Random fluctuations

Note that the term “seasonal variation” has a specific meaning in time series analysis. It relates to the variation in each period covered in the analysis.

Therefore it could mean a daily, weekly, quarterly or annual variation depending on the analysis.

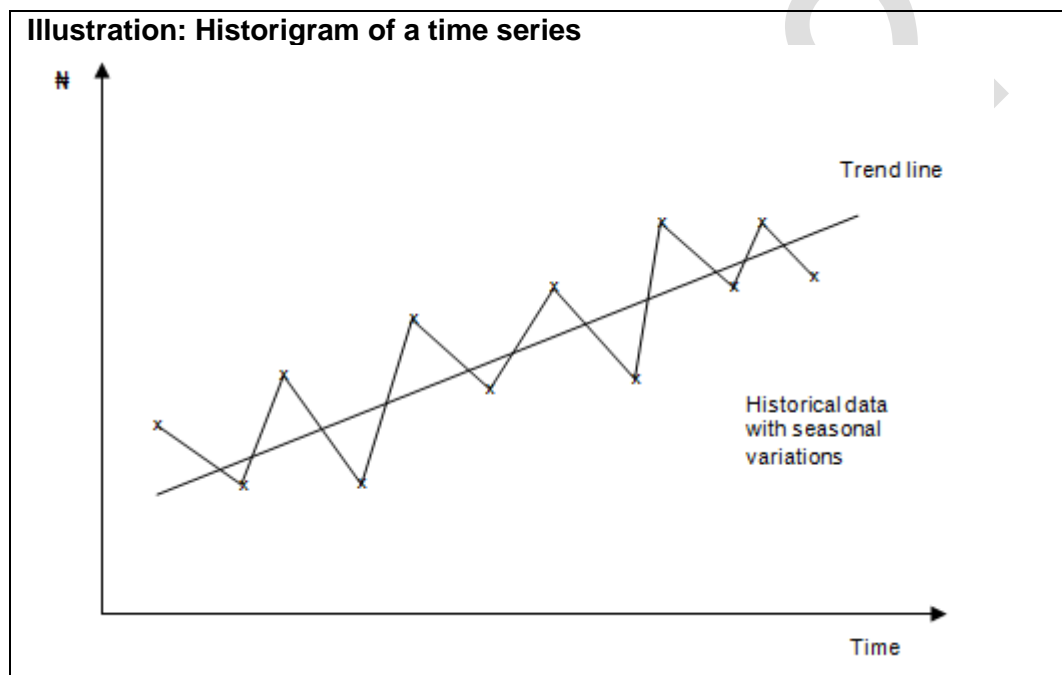
Questions requiring analysis of a time series will require the identification of a trend and seasonal variations.

Random fluctuations cannot be predicted. The usual assumption made is that they are negligible and can be ignored in any analysis.

Also, there is usually insufficient data to identify cyclical variations.

The plot of a time series as a graph is called a histogram.

The diagram below shows a trend line with seasonal variations above and below the trend line. The general trend in this diagram is up and the trend can be shown as a straight line. However the actual value in each time period is above or below the trend, because of the seasonal variations.



1.2 Analysing a time series

There are two aspects to analysing a time series from historical data:

estimating the trend line; and

calculating the amount of the seasonal variations (monthly variations or daily variations).

The time series can then be used to make estimates for a future time period, by calculating a trend line value and then either adding or subtracting the appropriate seasonal variation for that time period.

Two methods of calculating a trend line are:

Moving averages; and

Linear regression analysis.

Linear regression analysis is a technique that produces a line of best fit for observed data. This is covered in the next chapter. Note that both might be used together. Moving averages might be used to identify the underlying trend and then linear regression might be used to identify a line of best fit for the moving averages identified.

Methods of calculating seasonal variations are explained later.

1.3 Moving averages

Moving averages can be used to estimate a trend line, particularly when there are seasonal variations in the data.

The technique involves smoothing out fluctuations in the underlying observed data by calculating averages for small groups of observations from that data. The size of the small group is related to the type of data. If the data is quarterly then a group of 4 would be used or if the data was monthly a group of 12 would be used.

Moving averages are calculated as follows:

Step 1: Decide the length of the cycle. The cycle is a number of days or weeks, or seasons or years.

The cycle might be seven days when historical data is collected daily for each day of the week or perhaps six days if the business is closed for one day per week.

The cycle will be one year when data is collected monthly for each month of the year or quarterly for each season.

Step 2: Use the historical data to calculate a series of moving averages. A moving average is the average of all the historical data in one cycle.

For example, suppose that historical data is available for daily sales over a period Day 1 – Day 21, and there are seven days of selling each week.

A moving average can be calculated for Day 1 – Day 7. This represents an amount for the middle day in the data i.e. day 4.

Another moving average can be calculated for Day 2 – Day 8. . This represents an amount for the middle day in the data i.e. day 5.

This process continues until all of the data has been included. Note that as this is an averaging process, it results in a figure related to the mid-point of the overall period for which the average has been calculated.

Note that it is easier to number each day, month or quarter in a cycle starting from 1 rather than retain actual day names, dates etc.

Step 3: If there is an even number of items of data in the moving average calculation then the average will correspond to a point between the middle two time periods. A second average is calculated for each pair of values in the moving average column. This is done to centre the observation and align it with a time period.

For example:

A moving average for Quarter 1 – Quarter 4 gives a value which represents the mid-point of the range. This is Quarter 2.5;

A moving average for Quarter 2 – Quarter 5 gives a value which represents the mid-point of the range. This is Quarter 3.5; and

Quarters 2.5 and 3.5 do not exist so the values are averaged to give a value which is taken to represent Quarter 3.

Step 4: Use the moving averages (and their associated time periods) to calculate a trend line.

The following example illustrates the calculation of moving average in detail to ensure that you understand what it means before moving on to produce a complete trend.



Example: Calculating moving averages

A company operates for five days each week. Sales data for the most recent three weeks are as follows:

Sales	Monday	Tuesday	Wednesday	Thursday	Friday
	units	units	units	units	units
Week 1	78	83	89	85	85
Week 2	88	93	99	95	95
Week 3	98	103	109	105	105

Moving averages are calculated as follows:

Day Sales

1	78	}	=	420	÷ 5 days	=	84 per day
2	83						
3	89						
4	85						
5	85						

84 represents the sales on the middle day of the period (day 3)

Day Sales

2	83	}	=	430	÷ 5 days	=	86 per day
3	89						
4	85						
5	85						
6	88						

86 represents the sales on the middle day of the period (day 4)

The example is continued to complete the trend on the next page.



Example: Constructing a trend line with moving averages

A company operates for five days each week. Sales data for the most recent three weeks are as follows:

Sales	Monday	Tuesday	Wednesday	Thursday	Friday
	units	units	units	units	units
Week 1	78	83	89	85	85
Week 2	88	93	99	95	95
Week 3	98	103	109	105	105

For convenience, it is assumed that Week 1 consists of Days 1 – 5, Week 2 consists of Days 6 – 10, and Week 3 consists of Days 11 – 15.

This sales data can be used to estimate a trend line. A weekly cycle in this example is 5 days. Moving averages are calculated for five day periods, as follows:

Day	Sales	5 day total	Moving average (trend found by dividing the 5 day total by 5)
Day 1	78		
Day 2	83		
Day 3	89	420	84
Day 4	85	430	86
Day 5	85	440	88
Day 6	88	450	90
Day 7	93	460	92
Day 8	99	470	94
Day 9	95	480	96
Day 10	95	490	98
Day 11	98	500	100
Day 12	103	510	102
Day 13	109	520	104
Day 14	105	530	
Day 15	105	540	

Note that this process always results in a loss of values for points in time at the start and at the end of the range.

Line of best fit

The trend is an indication of the general movement in a set of data. In order to make predictions, the trend must be expressed as a straight line.

In the above example, the trend increases by 2 each day. This means that each moving average actually lies on a straight line. An equation can be found for this trend line by taking the first sales figure as a starting point and then adjusting it by the number of days multiplied by 2 per day to give the following formula:

$$\text{Daily sales} = 78 + 2x.$$

This trend line can be used to forecast a trend value for any day in the future. For example, the forecast for sales on day 50 is:

$$\text{Daily sales} = 78 + 50 \times 2 = 178$$

This of course assumes that sales will continue to grow at 2 per day on average.

This trend line can also be used to calculate the 'seasonal variations' (in this example the daily variations in sales above or below the trend).

In turn, these can be used to adjust the forecast value of the trend line to take account of whether day 50 is a Monday, Tuesday, Wednesday, Thursday or Friday.

This is explained later.

1.4 Centred moving averages

When there is an even number of seasons in a cycle, the moving averages will not correspond to an actual season. When this happens it is necessary to take moving averages of the moving averages in order to arrive at a value which corresponds to an actual season of the year.



Example: Constructing a trend line with centred moving averages

The following quarterly sales figures have been recorded for a company.

Sales	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	₦000	₦000	₦000	₦000
Year 1	20	24	27	31
Year 2	35	39	44	47
Year 3	49	56	60	64

In the following analysis the quarters are numbered from 1 to 12 for ease of reference. (Thus year 1: Q1 is numbered Q1 and year 3: Q4 is numbered Q12).

Moving average values for each quarter are calculated as follows:

Quarter	Sales ₦000	4 quarter total ₦000	Moving average (trend found by dividing the 4 quarter total by 4)
			₦000
1	20		
2	24		
3	27	102	25.5
4	31	117	29.25
5	35	132	33.00
6	39	149	37.25
7	44	165	41.25
8	47	179	44.75
9	49	196	49.00
10	56	212	53.00
11	60	229	57.25
12	64		

Each of the moving average figures above line up opposite a point between two quarters (seasons). For example, the average for quarters 1 to 4 sits between quarter 2 and quarter 3 at quarter 2.5.

Analysing seasonal variation requires the figures in the trend to lie opposite an actual season (quarter). This is achieved by carrying out a second averaging for each adjacent pair of numbers. The resultant numbers are called centred moving averages



Example: Constructing a trend line with centred moving averages (continued)

Quarter	Sales ₦000	Moving average ₦000	Centre total (of 2 moving averages) ₦000	Centred moving average (÷2) ₦000
1	20			
2	24			
		25.5		
3	27		25.5 + 29.25 = 54.75	27.38
		29.25		
4	31		29.25 + 33.00 = 62.25	31.13
		33.00		
5	35		33.00 + 37.25 = 70.25	35.13
		37.25		
6	39		37.25 + 41.25 = 78.50	39.25
		41.25		
7	44		41.25 + 44.75 = 86.00	43.00
		44.75		
8	47		44.75 + 49.00 = 93.75	46.88
		49.00		
9	49		49.00 + 53.00 = 102	51.00
		53.00		
10	56		53.00 + 57.25 = 110.25	55.13
		57.25		
11	60			
12	64			

The moving averages in the right hand column correspond with an actual season (quarter). These moving averages are used to estimate the trend line and the seasonal variations.

1.5 Line of best fit (high-low method)

As explained earlier, the trend is an indication of the general movement in a set of data but in order for it to be used to make predictions it must be expressed as a straight line.

The first moving average value can be used as a starting point in the equation of a straight line. One way of identifying the slope is to subtract the lowest moving average from the highest and divide the figure by the number of periods between those two figures.



Example: Line of best fit

From the previous example

	Moving average ₦000
Quarter 10	55.13
Quarter 3	(27.38)
	<hr/>
	27.75
Number of periods between Q10 and Q3	÷7
	<hr/>
	3.96

The equation of the line of best fit is:

$$y (\text{Sales}) = 27.38 + 3.96x$$

Care must be taken in using this equation. Remember the starting point for the equation is Q3 so any value must be calculated in reference to Q3.



Example: Line of best fit

From the previous example estimate the trend sales figure for Q4 in year 4.

This corresponds to Q16 in the example which is 13 quarters after the starting point.

$$y (\text{Sales}) = 27.38 + 3.96x$$

$$y (\text{Sales in Q4 of year 4}) = 27.38 + 3.96 (13) = 78.86$$

1.6 Line of best fit (least squares linear regression analysis)

This technique has already been explained in the context of cost estimation but it can also be used to construct a trend line for forecasting purposes. The time periods must be numbered sequentially (starting at zero or one) to provide values of x.



Example: Constructing a trend line using least squares linear regression

The following quarterly sales figures have been recorded for a company.

Sales	Quarter 1	Quarter 2	Quarter 3	Quarter 4
	₦000	₦000	₦000	₦000
Year 1	20	24	27	31
Year 2	35	39	44	47
Year 3	49	56	60	64

Required: Construct the equation of a line of best fit for this data.

Working:

x	y	x ²	xy
	₦000		₦000
1	20	1	20
2	24	4	48
3	27	9	81
4	31	16	124
5	35	25	175
6	39	36	234
7	44	49	308
8	47	64	376
9	49	81	441
10	56	100	560
11	60	121	660
12	64	144	768
78	496	650	3,795
= Σx	= Σy	= Σx²	= Σxy

$$b = \frac{n \sum xy - \sum x \sum y}{n \sum x^2 - (\sum x)^2}$$

$$b = \frac{12(3,795) - (78)(496)}{12(650) - (78)^2}$$

$$b = \frac{45,540 - 38,688}{7,800 - 6,084} = \frac{6,852}{1,716} = 3.99$$

$$a = \frac{\sum y}{n} - \frac{b \sum x}{n}$$

$$a = \frac{496}{12} - \frac{3.99(78)}{12}$$

$$a = 41.33 - 25.94 = 15.39$$

Line of best fit:

$$y = a + bx$$

$$y = 15.39 + 3.99x$$

1.7 Lines of best fit compared

Care must be taken when comparing the sales values predicted by each approach.

The centred moving averages approach results in the loss of data from each end of the original data range. The first data point on the straight line is now at Q3 of year 1. This becomes the value where $x = \text{zero}$.

There is no loss of data when using least squares linear regression. The “**a**” value found is where the straight line cuts the y axis, i.e. where $x = \text{zero}$. This is one quarter behind the first observation.

This is a bit difficult to visualise at first. Study the following example carefully to make sure that you can see where the values come from.



Example: Comparison of trend lines

The previous examples result in the following lines of best fit under each method.

These have been extrapolated forward to provide forecast data for the next four quarters.

		Line of best fit		
		Least squares method		Centred moving average method
		$y = 15.39 + 3.99x$	x^1	$y = 27.38 + 3.96x$
	x			
Q1, Year 1	1	19.37		
Q2, Year 1	2	23.36		
Q3, Year 1	3	27.36	0	27.38
Q4, Year 1	4	31.35	1	31.34
Q1, Year 2	5	35.34	2	35.30
Q2, Year 2	6	39.34	3	39.26
Q3, Year 2	7	43.33	4	43.22
Q4, Year 2	8	47.32	5	47.18
Q1, Year 3	9	51.32	6	51.14
Q2, Year 3	10	55.31	7	55.10
Q3, Year 3	11	59.30	8	59.06
Q4, Year 3	12	63.29	9	63.02
Forecasts:				
Q1, Year 4	13	67.29	10	66.98
Q2, Year 4	14	71.28	11	70.94
Q3, Year 4	15	75.27	12	74.90
Q4, Year 4	16	79.27	13	78.86

$x^1 = \text{centred values of } x$

Either of these lines can provide a basis for further analysis to find the seasonal variations. This chapter continues by using the trend data found by the centred moving average method.

2 SEASONAL VARIATIONS

Section overview

Introduction

The additive model

The proportional model

2.1 Introduction

The trend line on its own is not sufficient to make forecasts for the future. We also need estimates of the size of the 'seasonal' variation for each of the different seasons.

Consider the two examples above:

In the first example we need an estimate of the amount of the expected daily variation in sales, for each day of the week; and

In the second example we need to calculate the variation above or below the trend line for each season or quarter of the year.

A 'seasonal variation' can be measured from historical data as the difference between the actual historical value for the time period, and the corresponding trend value.

The seasonal variation is then used to adjust a forecast trend value.

There are two models used to estimate seasonal variation:

The additive model; and

The proportional model.

2.2 The additive model

This model assumes that seasonal variations above and below the trend line in each cycle adds up to zero. Seasonal variations below the trend line have a negative value and variations above the trend line have a positive value.

The seasonal variation for each season (or daily variation for each day) is estimated as follows, when the additive assumption is used:

Calculate the difference between the moving average value and the actual historical figure for each time period;

Group these seasonal variations into the different seasons of the year (days of the week; months or quarters of the year);

Calculate the average of these seasonal variations for each season (or day; month; quarter);

if the total seasonal variations for the cycle do not add up to zero the difference is spread evenly across each season (or day; month; quarter); and

This adjusted figure is the seasonal variation.



Example: Additive model

Using the previous example for quarterly sales, actual sales and the corresponding moving average value were as follows:

Quarter	Trend ₦000	Actual sales in the quarter ₦000	Variation (Actual – Moving average) ₦000
Year 1: Q3	27.375	27	-0.375
Year 1: Q4	31.125	31	-0.125
Year 2: Q1	35.125	35	-0.125
Year 2: Q2	39.250	39	-0.250
Year 2: Q3	43.000	44	1.000
Year 2: Q4	46.875	47	0.125
Year 3: Q1	51.000	49	-2.000
Year 3: Q2	55.125	56	0.875

The seasonal variation (daily variation) is now calculated as the average seasonal variation for each day, as follows:

Variation	Q1 ₦000	Q2 ₦000	Q3 ₦000	Q4 ₦000	Total ₦000
Year 1			-0.375	-0.125	
Year 2	-0.125	-0.250	1.000	0.125	
Year 3	-2.000	0.875			
Average	-1.063	0.313	0.313	0.0	-0.437
Adjustment:	0.10925	0.10925	0.10925	0.10925	0.437
Seasonal adjustment	-0.95375	0.42225	0.42225	0.10925	0

The seasonal variations can then be used, with the estimated trend line, to make forecasts for the future.



Example: Forecast sales

The forecast for the trend value of sales in Q4 in year 4 is 78.86.

The estimated sales in this quarter are:

	₦000
Trend value	78.86
Quarter 4 adjustment (rounded)	0.11
Sales forecast	<u>78.97</u>

2.3 The proportional model

This model expresses the actual value in each season as a proportion of the trend line value.

When a proportional model is used to calculate seasonal variations, rather than the additive model, the seasonal variations for each time period are calculated by dividing the actual data by corresponding moving average or trend line value.

The sum of the proportions for each time period must add up to 1. This means that the total of the proportions quarterly data must sum to 4. If this is not the case the difference is spread evenly over each quarter.



Example: Proportional model

Using the previous example for quarterly sales, actual sales and the corresponding moving average value were as follows:

Quarter	Trend	Actual sales in the quarter	Seasonal variation: actual sales as a proportion of the moving average
	₦000	₦000	₦000
Year 1: Q3	27.375	27	0.986
Year 1: Q4	31.125	31	0.996
Year 2: Q1	35.125	35	0.996
Year 2: Q2	39.250	39	0.994
Year 2: Q3	43.000	44	1.023
Year 2: Q4	46.875	47	1.003
Year 3: Q1	51.000	49	0.961
Year 3: Q2	55.125	56	1.016

The seasonal variation (daily variation) is now calculated as the average seasonal variation for each day, as follows:

Variation	Q1	Q2	Q3	Q4	Total
	₦000	₦000	₦000	₦000	₦000
Year 1			0.986	0.996	
Year 2	0.996	0.994	1.023	1.003	
Year 3	0.961	1.016			
Average	0.978	1.005	1.004	0.999	3.986
	0.00375	0.00375	0.00375	0.00375	0.015
	0.98175	1.00775	1.00775	1.00275	4.000



Example: Forecast sales

The forecast for the trend value of sales in Q4 in year 4 is 78.86.

The estimated sales in this quarter are:

	N000
Trend value	78.86
Quarter 4 adjustment (rounded)	<u>×1.003</u>
Sales forecast	<u>79.01</u>

3 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Construct a time series;

Identify and draw the trend line;

Derive the line of best fit using centred moving averages or least squares linear regression analysis;

Use the additive model to make forecasts; and

Use the proportional model to make forecasts.

Budgeting

Contents

- 1 The budgeting process
- 2 Preparing functional budgets
- 3 Cash budgets and cash flow forecasts
- 4 Master budget
- 5 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making	
	2	Budgeting
	a	Explain the importance of budgeting system.
	b	Describe the stages in the budgeting process.
	c	Explain the importance of principal budget factor.
	d	Prepare simple functional budgets.
	e	Prepare simple cash budget.
	f	Prepare simple master budget.

Exam context

This chapter explains the process of budgeting and various budgeting approaches. It also explains the role of budgeting in influencing the behaviour of workers.

By the end of this chapter you should be able to:

- Explain the purposes of budgeting;
- Construct functional budgets from information provided;
- Construct a cash budget from information provided; and
- Construct a master budget from information provided.

1 THE BUDGETING PROCESS

Section overview

Introduction to budgeting

- Preparing the budget
- Principal budget factor
- Stages in the budget process

1.1 Introduction to budgeting

Planning framework

A business entity should plan over the long term, medium-term and short-term. Long-term planning, or strategic planning, focuses on how to achieve the entity's long-term objectives.

Medium-term or tactical planning focuses on the next year or two.

Short-term or operational planning focuses on day-to-day and week-to-week plans.

Budgets are medium-term plans for the business, expressed in financial terms. A typical budget is prepared annually, and the overall budget is divided into control periods for the purpose of control reporting.

The nature of budgets

A budget is a formal plan, expressed mainly in financial terms and covering all the activities of the entity. It is for a specific period of time, typically one year. When budgets are prepared annually, they are for the next financial year.

The total budget period (one year) may be sub-divided into shorter control periods of one month or one quarter (three months).

Purposes of budgeting

Budgets have several purposes

To convert long-term plans (strategic plans) into more detailed shorter term (annual) plans.

To ensure that planning is linked to the long-term objectives and strategies of the organisation.

To co-ordinate the actions of all the different parts of the organisation, so that they all work towards the same goals. (This is known as 'goal congruence'). One of the benefits of budgeting is that it covers all activities, so the plan should try to ensure that all the different activities are properly co-ordinated and working towards the same objective.

To communicate the company's plans to the individuals (managers and other employees) who have to put the plans into action.

To motivate managers and employees, by setting targets for achievement, and possibly motivating them with the incentive of bonuses or other rewards if the targets are met.

To provide guidelines for authorising expenditure. Expenditure might not be permitted unless it has been planned in the budget or unless it is within the budgeted expenditure limits for the department.

To identify areas of responsibility for implementing the plans. For each part of the

budget, an individual manager should be made responsible for achieving the budget targets for performance.

To provide a benchmark against which actual performance can be measured.

To control costs. Costs can be controlled by comparing budgets with actual results and investigating any differences (or variances) between the two. This is known as **budgetary control**.

1.2 Preparing the budget

Preparing the annual budget is a major activity for many entities. In many medium-sized and large companies, there is a well-defined process for budget preparation, because a large number of individuals have to co-ordinate their efforts to prepare the budget plans. The budgeting process may take several months, from beginning to eventual approval by the board of directors.

The budget process might be supervised and controlled by a special committee (the **budget committee**). This consists of senior managers from all the main areas of the business. The committee co-ordinates the various functional budgets submitted to it for review, and gives instructions for changes to be made when the draft budgets are unsatisfactory or the functional budgets are not consistent with each other.

Although the budget committee manages the budget process, the functional budgets are usually prepared by the managers with responsibility for the particular aspect of operations covered by that functional budget.

Budget Officer

To coordinate the budgeting process on behalf of the budget committee, a manager, usually the management accountant or the head of the accounting function, is normally designated as budget officer. The duties of the budget officer include:

- He circulates the budget guidelines on behalf of the budget committee to all functional managers;
- He acts as a secretary of budget committee.
- He revises and amends the budget manual as directed by the budget committee from time to time;
- He designs appropriate forms, schedules and reports necessary in the budgeting process;
- He receives and scrutinises the budgets from functional managers to ensure they are in line with the budget guideline;
- He has to prepare summary budget, i.e., the master budget from the functional budgets.
- He circulates the approved budget to appropriate functional managers;
- He prepares monthly budgetary control reports and submits to the budget committee and appropriate functional managers

Budget manual

There should be a budget manual or budget handbook to guide everyone involved in the budgeting process. This should set out:

The key objectives of the budget;

The planning procedures and the timetables to follow when preparing the budget;

Instructions about the budget details that must be included in the functional budgets;

Responsibilities for preparing the functional budgets (sales budget, production budget, materials budgets, labour usage budget and overhead expenditure budgets); and

Details of the budget approval process. The budget must be approved by the budget committee and then by the board of directors.

The master budget

The 'master budget' is the final approved budget. It is usually presented in the form of financial statements - a budgeted income statement and a budgeted statement of financial position for the end of the financial year.

However, the master budget is the result of a large number of detailed plans, many of them prepared at a departmental or functional level. To prepare the master budget, it is therefore necessary to prepare functional budgets first.

Functional budgets

A functional budget is a budget for a particular aspect of the entity's operations. The functional budgets that are prepared vary with the type of business and industry. In a manufacturing company, functional budgets should include:

A sales budget;

A production budget;

A budget for production resources and resource costs (such as a materials cost budget and a labour cost budget);

A materials purchases budget; and

Expenditure budgets for every overhead cost centre and general overhead costs.

1.3 Principal budget factor

The budgeting process begins with the preparation of functional budgets, which must be co-ordinated and consistent with each other. To make sure that functional budgets are co-ordinated and consistent, the first functional budget that should be prepared is the budget for the principal budget factor.

The principal budget factor (also called the key budget factor) is the factor in the budget that will set a limit to the volume and scale of operations.

Sales demand (sales volume) as the principal budget factor

Normally, the principal budget factor is the expected sales demand. When this happens, the expected sales demand should set a limit on the volume of production (or volume of services). A company might have the capacity to increase its production and output, but producing larger quantities has no purpose unless the extra quantities can be sold.

A company will therefore prepare a budget on the basis of the sales volumes that it hopes or expects to achieve. When sales demand is the principal budget factor, the sales budget is the first functional budget that should be prepared.

A principal budget factor other than sales volume

Sometimes, there is a different limitation on budgeted activity. There might be a shortage of a key resource, such as machine time or the availability of skilled labour. When there is a shortage of a resource that will set a limit on budgeted production volume or budgeted activity, the first functional budget to prepare should be the budget for that resource.

In government, the principal budget factor for each government department is often an expenditure limit for the department. The department must then prepare a budget for the year that keeps the activities and spending plans of the department within the total expenditure limit for the department as a whole.

1.4 Stages in the budget process

The budgeting process for a manufacturing company is probably more complex than for many other types of organisation, and manufacturing company budgets are more likely to be the subject of an examination question than budgets for companies in other industries. This chapter therefore describes the budgeting process for a manufacturing company.

The stages in setting the budget might be as follows:

Stage 1: Identify the principal budget factor (or key budget factor). The principal budget factor is often sales volume;

Stage 2: Prepare the functional budget or plan for the principal budget factor. Usually, this means that the first functional budget to prepare is the sales budget; All the other functional budgets should be prepared within the limitation of the principal budget factor. For example, even if the company has the capacity to produce more output, it should not produce more than it can sell (unless it formally decides to increase the size of the finished goods inventory, in which case the production volume will be higher than the sales volume);

Stage 3: Prepare the other functional budgets, in logical sequence where necessary. When the sales budget has been prepared, a manufacturing organisation can then prepare budgets for inventories (= plans to increase or reduce the size of its inventories), a production budget, labour usage budgets and materials usage and purchases budgets. Expenditure budgets should also be prepared for overhead costs (production overheads, administration overheads and sales and distribution overheads). Overhead costs budgets are usually prepared for each cost centre individually;

Stage 4: Submit the functional budgets to the budget committee for review and approval. The functional budgets are co-ordinated by the budget committee, which must make sure that they are both realistic and consistent with each other;

Stage 5: Prepare the 'master budget'. This is the budget statement that summarises the plans for the budget period. The master budget might be presented in the form of: a budgeted income statement for the next financial year;

a budgeted statement of financial position as at the end of the next financial year; and a cash budget or cash flow forecast for the next financial year.

It should be possible to prepare the master budget statements from the functional budgets;

Stage 6: The master budget and the supporting functional budgets should be submitted to the board of directors for approval. The board approves and authorises the budget;

Stage 7: The detailed budgets are communicated to the managers responsible for their implementation; and

Stage 8: Control process. After the budget has been approved, actual performance should be monitored by comparing it with the budget. Actual results for the period should be recorded and reported to management. These results should be compared with the budget, and significant differences should be investigated. The reasons for the differences ('variances') should be established, and where appropriate control measures should be taken. Comparing actual results with the budget therefore provides a system of control. The managers responsible for activities where actual results differ significantly from the budget will be held responsible and accountable.

The planning process (budgeting) should therefore lead on to a management monitoring and control process (budgetary control).

The next section describes the approach that can normally be used to prepare functional budgets for a manufacturing organisation. In practice, budgets are usually prepared with a computer model, such as a **spreadsheet**. However, you need to understand the logic of budget preparation.

2 PREPARING FUNCTIONAL BUDGETS

Section overview

The sales budget

- Cost budgets
- The production budget
- The materials usage budget
- The materials purchases budget
- The labour usage budget
- Budgeted profit or loss account

2.1 The sales budget

The sales budget is the plan for the volume and value of sales in the budget period. It is prepared for each product individually, in units of sale and sales revenue, and for sales revenue in total.

It is calculated for each product simply by multiplying the volume of sales in units by the budgeted sales price per unit.



Example: Sales budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The sales price and expected sales volume for each product next year are as follows:

	Product P	Product Q
Sales price per unit	₦400	₦500
Budgeted sales volume	2,000 units	3,000 units

A sales budget can be prepared as follows:

Product	Budgeted sales quantity	Budgeted sales price	Budgeted sales revenue
	units	₦	₦
P	2,000	400	800,000
Q	3,000	500	1,500,000
Total			<u>2,300,000</u>

A sales budget might be prepared by making adjustments to actual sales in the current financial year.



Example: Sales budget

A company is preparing its sales budget for the year. In the current financial year it expects that total sales will be ₦2.6 million. Next year, it hopes to raise its selling prices by 3% and to increase sales volume by 5%.

The sales budget for next year is therefore: ₦2.6 million \times 1.03 \times 1.05 = ₦2.8 million (to the nearest ₦100,000).

2.2 Cost budgets

When sales volume is a key factor, the cost budgets will all flow from the number to be sold and must be prepared in the following order:

Production budget

This is the number of units to be produced in the period. This number starts with the number of units to be sold which is then adjusted for inventory movement. (For example, if 100 items are to be sold, in the absence of other information, the company would need to make 100 items. However, if 20 items can be taken from inventory, the company would only need to make 80 items).

Materials usage budget

This can only be constructed after the number of units to be made is known.

Materials purchases budget

This can only be constructed after the amount of raw material to be used is known.

Labour usage budget

This can only be constructed after the number of units to be made is known.

You can see from the above that the labour usage budget can be prepared before the materials usage budget if you prefer.

The various functional budgets can be combined to produce a profit or loss account for the period.

The process will be explained with a series of examples building the functional budgets and budgeted profit or loss account of Enugu Plastics limited.

2.3 The production budget

The production budget is calculated initially in units of output, although a budget for production costs can be prepared when production quantities have been decided.

The production budget for each product in units is the sales budget in units adjusted for any planned changes in finished goods inventories.

The production budget in units is prepared for each product, as follows:



Illustration: Production budget

	Units
Sales budget in units	X
Budgeted closing inventory	X
Opening inventory	(X)
Production budget	<u>X</u>



Example: Production budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 2,000 units of Product P and 3,000 units of Product Q.

The following opening and closing inventories are budgeted:

	Opening	Closing
Finished goods:	Units	Units
P	200	300
Q	150	100

A production budget can be prepared as follows:

	Product P	Product Q
	units	units
Sales budget	2,000	3,000
Budgeted closing inventory	300	100
	<u>2,300</u>	<u>3,100</u>
Opening inventory	(200)	(150)
Production budget	<u>2,100</u>	<u>2,950</u>



Practice question

1

A company makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 40,000 units of Product P and 27,000 units of Product Q.

It has been decided that inventory of Product P should be reduced to 2,000 units by the end of the budget period, and inventory of Product Q should be increased to 1,500 units.

It expects opening inventory of finished goods to be 4,000 units of Product P and 500 units of Product Q.

Prepare a production budget.

2.4 The materials usage budget

After the production budget has been prepared, budgets can be prepared for the resources required to achieve the production targets.

Production resources budgets will include a materials usage budget, a direct labour usage budget and possibly a machine hours budget.

Separate budgets can be prepared for each production centre, and these can be added together to create the total production budget. For example, if a manufacturing process consists of a machining department, a finishing department and an assembly department, production budgets will be prepared for each department separately, and these will then be combined to produce a total production department budget.

The materials usage budget is a budget for the quantities of materials that will be used. It is a statement of the quantities of direct materials required for production, and their cost.

The usage budget is prepared for each item of material separately, and a total cost of the materials used should also be shown.



Example: Materials usage budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company has determined that it will make 2,100 units of Product P and 2,950 units of Product Q next year.

The products are expected to use raw materials as follows:

	Product P	Product Q
Direct materials	Usage (kgs)	Usage (kgs)
Material A (₦40 per kg)	2	0.5
Material B (₦50 per kg)	0.5	3
Material C (₦70 per kg)	1	-

A material usage budget can be prepared as follows:

	A (kgs)	B (kgs)	C (kgs)
Usage to make 2,100 units of P			
2,100 units × 2 kgs	4,200		
2,100 units × 0.5 kgs		1,050	
2,100 units × 1 kgs			2,100
Usage to make 2,950 units of Q			
2,950 units × 0.5 kgs	1,475		
2,950 units × 3 kgs		8,850	
Usage in kgs	5,675	9,900	2,100
Cost per kg	₦40	₦50	₦70
Usage in naira	227,000	495,000	147,000
Total cost			<u>₦869,000</u>



Practice question

2

A company makes and sells two products, Product S and Product T. Its production budget for next year is to make 40,000 units of Product S and 10,000 units of Product T.

The materials required to make one unit of each product, and their cost, are as follows:

	Product S	Product T	Cost per kilo
	kilos	kilos	₦
Material M1	2.0	3.0	400
Material M 2	2.5	1.5	600

Prepare a materials usage budget.

2.5 The materials purchases budget

The budgeted cost of materials for use in production is not the same as the quantity and cost of materials that will be purchased. Material purchases and material usage will be different if there are plans to increase or reduce raw materials inventories.

The materials purchases budget is the budget for the purchase cost of materials that will be purchased in the budget period. The materials purchases budget might be prepared for all materials, direct and indirect, or for direct materials only.

The purchases budget differs from the materials usage budget by the amount of the planned increase or decrease in inventory levels of materials in the budget period.

The purchase quantities are calculated first. Purchase quantities are calculated as follows, for each item of material:



Illustration: Materials purchases budget

	kgs
Material usage	X
Budgeted closing inventory	X
Opening inventory	(X)
	<hr/>
Purchases budget	X
	<hr/>

The purchase quantities for each item of material are converted into a purchases cost at the budgeted purchase price for the item of material.

The total material purchases budget (in ₦) is the sum of the purchases budget for each of the individual items of material.



Example: Materials purchases budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company expects to use raw materials in the coming year as follows:

Direct materials	Usage (kgs)	
Material A	5,675	
Material B	9,900	
Material C	2,100	-

The following opening and closing inventories are budgeted:

Materials:	Cost per kg (₦)	Opening kgs	Closing kgs
A	40	500	600
B	50	550	400
C	70	100	250

A material purchases budget can be prepared as follows:

	A (kgs)	B (kgs)	C (kgs)
Usage	5,675	9,900	2,100
Closing inventory	600	400	250
	<hr/>	<hr/>	<hr/>
	6,275	10,300	2,350
Opening inventory	(500)	(550)	(100)
	<hr/>	<hr/>	<hr/>
Purchases (kgs)	5,775	9,750	2,250
Cost per kg (₦)	40	50	70
	<hr/>	<hr/>	<hr/>
Purchases (₦)	231,000	487,500	157,500
	<hr/>	<hr/>	<hr/>
Total cost			<u>₦876,000</u>

**Practice question****3**

A company makes and sells two products, Product X and Product Y. Its production budget for next year is to make 20,000 units of Product X and 15,000 units of Product Y.

The materials required to make one unit of each product, and their costs are as follows:

	Product X	Product Y	Cost per litre
	litres	litres	₦
Material M3	0.5	1.5	3
Material M4	1.0	2.0	4

The company expects to have opening inventory of 3,000 litres of Material M3 and 2,000 litres of Material M4. It plans to have closing inventory of 3,500 litres of Material M3 and 1,200 litres of Material M4

Required

Prepare the materials usage and purchases budget for the year.

**Practice question****4**

A company produces Products A and B and the budgeted production in the coming year is 5,000 units of A and 10,000 units of B.

Products A and B require the following quantities of raw materials to produce one unit.

	Product A	Product B
	per unit	per unit
Raw material X	5 kg	4 kg
Raw material Y	7 kg	3 kg

Raw material X costs ₦10 per kg and raw material Y costs ₦20 per kg.

Data relating to opening and closing inventory is as follows:

	Raw material	
	X	Y
Opening inventory	10,000	8,000
Closing inventory	8,000	4,000

Required

Prepare the materials usage and purchases budget for the year.

2.6 The labour usage budget

Direct labour usage budget

The direct labour usage budget is prepared in a similar way to the materials usage budget. It is a statement of the quantities of direct labour required for production, and its cost.

The budget is prepared for different grades of labour separately, but the total labour cost should also be shown.

The expected hours of work to make the budgeted production quantities of each product should be calculated separately for each grade of labour and then for all the products in total. The total budget in hours for each grade of labour is converted into a cost at the standard/budgeted rate per hour for the grade of labour.



Example: Labour usage budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company has determined that it will make 2,100 units of Product P and 2,950 units of Product Q next year.

The products are expected to require labour as follows:

Direct labour	Usage	Usage
	(hrs)	(hrs)
Product	P	Q
Grade X (₦100 per hr.)	0.25	0.5
Grade Y (₦80 per hr.)	0.25	0.75

A labour usage budget can be prepared as follows:

	Grade X (hrs)	Grade Y (hrs)
Usage to make 2,100 units of P		
2,100 units × 0.25 hrs	525	
2,100 units × 0.25 hrs		525
Usage to make 2,950 units of Q		
2,950 units × 0.5 hrs	1,475	
2,950 units × 0.75 hrs		2,212.5
Usage in hrs	2,000	2,737.5
Cost per hr (₦)	100	80
Usage in naira	200,000	219,000
Total cost(₦)		419,000



Practice question

5

A company makes and sells two products, Product S and Product T. Its sales budget is to sell 40,000 units of Product S and 10,000 units of Product T.

The expected opening inventories of finished goods are 500 units of Product S and 1,000 units of Product T, and the plan is to double finished goods inventories by the end of the budget period.

The direct labour hours required to make one unit of each product, and their cost, are as follows:

	Product S	Product T	Cost per hour
	hours	hours	₦
Grade G1 labour	0.2	0.6	20
Grade G2 labour	0.3	0.8	16

Prepare the direct labour usage budget.

Indirect labour costs

Budgets must also be prepared for indirect labour. It is usual to include indirect labour costs within the budget for the overhead cost centre or department where the employees work.

2.7 Budgeted profit or loss account

The functional budgets can be combined to produce a budgeted profit or loss account for the period. This is part of the master budget which is explained in more detail in section 4 of this chapter.

Full details from the Enugu Plastics examples are given below for your convenience.



Example: Preparing a functional budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 2,000 units of Product P at a sales price of ₦400 per unit and 3,000 units of Product Q at a sales price of ₦500 per unit.

The following cost information is expected to apply in the next year:

	Product P		Product Q	
	Usage (kgs)	Cost (₦)	Usage (kgs)	Cost (₦)
Direct materials				
Material A (₦40 per kg)	2	80	0.5	20
Material B (₦50 per kg)	0.5	25	3	150
Material C (₦70 per kg)	1	70	-	-
		<u>175</u>		<u>170</u>
Direct labour	Usage (hrs)		Usage (hrs)	
Grade X (₦100 per hr.)	0.25	25	0.5	50
Grade Y (₦80 per hr.)	0.25	20	0.75	60
		<u>45</u>		<u>110</u>
Unit cost		<u>220</u>		<u>280</u>

The following opening and closing inventories are budgeted:

	Opening			Closing	
Finished goods:	Cost (₦)	Units	Total (₦)	Units	Total (₦)
P	220	200	44,000	300	66,000
Q	280	150	42,000	100	28,000
			<u>86,000</u>		<u>94,000</u>
Materials:	Cost	kgs		kgs	
A	40	500	20,000	600	24,000
B	50	550	27,500	400	20,000
C	70	100	7,000	250	17,500
			<u>54,500</u>		<u>61,500</u>
Total inventory			<u>140,500</u>		<u>155,500</u>



Example: Budgeted profit or loss account

The following additional information has been derived from the above during the budget process:

	Product	Sales price (₦)	Units	₦
Sales budget	P	400	2,000	800,000
	Q	500	3,000	1,500,000
				2,300,000
Purchases				876,000
Labour usage				419,000

The above figures can be used to produce a budgeted profit or loss account for the year as follows:

	₦	₦
Sales budget		2,300,000
Cost of sales:		
Opening inventory	140,500	
Purchases	876,000	
Labour usage	419,000	
	1,435,500	
Closing inventory	(155,500)	
		(1,280,000)
Budgeted gross profit		1,020,000

The budgeted gross profit can be checked as follows:

	(Units × (Sales price – Unit cost))	₦
Profit from selling P	(2,000 units × (400 – 220))	360,000
Profit from selling Q	(3,000 units × (500 – 280))	660,000
		1,020,000

3 CASH BUDGETS AND CASH FLOW FORECASTS

Section overview

- Cash budgets
- Format of a cash budget
- Receipts from credit sales
- Payments to suppliers

3.1 Cash budgets

A cash budget is a detailed plan of cash receipts and cash payments during a planning period. The planning period is sub-divided into shorter periods, and the cash receipts and payments are forecast/planned for each of the sub-divisions of time.

The cash budget might be prepared on a monthly basis, or possibly a quarterly basis as part of the annual master budget but many businesses also prepare cash flow forecasts for shorter periods, for example the next week, or weekly cash flows for the next month.

The main uses of a cash budget are as follows:

To forecast how much cash receipts and payments are expected to be over the planning period;

To learn whether there will be a shortage of cash at any time during the period, or possibly a cash surplus;

If there is a forecast shortage of cash, to consider measures in advance for dealing with the problem - for example by planning to defer some purchases of non-current assets, or approaching the bank for a larger bank overdraft facility; and

To monitor actual cash flows during the planning period, by comparing actual cash flows with the budget.

Cash flow forecasts

Cash flow forecasts, like cash budgets, are used to predict future cash requirements, or future cash surpluses. However, unlike cash budgets they are prepared throughout the financial year, and are not a part of a formal budget plan.

The main objectives of cash flow forecasting, like the purposes of a cash budget, are to:

Make sure that the entity is still expected to have sufficient cash to meet its payment commitments as they fall due;

Identify periods when there will be a shortfall in cash resources, so that financing can be arranged;

Identify whether there will be a surplus of cash, so that the surplus can be invested; and

Assess whether operating activities are generating the cash that is expected from them.

The main focus of cash flow forecasting is likely to be operating cash flows, although some investing and financing cash flows might also be significant.

There is no real difference in the preparation of a cash flow budget and a cash flow forecast in terms of exam questions.

3.2 Format of a cash budget

A cash budget is a budget of cash receipts and cash payments during each control period of the budget. Cash budgets might be prepared on a month-by-month basis. However, cash budgets might be prepared on a week-by-week basis, or even a day-by-day basis if required for short-term planning.

A cash budget can be prepared by producing a table for the cash receipts and cash payments, containing each item of cash receipt and each item of cash payment. The cash receipts and then the cash payments should be listed in rows of the table, and each column of the table represents a time period, such as one month.

A typical format for a monthly cash budget is shown below.



Example: Cash flow budget

	January	February	March
	₦	₦	₦
Cash receipts			
Cash sales	5,000	6,000	5,000
Cash from credit sales	72,000	64,000	64,000
Other cash receipts	4,000	2,000	2,000
Total cash receipts	81,000	72,000	71,000
Cash payments			
Cash purchases	6,000	6,600	6,200
Payments for credit purchases	8,400	9,000	9,900
Rental payments	-	30,000	-
Wages and salaries	23,000	23,000	23,000
Dividend payments	-	-	40,000
Other payments	3,000	73,000	13,000
Total cash payments	(40,400)	(141,600)	(92,100)
Receipts minus payments (net cash flow)	40,600	(69,600)	(21,100)
Cash balance at the beginning of the month	45,000	85,600	16,000
Cash balance at the end of the month	85,600	16,000	(5,100)

The cash budget should show all cash items of receipt or payment, including:

Cash from issuing shares;

Interest or dividends received from investments;

Interest payments, but only in the months that interest is actually paid;

Taxation payments but only in the months that tax is actually paid; and

Dividend payments.

Receipts and payments must be recorded in the month when they are expected to occur. Non-cash expenditures, such as depreciation of non-current assets, must not be included.

3.3 Receipts from credit sales

One of the more difficult calculations in a cash budget is the cash receipts from trade receivables. When sales are on credit, payments will not be received until a later month.

A question will provide you with a collection pattern for cash on credit sales. This collection pattern must be applied to the monthly sales figures to identify which month the cash is collected.

There might also be information about bad debts which are dealt with easily by reducing the cash to be received. A question might also require you to estimate sales figures for a number of periods before being able to calculate the cash receipts.



Example: Receipts from credit sales

A company is in the process of preparing a cash budget for January to March 20X5.

The company has actual sales in October and November 20X4 of ₦100,000.

December sales are expected to remain at this level but a new advertising initiative to be launched on 1 January 20X5 are expected to lead to a month on month increase in sales of ₦10,000 per month for the first 6 months of next year.

10% of sales are for cash, 40% is collected in the next month and the balance (net of bad debts. of 1%) is collected in the following month. This means that 49% of the cash (being the remaining 50% less 1% bad debt) is collected in the second month.

A table of workings for cash receipts can now be prepared, as follows (with all figures in ₦000):

		Cash receipts:				
	Sales	Nov	Dec	Jan	Feb	Mar
Nov	100	10	40	49		
Dec	100		10	40	49	
Jan	110			11	44	53.9
Feb	120				12	48
Mar	130					13
				100	105	114.9

Note that it is necessary to find the sales figures for each month before the cash flows can be found.



Practice question

6

	Product P (units)	Product Q (units)
November	1,500	2,000
December	2,000	3,000
January	1,000	2,000
February	2,000	3,000
March	3,000	4,000

Product P is sold for ₦20 per unit, and Product Q for ₦30.

All sales are on credit. 20% of total sales are paid for in the month of sale, and 40% in the following month.

The rest, excluding bad debts, are paid at the end of the second month.

Bad debts are 2% of total sales and are written off at the end of the second month following sale.

Calculate the cash receipts expected in January, February and March.

3.4 Payments to suppliers

Payments to suppliers can be calculated in a similar way to cash receipts from credit sales. This can be a little tricky.

The starting point for calculating payments in each month is the purchases in each month. When calculating this figure you might need to take cost structures and inventory policies into account.

Having established total purchases, you can then work out when the payments will be made. Remember that bad debts are irrelevant as all goods purchased must be paid for whether or not the cash is received from their subsequent sale.



Example: Payments for credit purchases

A company is in the process of preparing a cash budget for January to March 20X5.

The company has actual sales in October and November 20X4 of ₦100,000.

December sales are expected to remain at this level but a new advertising initiative to be launched on 1 January 20X5 are expected to lead to a month on month increase in sales of ₦10,000 per month for the first 6 months of next year.

Cost of sales is budgeted to be 60% of the sales figure in each month.

It is the company's policy to have enough closing inventory at each month end to cover 10% of the next month's sales.

(This means that if sales in month 2 are expected to be 100 the closing inventory at the end of month 1 will be 6 being $10\% \times 100 \times 60\%$).

Half of all purchases in each month are paid for in that month and the remaining balance is paid in the next month.

The cash payments made in January, February and March can be calculated as follows:



Example (continued): Payments for credit purchases

The first step is to calculate the purchases figures for each month by constructing a cost of sale working.

This will be done in stages to allow you to understand the process.

Cost of sales in each month is 60% of the sales figure for that month.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory					
Purchases					
Closing inventory					
Cost of sales	60.0	60.0	66.0	72.0	78.0

The closing inventory at the end of each month is 10% of the next month's sales multiplied by 60% (to reduce selling price to cost). A short cut way of calculating this is to simply take 10% of the following month's cost of sales figure.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory					
Purchases					
Closing inventory					
Cost of sales	60.0	60.0	66.0	72.0	78.0

The closing inventory at the end of each month becomes the opening inventory for the next month. These figures can be entered and the purchases figures are found as balancing figures.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory	6.0	6.0	6.6	7.2	7.8
Purchases	60.0	60.6	66.6	72.6	78.6
Closing inventory	(6.0)	(6.6)	(7.2)	(7.8)	(8.4)
Cost of sales	60.0	60.0	66.0	72.0	78.0

A table of workings for cash payments can now be prepared, as follows (with all figures in ₦000):

		Cash payments			
Purchases		Dec	Jan	Feb	Mar
Dec	60.6	30.3	30.3		
Jan	66.6		33.3	33.3	
Feb	72.6			36.3	36.3
Mar	78.6				39.3
			63.3	69.6	75.6

4 MASTER BUDGET

Section overview

- Nature of the master budget
- Budgeted statement of profit or loss
- Budgeted statement of financial position

4.1 Nature of the master budget

The 'master budget' is the final approved budget. This is the budget statement that summarises the plans for the budget period. The master budget is usually presented in the form of a series of financial statements as follows:

a budgeted income statement for the next financial year;
a budgeted statement of financial position as at the end of the next financial year; and
a cash budget or cash flow forecast for the next financial year (covered in section 3 of this chapter).

The master budget combines a series of subsidiary budgets prepared for each part of the organisation into a whole.

4.2 Budgeted statement of profit or loss

A budgeted statement of profit or loss can be constructed from the functional budgets in the way described in section 2 of this chapter. Further information about depreciation policy and other operating expenses can be incorporated into this statement.

An alternative approach might involve the use of profit or loss account ratios. These ratios can be used to state the relationship between items in the statement of profit or loss and the sales figure.



Illustration: Statement of profit or loss ratios

	%
Sales	100
Cost of sales	(60)
Gross profit margin	40
Administrative expenses	(10)
Distribution costs	(15)
Net profit	15



Example: Budgeted statement of profit or loss

A business is preparing its budget for the next financial year.

The company is budgeting revenue of ₦1,300,000.

The company aims to earn a gross profit margin of 75% of sales.

Operating costs are budgeted as the following percentages of sales:

Administrative expenses	25%
Distribution costs	20%
Finance expense	4%

A budgeted statement of profit or loss can be prepared as follows:

	%	₦
Sales	100	1,300,000
Cost of sales	(25)	(325,000)
Gross profit	75	975,000
Administrative expenses	(25)	(325,000)
Distribution costs	(20)	(260,000)
Finance expense	(4)	(52,000)
Budgeted profit	26	338,000

4.3 Budgeted statement of financial position

Constructing a statement of financial position requires information about the closing position for assets and liabilities.

A key element of the construction of the budgeted statement of financial position is calculation of budgeted closing receivables and payables. There are different ways in which these might be calculated including:

Use of collection and payment periods; and

Use of information used in the construction of the cash budget.

Use of collection and payment periods

Budgeted relationships between budgeted levels of activity in the budgeted statement of profit or loss and equivalent figures in the budgeted statement of financial position can be used to construct these figures.

There are three main relationships that can be used:

The budgeted receivables collection period (the length of credit taken by, or given to, credit customers).

The budgeted payables period (average time taken to pay suppliers).

(The budgeted inventory holding period (the length of time that inventory is held before it is used or sold) can also be used to estimate the budgeted closing inventory).



Example: Budgeted receivables

A company has budgeted sales to be ₦1,200,000 in the coming year and budgeted receivables to be 3 months of sales.

Budgeted receivable at the end of the next year are found as follows:

Budgeted receivables:

Sales for the year	1,200,000
Therefore, sales per month =	100,000
Therefore, budgeted receivables at next year end (3 months sales) =	300,000

This could also have been calculated as:

$$\text{Sales} \times 3\text{m}/12\text{m} = 1,200,000 \times 3\text{m}/12\text{m} \quad 300,000$$

Note: m means month.

A similar approach can be used to find the budgeted closing inventory.



Example: Budgeted closing inventory

A company has budgeted cost of sales to be ₦600,000 for the coming year.

Closing inventory is budgeted to be sufficient to cover 2 months' sales activity.

Budgeted inventory at the end of the next year are found as follows:

Budgeted inventory

Cost of sales for the year	600,000
Therefore, cost of sales per month =	50,000
Therefore, budgeted inventory at next year end (2 months cost of sales) =	100,000

This could also have been calculated as:

$$\text{COS} \times 2\text{m}/12\text{m} = 600,000 \times 2\text{m}/12\text{m} \quad 100,000$$

Note: m means month.

Budgeted payables can be calculated in the same way from budgeted purchases.



Example: Budgeted payables

A company has budgeted purchases of ₦900,000 for the coming year.

The company intends to take 4 months credit from its suppliers.

Budgeted payables at the end of the next year are found as follows:

Budgeted payables	
Purchases	900,000
Therefore, purchases per month =	75,000
Therefore, budgeted payables at next year end (4 months purchases) =	300,000

This could also have been calculated as:

Purchases × 4m/12m = 900,000 × 4m/12m	300,000
---------------------------------------	---------

Note: m means month.

Budgeted payables must be based on budgeted purchases. If budgeted opening inventory is the same as budgeted closing inventory, purchases is the same as cost of sales. However, if the company is budgeting to change inventory level it might be necessary to calculate budgeted purchases by adjusting budgeted cost of sales by the budgeted inventory movement before the budgeted payables figure can be calculated.



Example: Budgeted payables

The following information has been extracted from a company's budget for the following year.

Sales	₦6,000,000
Budgeted gross profit margin	45%
Budgeted credit to be taken	3 months
Closing inventory at the end of the current period (and hence opening inventory for the next period)	150,000
Budgeted closing inventory at the end of the next period	250,000

The budgeted closing payables can be found as follows:

Step 1: Construct the budgeted trading account from the information provided and identify purchases as the balancing figure

Sales	6,000,000	100%
Cost of sales:		
Opening inventory	150,000	
Purchases (balancing figure)	3,400,000	
Closing inventory	(250,000)	
Cost of sales	(3,300,000)	55%
Gross profit	2,700,000	45%

Step 2: Calculate the budgeted closing payable figure

Purchases × 3m/12m = 3,400,000 × 4m/12m = 850,000

Note: m means month.

Use of information used in the construction of the cash budget

It is also possible to calculate budgeted receivables and payables for the information and workings used to construct the cash budget.



Example: Receipts from credit sales

A company is in the process of preparing a cash budget for the coming year. The company has budgeted sales in November and December to be ₦100,000.

All sales are on credit. 40% is collected in the next month and the balance is collected in the following month.

Closing receivables are calculated as follows (with all figures in ₦000):

		Collected after the year-end		
	Sales	Dec	Jan	Feb
Nov	100	40	60	
Dec	100		40	60
	↑		100	60
	↑			

Sales made before the year-end but collected after are receivables.

Receivables are 160,000 (100,000 + 60,000).



Practice question

7

A business is setting up a new branch and is preparing a budget for the first 12 months of operation.

The following information is relevant.

Forecast sales	
Months 1 to 6	10,000
Months 7 to 12 (and thereafter)	11,000
Budgeted gross profit margin	20%
Credit given to customers	2 months
Credit taken from suppliers	2 months
Month end inventories	3 months of demand
Monthly operating expenses (excluding depreciation)	1,000

At the start of the budget period a non-current asset with a carrying amount of 60,000 and useful life of 6 years is to be transferred to the branch and 40,000 cash provided.

Construct the budgeted statement of profit or loss and the budgeted statement of financial position. (The closing cash balance is to be calculated as a balancing figure).

5 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the purposes of budgeting;

Construct functional budgets from information provided;

Construct a cash budget from information provided; and

Construct a master budget from information provided.

SOLUTIONS TO PRACTICE QUESTIONS

Solution

1

	Product P units	Product Q units
Sales budget	40,000	27,000
Budgeted closing inventory	2,000	1,500
Opening inventory	(4,000)	(500)
Production budget	38,000	28,000

Solution

2

A materials usage budget can be prepared as follows:

	Material M1 kilos	Material M2 kilos	Total
To make 40,000 S	80,000	100,000	
To make 10,000 T	30,000	15,000	
Total quantities	110,000	115,000	
Price per kilo (₦)	400	600	
Total cost (₦)	44,000,000	69,000,000	113,000,000

Solution	Material M3	Material M4	3
	litres	litres	Total
To make 20,000 X	10,000	20,000	
To make 15,000 Y	22,500	30,000	
Material usage quantities	<u>32,500</u>	<u>50,000</u>	
Closing inventory	3,500	1,200	
Opening inventory	<u>(3,000)</u>	<u>(2,000)</u>	
	<u>33,000</u>	<u>49,200</u>	
Price per litre (₦)	3	4	
Total cost (₦)	<u>99,000</u>	<u>196,800</u>	<u>295,800</u>

Solution**4**

Materials usage budget	Raw material X (kgs)	Raw material Y (kgs)	Total (kgs)
To make 5,000 A	25,000	35,000	60,000
To make 10,000 B	40,000	30,000	70,000
Total quantities	65,000	65,000	130,000
Price per kilo (₦)	10	20	
Total cost (₦)	650,000	1,300,000	1,950,000

Materials purchases budget	Raw material X (kgs)	Raw material Y (kgs)	Total (kgs)
Materials usage budget	65,000	65,000	
Closing inventory	8,000	4,000	
	73,000	69,000	
Opening inventory	(10,000)	(8,000)	
Budgeted materials purchases	63,000	61,000	
Price per kilo (₦)	10	20	
Materials purchases budget (₦)	630,000	1,220,000	1,850,000

Solution**5**

A direct labour usage budget can be prepared as follows, after a production budget has been established.

	Product S units	Product T units
Sales budget	40,000	10,000
Plus: Budgeted closing inventory	1,000	2,000
Minus: Opening inventory	(500)	(1,000)
Production budget	40,500	11,000

	Grade G1 hours	Grade G2 hours	Total
To make 40,500 S	8,100	12,150	
To make 11,000 T	6,600	8,800	
Total labour hours	14,700	20,950	
Rate of pay per hour (₦)	20	16	
Total direct labour cost (₦)	294,000	335,200	629,200

Solution**6**

The total sales in each month must be calculated.

	Sales of product P			Sales of product Q			Total sales
	units	SP(₦)	₦	units	SP(₦)	₦	₦
Nov	1,500	20	30,000	2,000	30	60,000	90,000
Dec	2,000	20	40,000	3,000	30	90,000	130,000
Jan	1,000	20	20,000	2,000	30	60,000	80,000
Feb	2,000	20	40,000	3,000	30	90,000	130,000
Mar	3,000	20	60,000	4,000	30	120,000	180,000

A table of workings for cash receipts can now be prepared, as follows (with all figures in ₦000):

	Sales	Cash receipts:				
		Nov	Dec	Jan	Feb	Mar
Nov	90	18	36	32.2		
Dec	130		26	52	49.4	
Jan	80			16	32	30.4
Feb	130				26	52
Mar	180					36
				102.2	107.4	118.4

Solution**7****Budgeted statement of profit or loss can be prepared as follows:**

	#
Sales (6m × 10k) + (6 m × 11k)	126,000
Cost of sales (80%)	(100,800)
Gross profit (20%)	<u>25,200</u>
Expenses:	
Depreciation (60,000/6 years)	(10,000)
Operating expenses (12 × 1,000)	(12,000)
Budgeted profit	<u><u>3,200</u></u>

Budgeted statement of financial position

	#
Non-current assets (60,000 + 10,000)	50,000
Current assets	
Inventory (3m × 11,000 × 80%)	26,400
Receivables (2m × 11,000)	22,000
Cash (balancing figure)	22,400
Current liabilities (2m × 11,000 × 80%)	(17,600)
	<u>103,200</u>
Capital	
Opening capital (60,000 + 40,000)	100,000
Budgeted profit for the year	3,200
	<u><u>103,200</u></u>

Note: m means month.

Budgeting

Contents

- 1 The budgeting process
- 2 Preparing functional budgets
- 3 Cash budgets and cash flow forecasts
- 4 Master budget
- 5 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making	
	2	Budgeting
	a	Explain the importance of budgeting system.
	b	Describe the stages in the budgeting process.
	c	Explain the importance of principal budget factor.
	d	Prepare simple functional budgets.
	e	Prepare simple cash budget.
	f	Prepare simple master budget.

Exam context

This chapter explains the process of budgeting and various budgeting approaches. It also explains the role of budgeting in influencing the behaviour of workers.

By the end of this chapter you should be able to:

- Explain the purposes of budgeting;
- Construct functional budgets from information provided;
- Construct a cash budget from information provided; and
- Construct a master budget from information provided.

1 THE BUDGETING PROCESS

Section overview

Introduction to budgeting

- Preparing the budget
- Principal budget factor
- Stages in the budget process

1.1 Introduction to budgeting

Planning framework

A business entity should plan over the long term, medium-term and short-term. Long-term planning, or strategic planning, focuses on how to achieve the entity's long-term objectives.

Medium-term or tactical planning focuses on the next year or two.

Short-term or operational planning focuses on day-to-day and week-to-week plans.

Budgets are medium-term plans for the business, expressed in financial terms. A typical budget is prepared annually, and the overall budget is divided into control periods for the purpose of control reporting.

The nature of budgets

A budget is a formal plan, expressed mainly in financial terms and covering all the activities of the entity. It is for a specific period of time, typically one year. When budgets are prepared annually, they are for the next financial year.

The total budget period (one year) may be sub-divided into shorter control periods of one month or one quarter (three months).

Purposes of budgeting

Budgets have several purposes

To convert long-term plans (strategic plans) into more detailed shorter term (annual) plans.

To ensure that planning is linked to the long-term objectives and strategies of the organisation.

To co-ordinate the actions of all the different parts of the organisation, so that they all work towards the same goals. (This is known as 'goal congruence'). One of the benefits of budgeting is that it covers all activities, so the plan should try to ensure that all the different activities are properly co-ordinated and working towards the same objective.

To communicate the company's plans to the individuals (managers and other employees) who have to put the plans into action.

To motivate managers and employees, by setting targets for achievement, and possibly motivating them with the incentive of bonuses or other rewards if the targets are met.

To provide guidelines for authorising expenditure. Expenditure might not be permitted unless it has been planned in the budget or unless it is within the budgeted expenditure limits for the department.

To identify areas of responsibility for implementing the plans. For each part of the budget, an individual manager should be made responsible for achieving the budget targets for performance.

To provide a benchmark against which actual performance can be measured.
To control costs. Costs can be controlled by comparing budgets with actual results and investigating any differences (or variances) between the two. This is known as **budgetary control**.

1.2 Preparing the budget

Preparing the annual budget is a major activity for many entities. In many medium-sized and large companies, there is a well-defined process for budget preparation, because a large number of individuals have to co-ordinate their efforts to prepare the budget plans. The budgeting process may take several months, from beginning to eventual approval by the board of directors.

The budget process might be supervised and controlled by a special committee (the **budget committee**). This consists of senior managers from all the main areas of the business. The committee co-ordinates the various functional budgets submitted to it for review, and gives instructions for changes to be made when the draft budgets are unsatisfactory or the functional budgets are not consistent with each other.

Although the budget committee manages the budget process, the functional budgets are usually prepared by the managers with responsibility for the particular aspect of operations covered by that functional budget.

Budget Officer

To coordinate the budgeting process on behalf of the budget committee, a manager, usually the management accountant or the head of the accounting function, is normally designated as budget officer. The duties of the budget officer include:

- He circulates the budget guidelines on behalf of the budget committee to all functional managers;
- He acts as a secretary of budget committee.
- He revises and amends the budget manual as directed by the budget committee from time to time;
- He designs appropriate forms, schedules and reports necessary in the budgeting process;
- He receives and scrutinises the budgets from functional managers to ensure they are in line with the budget guideline;
- He has to prepare summary budget, i.e., the master budget from the functional budgets.
- He circulates the approved budget to appropriate functional managers;
- He prepares monthly budgetary control reports and submits to the budget committee and appropriate functional managers

Budget manual

There should be a budget manual or budget handbook to guide everyone involved in the budgeting process. This should set out:

The key objectives of the budget;

The planning procedures and the timetables to follow when preparing the budget;

Instructions about the budget details that must be included in the functional budgets;

Responsibilities for preparing the functional budgets (sales budget, production budget, materials budgets, labour usage budget and overhead expenditure budgets); and

Details of the budget approval process. The budget must be approved by the budget committee and then by the board of directors.

The master budget

The 'master budget' is the final approved budget. It is usually presented in the form of financial statements - a budgeted income statement and a budgeted statement of financial position for the end of the financial year.

However, the master budget is the result of a large number of detailed plans, many of them prepared at a departmental or functional level. To prepare the master budget, it is therefore necessary to prepare functional budgets first.

Functional budgets

A functional budget is a budget for a particular aspect of the entity's operations. The functional budgets that are prepared vary with the type of business and industry. In a manufacturing company, functional budgets should include:

A sales budget;

A production budget;

A budget for production resources and resource costs (such as a materials cost budget and a labour cost budget);

A materials purchases budget; and

Expenditure budgets for every overhead cost centre and general overhead costs.

1.3 Principal budget factor

The budgeting process begins with the preparation of functional budgets, which must be co-ordinated and consistent with each other. To make sure that functional budgets are co-ordinated and consistent, the first functional budget that should be prepared is the budget for the principal budget factor.

The principal budget factor (also called the key budget factor) is the factor in the budget that will set a limit to the volume and scale of operations.

Sales demand (sales volume) as the principal budget factor

Normally, the principal budget factor is the expected sales demand. When this happens, the expected sales demand should set a limit on the volume of production (or volume of services). A company might have the capacity to increase its production and output, but producing larger quantities has no purpose unless the extra quantities can be sold.

A company will therefore prepare a budget on the basis of the sales volumes that it hopes or expects to achieve. When sales demand is the principal budget factor, the sales budget is the first functional budget that should be prepared.

A principal budget factor other than sales volume

Sometimes, there is a different limitation on budgeted activity. There might be a shortage of a key resource, such as machine time or the availability of skilled labour. When there is a shortage of a resource that will set a limit on budgeted production volume or budgeted activity, the first functional budget to prepare should be the budget for that resource.

In government, the principal budget factor for each government department is often an expenditure limit for the department. The department must then prepare a budget for the year that keeps the activities and spending plans of the department within the total expenditure limit for the department as a whole.

1.4 Stages in the budget process

The budgeting process for a manufacturing company is probably more complex than for many other types of organisation, and manufacturing company budgets are more likely to be the subject of an examination question than budgets for companies in other industries. This chapter therefore describes the budgeting process for a manufacturing company.

The stages in setting the budget might be as follows:

Stage 1: Identify the principal budget factor (or key budget factor). The principal budget factor is often sales volume;

Stage 2: Prepare the functional budget or plan for the principal budget factor. Usually, this means that the first functional budget to prepare is the sales budget; All the other functional budgets should be prepared within the limitation of the principal budget factor. For example, even if the company has the capacity to produce more output, it should not produce more than it can sell (unless it formally decides to increase the size of the finished goods inventory, in which case the production volume will be higher than the sales volume);

Stage 3: Prepare the other functional budgets, in logical sequence where necessary. When the sales budget has been prepared, a manufacturing organisation can then prepare budgets for inventories (= plans to increase or reduce the size of its inventories), a production budget, labour usage budgets and materials usage and purchases budgets. Expenditure budgets should also be prepared for overhead costs (production overheads, administration overheads and sales and distribution overheads). Overhead costs budgets are usually prepared for each cost centre individually;

Stage 4: Submit the functional budgets to the budget committee for review and approval. The functional budgets are co-ordinated by the budget committee, which must make sure that they are both realistic and consistent with each other;

Stage 5: Prepare the 'master budget'. This is the budget statement that summarises the plans for the budget period. The master budget might be presented in the form of: a budgeted income statement for the next financial year;

a budgeted statement of financial position as at the end of the next financial year; and a cash budget or cash flow forecast for the next financial year.

It should be possible to prepare the master budget statements from the functional budgets;

Stage 6: The master budget and the supporting functional budgets should be submitted to the board of directors for approval. The board approves and authorises the budget;

Stage 7: The detailed budgets are communicated to the managers responsible for their implementation; and

Stage 8: Control process. After the budget has been approved, actual performance should be monitored by comparing it with the budget. Actual results for the period should be recorded and reported to management. These results should be compared with the budget, and significant differences should be investigated. The reasons for the differences ('variances') should be established, and where appropriate control measures should be taken. Comparing actual results with the budget therefore provides a system of control. The managers responsible for activities where actual results differ significantly from the budget will be held responsible and accountable. The planning process (budgeting) should therefore lead on to a management monitoring and control process (budgetary control).

The next section describes the approach that can normally be used to prepare functional budgets for a manufacturing organisation. In practice, budgets are usually prepared with a computer model, such as a **spreadsheet**. However, you need to understand the logic of budget preparation.

2 PREPARING FUNCTIONAL BUDGETS

Section overview

The sales budget

- Cost budgets
- The production budget
- The materials usage budget
- The materials purchases budget
- The labour usage budget
- Budgeted profit or loss account

2.1 The sales budget

The sales budget is the plan for the volume and value of sales in the budget period. It is prepared for each product individually, in units of sale and sales revenue, and for sales revenue in total.

It is calculated for each product simply by multiplying the volume of sales in units by the budgeted sales price per unit.



Example: Sales budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The sales price and expected sales volume for each product next year are as follows:

	Product P	Product Q
Sales price per unit	₦400	₦500
Budgeted sales volume	2,000 units	3,000 units

A sales budget can be prepared as follows:

Product	Budgeted sales quantity	Budgeted sales price	Budgeted sales revenue
	units	₦	₦
P	2,000	400	800,000
Q	3,000	500	1,500,000
Total			<u>2,300,000</u>

A sales budget might be prepared by making adjustments to actual sales in the current financial year.



Example: Sales budget

A company is preparing its sales budget for the year. In the current financial year it expects that total sales will be ₦2.6 million. Next year, it hopes to raise its selling prices by 3% and to increase sales volume by 5%.

The sales budget for next year is therefore: ₦2.6 million \times 1.03 \times 1.05 = ₦2.8 million (to the nearest ₦100,000).

2.2 Cost budgets

When sales volume is a key factor, the cost budgets will all flow from the number to be sold and must be prepared in the following order:

Production budget

This is the number of units to be produced in the period. This number starts with the number of units to be sold which is then adjusted for inventory movement. (For example, if 100 items are to be sold, in the absence of other information, the company would need to make 100 items. However, if 20 items can be taken from inventory, the company would only need to make 80 items).

Materials usage budget

This can only be constructed after the number of units to be made is known.

Materials purchases budget

This can only be constructed after the amount of raw material to be used is known.

Labour usage budget

This can only be constructed after the number of units to be made is known.

You can see from the above that the labour usage budget can be prepared before the materials usage budget if you prefer.

The various functional budgets can be combined to produce a profit or loss account for the period.

The process will be explained with a series of examples building the functional budgets and budgeted profit or loss account of Enugu Plastics limited.

2.3 The production budget

The production budget is calculated initially in units of output, although a budget for production costs can be prepared when production quantities have been decided.

The production budget for each product in units is the sales budget in units adjusted for any planned changes in finished goods inventories.

The production budget in units is prepared for each product, as follows:



Illustration: Production budget

	Units
Sales budget in units	X
Budgeted closing inventory	X
Opening inventory	(X)
Production budget	<u>X</u>



Example: Production budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 2,000 units of Product P and 3,000 units of Product Q.

The following opening and closing inventories are budgeted:

	Opening	Closing
Finished goods:	Units	Units
P	200	300
Q	150	100

A production budget can be prepared as follows:

	Product P	Product Q
	units	units
Sales budget	2,000	3,000
Budgeted closing inventory	300	100
	<u>2,300</u>	<u>3,100</u>
Opening inventory	(200)	(150)
Production budget	<u>2,100</u>	<u>2,950</u>



Practice question

1

A company makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 40,000 units of Product P and 27,000 units of Product Q.

It has been decided that inventory of Product P should be reduced to 2,000 units by the end of the budget period, and inventory of Product Q should be increased to 1,500 units.

It expects opening inventory of finished goods to be 4,000 units of Product P and 500 units of Product Q.

Prepare a production budget.

2.4 The materials usage budget

After the production budget has been prepared, budgets can be prepared for the resources required to achieve the production targets.

Production resources budgets will include a materials usage budget, a direct labour usage budget and possibly a machine hours budget.

Separate budgets can be prepared for each production centre, and these can be added together to create the total production budget. For example, if a manufacturing process consists of a machining department, a finishing department and an assembly department, production budgets will be prepared for each department separately, and these will then be combined to produce a total production department budget.

The materials usage budget is a budget for the quantities of materials that will be used. It is a statement of the quantities of direct materials required for production, and their cost.

The usage budget is prepared for each item of material separately, and a total cost of the materials used should also be shown.



Example: Materials usage budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company has determined that it will make 2,100 units of Product P and 2,950 units of Product Q next year.

The products are expected to use raw materials as follows:

	Product P	Product Q
Direct materials	Usage (kgs)	Usage (kgs)
Material A (₦40 per kg)	2	0.5
Material B (₦50 per kg)	0.5	3
Material C (₦70 per kg)	1	-

A material usage budget can be prepared as follows:

	A (kgs)	B (kgs)	C (kgs)
Usage to make 2,100 units of P			
2,100 units × 2 kgs	4,200		
2,100 units × 0.5 kgs		1,050	
2,100 units × 1 kgs			2,100
Usage to make 2,950 units of Q			
2,950 units × 0.5 kgs	1,475		
2,950 units × 3 kgs		8,850	
Usage in kgs	5,675	9,900	2,100
Cost per kg	₦40	₦50	₦70
Usage in naira	227,000	495,000	147,000
Total cost			<u>₦869,000</u>



Practice question

2

A company makes and sells two products, Product S and Product T. Its production budget for next year is to make 40,000 units of Product S and 10,000 units of Product T.

The materials required to make one unit of each product, and their cost, are as follows:

	Product S	Product T	Cost per kilo
	kilos	kilos	₦
Material M1	2.0	3.0	400
Material M 2	2.5	1.5	600

Prepare a materials usage budget.

2.5 The materials purchases budget

The budgeted cost of materials for use in production is not the same as the quantity and cost of materials that will be purchased. Material purchases and material usage will be different if there are plans to increase or reduce raw materials inventories.

The materials purchases budget is the budget for the purchase cost of materials that will be purchased in the budget period. The materials purchases budget might be prepared for all materials, direct and indirect, or for direct materials only.

The purchases budget differs from the materials usage budget by the amount of the planned increase or decrease in inventory levels of materials in the budget period.

The purchase quantities are calculated first. Purchase quantities are calculated as follows, for each item of material:



Illustration: Materials purchases budget

	kgs
Material usage	X
Budgeted closing inventory	X
Opening inventory	(X)
	<hr/>
Purchases budget	X
	<hr/>

The purchase quantities for each item of material are converted into a purchases cost at the budgeted purchase price for the item of material.

The total material purchases budget (in ₦) is the sum of the purchases budget for each of the individual items of material.



Example: Materials purchases budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company expects to use raw materials in the coming year as follows:

Direct materials	Usage (kgs)	
Material A	5,675	
Material B	9,900	
Material C	2,100	-

The following opening and closing inventories are budgeted:

Materials:	Cost per kg (₦)	Opening kgs	Closing kgs
A	40	500	600
B	50	550	400
C	70	100	250

A material purchases budget can be prepared as follows:

	A (kgs)	B (kgs)	C (kgs)
Usage	5,675	9,900	2,100
Closing inventory	600	400	250
	<hr/>	<hr/>	<hr/>
	6,275	10,300	2,350
Opening inventory	(500)	(550)	(100)
	<hr/>	<hr/>	<hr/>
Purchases (kgs)	5,775	9,750	2,250
Cost per kg (₦)	40	50	70
	<hr/>	<hr/>	<hr/>
Purchases (₦)	231,000	487,500	157,500
	<hr/>	<hr/>	<hr/>
Total cost			<u>₦876,000</u>

**Practice question****3**

A company makes and sells two products, Product X and Product Y. Its production budget for next year is to make 20,000 units of Product X and 15,000 units of Product Y.

The materials required to make one unit of each product, and their costs are as follows:

	Product X	Product Y	Cost per litre
	litres	litres	₦
Material M3	0.5	1.5	3
Material M4	1.0	2.0	4

The company expects to have opening inventory of 3,000 litres of Material M3 and 2,000 litres of Material M4. It plans to have closing inventory of 3,500 litres of Material M3 and 1,200 litres of Material M4

Required

Prepare the materials usage and purchases budget for the year.

**Practice question****4**

A company produces Products A and B and the budgeted production in the coming year is 5,000 units of A and 10,000 units of B.

Products A and B require the following quantities of raw materials to produce one unit.

	Product A	Product B
	per unit	per unit
Raw material X	5 kg	4 kg
Raw material Y	7 kg	3 kg

Raw material X costs ₦10 per kg and raw material Y costs ₦20 per kg.

Data relating to opening and closing inventory is as follows:

	Raw material	
	X	Y
Opening inventory	10,000	8,000
Closing inventory	8,000	4,000

Required

Prepare the materials usage and purchases budget for the year.

2.6 The labour usage budget

Direct labour usage budget

The direct labour usage budget is prepared in a similar way to the materials usage budget. It is a statement of the quantities of direct labour required for production, and its cost.

The budget is prepared for different grades of labour separately, but the total labour cost should also be shown.

The expected hours of work to make the budgeted production quantities of each product should be calculated separately for each grade of labour and then for all the products in total. The total budget in hours for each grade of labour is converted into a cost at the standard/budgeted rate per hour for the grade of labour.



Example: Labour usage budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q.

The company has determined that it will make 2,100 units of Product P and 2,950 units of Product Q next year.

The products are expected to require labour as follows:

Direct labour	Usage	Usage
	(hrs)	(hrs)
Product	P	Q
Grade X (₦100 per hr.)	0.25	0.5
Grade Y (₦80 per hr.)	0.25	0.75

A labour usage budget can be prepared as follows:

	Grade X (hrs)	Grade Y (hrs)
Usage to make 2,100 units of P		
2,100 units × 0.25 hrs	525	
2,100 units × 0.25 hrs		525
Usage to make 2,950 units of Q		
2,950 units × 0.5 hrs	1,475	
2,950 units × 0.75 hrs		2,212.5
Usage in hrs	2,000	2,737.5
Cost per hr (₦)	100	80
Usage in naira	200,000	219,000
Total cost(₦)		419,000



Practice question

5

A company makes and sells two products, Product S and Product T. Its sales budget is to sell 40,000 units of Product S and 10,000 units of Product T.

The expected opening inventories of finished goods are 500 units of Product S and 1,000 units of Product T, and the plan is to double finished goods inventories by the end of the budget period.

The direct labour hours required to make one unit of each product, and their cost, are as follows:

	Product S	Product T	Cost per hour
	Hours	hours	₦
Grade G1 labour	0.2	0.6	20
Grade G2 labour	0.3	0.8	16

Prepare the direct labour usage budget.

Indirect labour costs

Budgets must also be prepared for indirect labour. It is usual to include indirect labour costs within the budget for the overhead cost centre or department where the employees work.

2.7 Budgeted profit or loss account

The functional budgets can be combined to produce a budgeted profit or loss account for the period. This is part of the master budget which is explained in more detail in section 4 of this chapter.

Full details from the Enugu Plastics examples are given below for your convenience.



Example: Preparing a functional budget

Enugu Plastics Ltd makes and sells two products, Product P and Product Q. Its sales budget for next year is to sell 2,000 units of Product P at a sales price of ₦400 per unit and 3,000 units of Product Q at a sales price of ₦500 per unit.

The following cost information is expected to apply in the next year:

	Product P		Product Q	
	Usage (kgs)	Cost (₦)	Usage (kgs)	Cost (₦)
Direct materials				
Material A (₦40 per kg)	2	80	0.5	20
Material B (₦50 per kg)	0.5	25	3	150
Material C (₦70 per kg)	1	70	-	-
		<u>175</u>		<u>170</u>
Direct labour	Usage (hrs)		Usage (hrs)	
Grade X (₦100 per hr.)	0.25	25	0.5	50
Grade Y (₦80 per hr.)	0.25	20	0.75	60
		<u>45</u>		<u>110</u>
Unit cost		<u>220</u>		<u>280</u>

The following opening and closing inventories are budgeted:

	Opening			Closing	
Finished goods:	Cost (₦)	Units	Total (₦)	Units	Total (₦)
P	220	200	44,000	300	66,000
Q	280	150	42,000	100	28,000
			<u>86,000</u>		<u>94,000</u>
Materials:	Cost	kgs		kgs	
A	40	500	20,000	600	24,000
B	50	550	27,500	400	20,000
C	70	100	7,000	250	17,500
			<u>54,500</u>		<u>61,500</u>
Total inventory			<u>140,500</u>		<u>155,500</u>



Example: Budgeted profit or loss account

The following additional information has been derived from the above during the budget process:

	Product	Sales price (₦)	Units	₦
Sales budget	P	400	2,000	800,000
	Q	500	3,000	1,500,000
				2,300,000
Purchases				876,000
Labour usage				419,000

The above figures can be used to produce a budgeted profit or loss account for the year as follows:

Sales budget	₦	2,300,000
Cost of sales:		
Opening inventory	140,500	
Purchases	876,000	
Labour usage	419,000	
	1,435,500	
Closing inventory	(155,500)	
		(1,280,000)
Budgeted gross profit		<u>1,020,000</u>

The budgeted gross profit can be checked as follows:

	(Units × (Sales price – Unit cost))	₦
Profit from selling P	(2,000 units × (400 – 220))	360,000
Profit from selling Q	(3,000 units × (500 – 280))	660,000
		<u>1,020,000</u>

3 CASH BUDGETS AND CASH FLOW FORECASTS

Section overview

- Cash budgets
- Format of a cash budget
- Receipts from credit sales
- Payments to suppliers

3.1 Cash budgets

A cash budget is a detailed plan of cash receipts and cash payments during a planning period. The planning period is sub-divided into shorter periods, and the cash receipts and payments are forecast/planned for each of the sub-divisions of time. The cash budget might be prepared on a monthly basis, or possibly a quarterly basis as part of the annual master budget but many businesses also prepare cash flow forecasts for shorter periods, for example the next week, or weekly cash flows for the next month.

The main uses of a cash budget are as follows:

To forecast how much cash receipts and payments are expected to be over the planning period;

To learn whether there will be a shortage of cash at any time during the period, or possibly a cash surplus;

If there is a forecast shortage of cash, to consider measures in advance for dealing with the problem - for example by planning to defer some purchases of non-current assets, or approaching the bank for a larger bank overdraft facility; and

To monitor actual cash flows during the planning period, by comparing actual cash flows with the budget.

Cash flow forecasts

Cash flow forecasts, like cash budgets, are used to predict future cash requirements, or future cash surpluses. However, unlike cash budgets they are prepared throughout the financial year, and are not a part of a formal budget plan.

The main objectives of cash flow forecasting, like the purposes of a cash budget, are to:

Make sure that the entity is still expected to have sufficient cash to meet its payment commitments as they fall due;

Identify periods when there will be a shortfall in cash resources, so that financing can be arranged;

Identify whether there will be a surplus of cash, so that the surplus can be invested; and

Assess whether operating activities are generating the cash that is expected from them.

The main focus of cash flow forecasting is likely to be operating cash flows, although some investing and financing cash flows might also be significant.

There is no real difference in the preparation of a cash flow budget and a cash flow forecast in terms of exam questions.

3.2 Format of a cash budget

A cash budget is a budget of cash receipts and cash payments during each control period of the budget. Cash budgets might be prepared on a month-by-month basis. However, cash budgets might be prepared on a week-by-week basis, or even a day-by-day basis if required for short-term planning.

A cash budget can be prepared by producing a table for the cash receipts and cash payments, containing each item of cash receipt and each item of cash payment. The cash receipts and then the cash payments should be listed in rows of the table, and each column of the table represents a time period, such as one month.

A typical format for a monthly cash budget is shown below.



Example: Cash flow budget

	January	February	March
	₦	₦	₦
Cash receipts			
Cash sales	5,000	6,000	5,000
Cash from credit sales	72,000	64,000	64,000
Other cash receipts	4,000	2,000	2,000
Total cash receipts	81,000	72,000	71,000
Cash payments			
Cash purchases	6,000	6,600	6,200
Payments for credit purchases	8,400	9,000	9,900
Rental payments	-	30,000	-
Wages and salaries	23,000	23,000	23,000
Dividend payments	-	-	40,000
Other payments	3,000	73,000	13,000
Total cash payments	(40,400)	(141,600)	(92,100)
Receipts minus payments (net cash flow)	40,600	(69,600)	(21,100)
Cash balance at the beginning of the month	45,000	85,600	16,000
Cash balance at the end of the month	85,600	16,000	(5,100)

The cash budget should show all cash items of receipt or payment, including:
 Cash from issuing shares;
 Interest or dividends received from investments;
 Interest payments, but only in the months that interest is actually paid;
 Taxation payments but only in the months that tax is actually paid; and
 Dividend payments.

Receipts and payments must be recorded in the month when they are expected to occur. Non-cash expenditures, such as depreciation of non-current assets, must not be included.

3.3 Receipts from credit sales

One of the more difficult calculations in a cash budget is the cash receipts from trade receivables. When sales are on credit, payments will not be received until a later month.

A question will provide you with a collection pattern for cash on credit sales. This collection pattern must be applied to the monthly sales figures to identify which month the cash is collected.

There might also be information about bad debts which are dealt with easily by reducing the cash to be received. A question might also require you to estimate sales figures for a number of periods before being able to calculate the cash receipts.



Example: Receipts from credit sales

A company is in the process of preparing a cash budget for January to March 20X5.

The company has actual sales in October and November 20X4 of ₦100,000.

December sales are expected to remain at this level but a new advertising initiative to be launched on 1 January 20X5 are expected to lead to a month on month increase in sales of ₦10,000 per month for the first 6 months of next year.

10% of sales are for cash, 40% is collected in the next month and the balance (net of bad debts. of 1%) is collected in the following month. This means that 49% of the cash (being the remaining 50% less 1% bad debt) is collected in the second month.

A table of workings for cash receipts can now be prepared, as follows (with all figures in ₦000):

		Cash receipts:				
	Sales	Nov	Dec	Jan	Feb	Mar
Nov	100	10	40	49		
Dec	100		10	40	49	
Jan	110			11	44	53.9
Feb	120				12	48
Mar	130					13
				100	105	114.9

Note that it is necessary to find the sales figures for each month before the cash flows can be found.



Practice question

6

	Product P (units)	Product Q (units)
November	1,500	2,000
December	2,000	3,000
January	1,000	2,000
February	2,000	3,000
March	3,000	4,000

Product P is sold for ₦20 per unit, and Product Q for ₦30.

All sales are on credit. 20% of total sales are paid for in the month of sale, and 40% in the following month.

The rest, excluding bad debts, are paid at the end of the second month.

Bad debts are 2% of total sales and are written off at the end of the second month following sale.

Calculate the cash receipts expected in January, February and March.

3.4 Payments to suppliers

Payments to suppliers can be calculated in a similar way to cash receipts from credit sales. This can be a little tricky.

The starting point for calculating payments in each month is the purchases in each month. When calculating this figure you might need to take cost structures and inventory policies into account.

Having established total purchases, you can then work out when the payments will be made. Remember that bad debts are irrelevant as all goods purchased must be paid for whether or not the cash is received from their subsequent sale.



Example: Payments for credit purchases

A company is in the process of preparing a cash budget for January to March 20X5.

The company has actual sales in October and November 20X4 of ₦100,000.

December sales are expected to remain at this level but a new advertising initiative to be launched on 1 January 20X5 are expected to lead to a month on month increase in sales of ₦10,000 per month for the first 6 months of next year.

Cost of sales is budgeted to be 60% of the sales figure in each month.

It is the company's policy to have enough closing inventory at each month end to cover 10% of the next month's sales.

(This means that if sales in month 2 are expected to be 100 the closing inventory at the end of month 1 will be 6 being $10\% \times 100 \times 60\%$).

Half of all purchases in each month are paid for in that month and the remaining balance is paid in the next month.

The cash payments made in January, February and March can be calculated as follows:



Example (continued): Payments for credit purchases

The first step is to calculate the purchases figures for each month by constructing a cost of sale working.

This will be done in stages to allow you to understand the process.

Cost of sales in each month is 60% of the sales figure for that month.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory					
Purchases					
Closing inventory					
Cost of sales	60.0	60.0	66.0	72.0	78.0

The closing inventory at the end of each month is 10% of the next month's sales multiplied by 60% (to reduce selling price to cost). A short cut way of calculating this is to simply take 10% of the following month's cost of sales figure.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory					
Purchases					
Closing inventory					
Cost of sales	60.0	60.0	66.0	72.0	78.0

The closing inventory at the end of each month becomes the opening inventory for the next month. These figures can be entered and the purchases figures are found as balancing figures.

	Nov	Dec	Jan	Feb	Mar
Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory	6.0	6.0	6.6	7.2	7.8
Purchases	60.0	60.6	66.6	72.6	78.6
Closing inventory	(6.0)	(6.6)	(7.2)	(7.8)	(8.4)
Cost of sales	60.0	60.0	66.0	72.0	78.0

A table of workings for cash payments can now be prepared, as follows (with all figures in ₦000):

		Cash payments			
Purchase		Dec	Jan	Feb	Mar
Dec	60.6	30.3	30.3		
Jan	66.6		33.3	33.3	
Feb	72.6			36.3	36.3
Mar	78.6				39.3
			63.3	69.6	75.6

4 MASTER BUDGET

Section overview

- Nature of the master budget
- Budgeted statement of profit or loss
- Budgeted statement of financial position

4.1 Nature of the master budget

The 'master budget' is the final approved budget. This is the budget statement that summarises the plans for the budget period. The master budget is usually presented in the form of a series of financial statements as follows:

a budgeted income statement for the next financial year;
a budgeted statement of financial position as at the end of the next financial year; and

a cash budget or cash flow forecast for the next financial year (covered in section 3 of this chapter).

The master budget combines a series of subsidiary budgets prepared for each part of the organisation into a whole.

4.2 Budgeted statement of profit or loss

A budgeted statement of profit or loss can be constructed from the functional budgets in the way described in section 2 of this chapter. Further information about depreciation policy and other operating expenses can be incorporated into this statement.

An alternative approach might involve the use of profit or loss account ratios. These ratios can be used to state the relationship between items in the statement of profit or loss and the sales figure.



Illustration: Statement of profit or loss ratios

	%
Sales	100
Cost of sales	(60)
Gross profit margin	<u>40</u>
Administrative expenses	(10)
Distribution costs	<u>(15)</u>
Net profit	<u>15</u>



Example: Budgeted statement of profit or loss

A business is preparing its budget for the next financial year.

The company is budgeting revenue of ₦1,300,000.

The company aims to earn a gross profit margin of 75% of sales.

Operating costs are budgeted as the following percentages of sales:

Administrative expenses	25%
Distribution costs	20%
Finance expense	4%

A budgeted statement of profit or loss can be prepared as follows:

	%	₦
Sales	100	1,300,000
Cost of sales	(25)	(325,000)
Gross profit	75	975,000
Administrative expenses	(25)	(325,000)
Distribution costs	(20)	(260,000)
Finance expense	(4)	(52,000)
Budgeted profit	26	338,000

4.3 Budgeted statement of financial position

Constructing a statement of financial position requires information about the closing position for assets and liabilities.

A key element of the construction of the budgeted statement of financial position is calculation of budgeted closing receivables and payables. There are different ways in which these might be calculated including:

Use of collection and payment periods; and

Use of information used in the construction of the cash budget.

Use of collection and payment periods

Budgeted relationships between budgeted levels of activity in the budgeted statement of profit or loss and equivalent figures in the budgeted statement of financial position can be used to construct these figures.

There are three main relationships that can be used:

The budgeted receivables collection period (the length of credit taken by, or given to, credit customers).

The budgeted payables period (average time taken to pay suppliers).

(The budgeted inventory holding period (the length of time that inventory is held before it is used or sold) can also be used to estimate the budgeted closing inventory).



Example: Budgeted receivables

A company has budgeted sales to be ₦1,200,000 in the coming year and budgeted receivables to be 3 months of sales.

Budgeted receivable at the end of the next year are found as follows:

Budgeted receivables:

Sales for the year	1,200,000
Therefore, sales per month =	100,000
Therefore, budgeted receivables at next year end (3 months sales) =	300,000

This could also have been calculated as:

$$\text{Sales} \times 3\text{m}/12\text{m} = 1,200,000 \times 3\text{m}/12\text{m} \quad 300,000$$

Note: m means month.

A similar approach can be used to find the budgeted closing inventory.



Example: Budgeted closing inventory

A company has budgeted cost of sales to be ₦600,000 for the coming year.

Closing inventory is budgeted to be sufficient to cover 2 months' sales activity.

Budgeted inventory at the end of the next year are found as follows:

Budgeted inventory

Cost of sales for the year	600,000
Therefore, cost of sales per month =	50,000
Therefore, budgeted inventory at next year end (2 months cost of sales) =	100,000

This could also have been calculated as:

$$\text{COS} \times 2\text{m}/12\text{m} = 600,000 \times 2\text{m}/12\text{m} \quad 100,000$$

Note: m means month.

Budgeted payables can be calculated in the same way from budgeted purchases.



Example: Budgeted payables

A company has budgeted purchases of ₦900,000 for the coming year.

The company intends to take 4 months credit from its suppliers.

Budgeted payables at the end of the next year are found as follows:

Budgeted payables

Purchases	900,000
Therefore, purchases per month =	75,000
Therefore, budgeted payables at next year end (4 months purchases) =	300,000

This could also have been calculated as:

$$\text{Purchases} \times 4\text{m}/12\text{m} = 900,000 \times 4\text{m}/12\text{m} \quad 300,000$$

Note: m means month.

Budgeted payables must be based on budgeted purchases. If budgeted opening inventory is the same as budgeted closing inventory, purchases is the same as cost of sales. However, if the company is budgeting to change inventory level it might be necessary to calculate budgeted purchases by adjusting budgeted cost of sales by the budgeted inventory movement before the budgeted payables figure can be calculated.



Example: Budgeted payables

The following information has been extracted from a company's budget for the following year.

Sales	₦6,000,000
Budgeted gross profit margin	45%
Budgeted credit to be taken	3 months

Closing inventory at the end of the current period (and hence opening inventory for the next period)	150,000
Budgeted closing inventory at the end of the next period	250,000

The budgeted closing payables can be found as follows:

Step 1: Construct the budgeted trading account from the information provided and identify purchases as the balancing figure

Sales	6,000,000	100%
Cost of sales:		
Opening inventory	150,000	
Purchases (balancing figure)	3,400,000	
Closing inventory	(250,000)	
Cost of sales	<u>(3,300,000)</u>	55%
Gross profit	<u>2,700,000</u>	45%

Step 2: Calculate the budgeted closing payable figure

Purchases \times 3m/12m = 3,400,000 \times 4m/12m = 850,000

Note: m means month.

Use of information used in the construction of the cash budget

It is also possible to calculate budgeted receivables and payables for the information and workings used to construct the cash budget.



Example: Receipts from credit sales

A company is in the process of preparing a cash budget for the coming year. The company has budgeted sales in November and December to be ₦100,000.

All sales are on credit. 40% is collected in the next month and the balance is collected in the following month.

Closing receivables are calculated as follows (with all figures in ₦000):

		Collected after the year-end		
	Sales	Dec	Jan	Feb
Nov	100	40	60	
Dec	100		40	60
	↑		100	60
	↑			

Sales made before the year-end but collected after are receivables.

Receivables are 160,000 (100,000 + 60,000).



Practice question

7

A business is setting up a new branch and is preparing a budget for the first 12 months of operation.

The following information is relevant.

Forecast sales	
Months 1 to 6	10,000
Months 7 to 12 (and thereafter)	11,000
Budgeted gross profit margin	20%
Credit given to customers	2 months
Credit taken from suppliers	2 months
Month end inventories	3 months of demand
Monthly operating expenses (excluding depreciation)	1,000

At the start of the budget period a non-current asset with a carrying amount of 60,000 and useful life of 6 years is to be transferred to the branch and 40,000 cash provided.

Construct the budgeted statement of profit or loss and the budgeted statement of financial position. (The closing cash balance is to be calculated as a balancing figure).

5 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the purposes of budgeting;

Construct functional budgets from information provided;

Construct a cash budget from information provided; and

Construct a master budget from information provided.

SOLUTIONS TO PRACTICE QUESTIONS

Solution

1

	Product P units	Product Q units
Sales budget	40,000	27,000
Budgeted closing inventory	2,000	1,500
Opening inventory	(4,000)	(500)
Production budget	38,000	28,000

Solution

2

A materials usage budget can be prepared as follows:

	Material M1 kilos	Material M2 kilos	Total
To make 40,000 S	80,000	100,000	
To make 10,000 T	30,000	15,000	
Total quantities	110,000	115,000	
Price per kilo (₦)	400	600	
Total cost (₦)	44,000,000	69,000,000	113,000,000

Solution**3**

	Material M3	Material M4	Total
	litres	litres	
To make 20,000 X	10,000	20,000	
To make 15,000 Y	22,500	30,000	
Material usage quantities	<u>32,500</u>	<u>50,000</u>	
Closing inventory	3,500	1,200	
Opening inventory	<u>(3,000)</u>	<u>(2,000)</u>	
	<u>33,000</u>	<u>49,200</u>	
Price per litre (₦)	3	4	
Total cost (₦)	<u>99,000</u>	<u>196,800</u>	<u>295,800</u>

Solution**4**

Materials usage budget	Raw material X (kgs)	Raw material Y (kgs)	Total (kgs)
To make 5,000 A	25,000	35,000	60,000
To make 10,000 B	40,000	30,000	70,000
Total quantities	65,000	65,000	130,000
Price per kilo (₦)	10	20	
Total cost (₦)	650,000	1,300,000	1,950,000

Materials purchases budget	Raw material X (kgs)	Raw material Y (kgs)	Total (kgs)
Materials usage budget	65,000	65,000	
Closing inventory	8,000	4,000	
	73,000	69,000	
Opening inventory	(10,000)	(8,000)	
Budgeted materials purchases	63,000	61,000	
Price per kilo (₦)	10	20	
Materials purchases budget (₦)	630,000	1,220,000	1,850,000

Solution**5**

A direct labour usage budget can be prepared as follows, after a production budget has been established.

	Product S units	Product T units
Sales budget	40,000	10,000
Plus: Budgeted closing inventory	1,000	2,000
Minus: Opening inventory	(500)	(1,000)
Production budget	40,500	11,000

	Grade G1 hours	Grade G2 hours	Total
To make 40,500 S	8,100	12,150	
To make 11,000 T	6,600	8,800	
Total labour hours	14,700	20,950	
Rate of pay per hour (₦)	20	16	
Total direct labour cost (₦)	294,000	335,200	629,200

Solution**6**

The total sales in each month must be calculated.

	Sales of product P			Sales of product Q			Total sales
	units	SP(₦)	₦	units	SP(₦)	₦	₦
Nov	1,500	20	30,000	2,000	30	60,000	90,000
Dec	2,000	20	40,000	3,000	30	90,000	130,000
Jan	1,000	20	20,000	2,000	30	60,000	80,000
Feb	2,000	20	40,000	3,000	30	90,000	130,000
Mar	3,000	20	60,000	4,000	30	120,000	180,000

A table of workings for cash receipts can now be prepared, as follows (with all figures in ₦000):

		Cash receipts:				
	Sales	Nov	Dec	Jan	Feb	Mar
Nov	90	18	36	32.2		
Dec	130		26	52	49.4	
Jan	80			16	32	30.4
Feb	130				26	52
Mar	180					36
				102.2	107.4	118.4

Solution**7****Budgeted statement of profit or loss can be prepared as follows:**

	#
Sales (6m × 10k) + (6 m × 11k)	126,000
Cost of sales (80%)	(100,800)
Gross profit (20%)	<u>25,200</u>
Expenses:	
Depreciation (60,000/6 years)	(10,000)
Operating expenses (12 × 1,000)	(12,000)
Budgeted profit	<u>3,200</u>

Budgeted statement of financial position

	#
Non-current assets (60,000 + 10,000)	50,000
Current assets	
Inventory (3m × 11,000 × 80%)	26,400
Receivables (2m × 11,000)	22,000
Cash (balancing figure)	22,400
Current liabilities (2m × 11,000 × 80%)	(17,600)
	<u>103,200</u>
Capital	
Opening capital (60,000 + 40,000)	100,000
Budgeted profit for the year	3,200
	<u>103,200</u>

Note: m means month.

Variance analysis

Contents

- 1 Standard costs
- 2 Direct materials variances
- 3 Direct labour variances
- 4 Variable production overhead variances
- 5 Fixed production overhead cost variances: absorption costing
- 6 Sales variances
- 7 Interrelationships between variances
- 8 Reconciling budgeted and actual profit: standard absorption costing
- 9 Standard marginal costing
- 10 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making (continued)		
	3	Basic variance analysis	
		a	The purpose and principles of standard costing.
			i Identify types of standard and calculate the following basic variances:
			• Direct material price and usage;
			• Direct labour rate and efficiency;
			• Variable production overhead expenditure and efficiency;
			• Fixed production overhead expenditure and volume; and
			• Sales price and volume.
		b	Explain possible causes of the variances.

Exam context

This chapter explains the techniques of variance analysis.

The chapter explains that a flexed budget shows what would have been achieved based on the actual level of activity but assuming revenue per unit and all costs per unit have been the same as budgeted. It is a new budget drawn up for the actual levels of unit sales and unit output.

Variance analysis reconciles the difference between the budgeted profit figure and that actually achieved. This reconciliation occurs in two steps. The difference between the original budgeted profit and the flexed budgeted profit is shown as a volume variance. The differences between the flexed budget and the actual results are shown in detail.

By the end of this chapter you should be able to:

- Explain standard costing using examples;
- Explain and construct a flexed budget;
- Calculate sales volume variance;
- Calculate, analyse and interpret various variances relating to material, labour and factory overhead(both variable and fixed); and
- Prepare an operating statement (TAC and MC) to reconcile budgeted profit to actual profit.

1 STANDARD COSTS

Section overview

Introduction to budgets
Fixed budget
Flexed budget
Comparison of actual results to the flexed budget
Cost variances

1.1 Introduction to budgets

Business entities plan their future activities. This is often done through the drafting of budgets.



Definition: Budget

A budget is a formal plan (for a specified time period), expressed mainly in financial terms and covering all the activities of the entity.

A budget is more than a forecast. It is a commitment to achieve the budgeted levels of activity and thus the budgeted profit. It is a statement of what the entity is going to strive to achieve in the future.

Standard costing is a component of budgeting in some companies. It is appropriate for companies engaged in mass production of large numbers of homogenous (identical) items where there is a great deal of repetition in the production process. In such cases, it is relatively straightforward to identify a standard unit of output (cost unit) and to establish cost of producing a single unit of output.

Standard costs are constructed by estimating the quantities of standard amounts of input (for example materials and labour) and estimating the cost of buying these over the future period covered by the standard.

Companies can often measure the standard quantities with a high degree of confidence. Remember that standard costing is appropriate in conditions of high production numbers and a lot of repetition. Companies might make thousands of items and this experience leads to knowledge of the process.

Standard costs for a unit are often set out in a record called a standard cost card. A typical standard cost card is as follows.



Example: Standard cost card (Lagos Manufacturing Limited)

		₦
Direct materials	5 kg @ ₦1,000 per kg	5,000
Direct labour	4 hours @ ₦500 per hour	2,000
Variable overhead	4 hours @ ₦200 per hour	800
Marginal production cost		<u>7,800</u>
Fixed production overhead	4 hours @ ₦600 per hour	2,400
Total absorption cost		<u><u>10,200</u></u>

The above standard costs will be used in examples throughout this chapter to illustrate variance analysis.

Standard costs link to the budget through activity levels. For example, if a company wanted to make 1,200 of the above units the budget would show a material cost of ₦6,000,000 (1,200 × ₦5,000)

1.2 Fixed budget

The original budget prepared at the beginning of a budget period is known as the fixed budget. A fixed budget is a budget for a specific volume of output and sales activity, and it is the 'master plan' for the financial year that the company tries to achieve.



Example: Fixed budget for a period

Lagos Manufacturing Limited has budgeted to make 1,200 units and sell 1,000 units in January.

The selling price per unit is budgeted at ₦15,000.

The standard costs of production are as given in the previous example.

The budget prepared for January is as follows:

Unit sales	1,000
Unit production	1,200

Budget		₦'000
Sales	(1,000 units × 15,000)	15,000
Cost of sales:		
Materials	(1,200 units × ₦5,000 per unit)	6,000
Labour	(1,200 units × ₦2,000 per unit)	2,400
Variable overhead	(1,200 units × ₦800 per unit)	960
Fixed overhead	(1,200 units × ₦2,400 per unit)	2,880
		12,240
Closing inventory	(200 units × ₦10,200 per unit)	(2,040)
Cost of sales	(1,000 units × ₦10,200 per unit)	(10,200)
Profit		<u>4,800</u>

Note:

Budgeted profit = 1,000 units × (₦15,000 – ₦10,200 per unit) = ₦4,800,000

One of the main purposes of budgeting is budgetary control and the control of costs. Costs can be controlled by comparing budgets with the results actually achieved.

Differences between expected results and actual results are known as variances. Variances can be either favourable (F) or adverse (A) depending on whether the results achieved are better or worse than expected.

Consider the following:



Example: Fixed budget and actual results for a period.

At the end of January Lagos Manufacturing Limited recorded its actual results as follows.

	Budget	Actual
Unit sales	1,000	900
Unit production	1,200	1,000

Budget	Budget ₦'000	Actual ₦'000
Sales	15,000	12,600
Cost of sales:		
Materials	6,000	4,608
Labour	2,400	2,121
Variable overhead	960	945
Fixed overhead	2,880	2,500
	12,240	10,174
Closing inventory	(2,040)	(1,020)
Cost of sales	(10,200)	(9,154)
Profit	<u>4,800</u>	<u>3,446</u>

Note:

The actual closing inventory of 1,000 units is measured at the standard cost of ₦10,200 per unit. This is what happens in standard costing systems.

What does this tell us?

The actual results differ from the budget. The company has not achieved its plan in January. Profit is less than budgeted. The company would like to understand the reason for this in as much detail as possible.

The technique that explains the difference between actual results and the budget is called variance analysis. This technique identifies the components of the difference between the budgeted profit and the actual profit in detail so that they can be investigated and understood by the company.

The sales figure is less than budgeted but why? The sales figure is a function of the quantity sold and the selling price per unit. The quantity sold is 100 units less than budgeted but what about the impact of any difference in the sales price?

At first sight it looks as if the company has made savings on every cost line. For example budgeted material cost was ₦6,000,000 but actual spend was only ₦4,608,000. However, this is not a fair comparison because the budgeted cost was to make 1,200 units whereas the company only made 1,000 units.

1.3 Flexed budget

Variations are not calculated by comparing actual results to the fixed budget directly because the figures relate to different levels of activity and the comparison would not be like to like. A second budget is drawn up at the end of the period. This budget is based on the actual levels of activity and the standard revenue and standard costs. This budget is called a flexed budget.



Example: Flexed budget for a period

The flexed budget prepared by Lagos Manufacturing Limited at the end of January (based on actual levels of activity and standard revenue per unit and standard cost per unit) is as follows:

Unit sales		900
Unit production		1,000
Budget		₦'000
Sales	(900 units × 15,000)	13,500
Cost of sales:		
Materials	(1,000 units × 5,000 per unit)	5,000
Labour	(1,000 units × 2,000 per unit)	2,000
Variable overhead	(1,000 units × 800 per unit)	800
Fixed overhead	(1,000 units × 2,400 per unit)	2,400
		10,200
Closing inventory	(100 units × 10,200 per unit)	(1,020)
Cost of sales	(900 units × 10,200 per unit)	(9,180)
Profit		<u>4,320</u>

This shows the amount that the company would have received for the actual number of units sold if they had been sold at the budgeted revenue per item.

It shows what the actual number of units produced (1,000 units) would have cost if they had been made at the standard cost.

The flexed budget is a vital concept. It sits at the heart of variance analysis.

1.4 Comparison of actual results to the flexed budget.

All three statements can be combined as follows:



Example: Fixed budget, flexed budget and actual results for a period.

At the end of January, Lagos Manufacturing Limited has recorded its actual results as follows (together with the original fixed budget and the flexed budget for the month).

	Fixed budget	Flexed budget	Actual
Unit sales	1,000	900	900
Unit production	1,200	1,000	1,000

Budget	Budget ₦'000	Actual ₦'000	Actual ₦'000
Sales	15,000	13,500	12,600
Cost of sales:			
Materials	6,000	5,000	4,608
Labour	2,400	2,000	2,121
Variable overhead	960	800	945
Fixed overhead	2,880	2,400	2,500
	12,240	10,200	10,174
Closing inventory	(2,040)	(1,020)	(1,020)
Cost of sales	(10,200)	(9,180)	(9,154)
Profit	4,800	4,320	3,446

Note:

The actual closing inventory of 100 units is measured at the standard total absorption cost of ₦10,200 per unit. This is what happens in standard costing systems.

The information for Lagos Manufacturing Limited's performance in January will be used throughout this chapter to illustrate variance analysis.

Note that the above example is unlikely to be something that you would have to produce in the exam. It is provided to help you to understand what variance analysis is about.

Commentary

Variance analysis explains the difference between the fixed budget profit and the actual profit in detail. This paragraph provides an initial commentary before looking at the detailed calculations in later sections of this chapter.

Both the fixed budget and the flexed budget are based on the standard revenue per unit and the standard costs per unit. Therefore, the difference between the fixed budget and the flexed budget is caused only by difference in volume. This figure of

₦480,000 (₦4,800,000 – ₦4,320,000) is called the sales volume variance. This is revisited in detail later in this chapter.

Revenue is sales quantity × sales price per unit. The revenue in the flexed budget and the actual revenue are both based on the actual quantity sold. Therefore the difference between the two figures of ₦900,000 (₦13,500,000 – ₦12,600,000) is due to a difference in the selling price per unit. This difference is called the sales price variance. This is revisited in detail later in this chapter.

The difference between each variable cost line in the flexed budget and the equivalent actual figure is a total cost variance for that item. For example the actual results show that 1,000 units use material which cost ₦4,608,000. The flexed budget shows that these units should have used material which cost ₦5,000,000. The difference of ₦392,000 is due to a combination of the actual material used being different to the budgeted usage of 5kgs per unit and the actual price per kg being different to the budgeted price per kg. In other words, the total variance can be explained in terms of usage and price. This is explained in detail later in this chapter.

Variable cost variances can be calculated for all items of variable cost (direct materials, direct labour and variable production overhead). The method of calculating the variances is similar for each variable cost item.

The total cost variance for the variable cost item is the difference between the actual variable cost of production and the standard variable cost of producing the items.

However, the total cost variance is not usually calculated. Instead, the total variance is calculated in two parts, that add up to the total cost variance:

a price variance or rate variance or expenditure per hour variance.

a usage or efficiency variance.

The difference between the fixed overhead in the flexed budget and the actual fixed overhead is over absorption. This was covered in an earlier chapter but will be revisited in full later in this chapter.

1.5 Cost variances

Adverse and favourable cost variances

In a standard costing system, all units of output are valued at their standard cost. Cost of production and cost of sales are therefore valued at standard cost.

Actual costs will differ from standard costs. A cost variance is the difference between an actual cost and a standard cost.

When actual cost is higher than standard cost, the cost variance is adverse (A) or unfavourable (U).

When actual cost is less than standard cost, the cost variance is favourable (F).

Different variances are calculated, relating to direct materials, direct labour, variable production overhead and fixed production overhead. (There are also sales variances. These are explained in a later section.)

In a cost accounting system, cost variances are adjustments to the profit in an accounting period.

Favourable variances increase the reported profit.

Adverse variances reduce the reported profit.

The method of calculating cost variances is similar for all variable production cost items (direct materials, direct labour and variable production overhead).

A different method of calculating cost variances is required for fixed production overhead.

Variances and performance reporting

Variance reports are produced at the end of each control period (say, at the end of each month).

Large adverse variances indicate poor performance and the need for control action by management.

Large favourable variances indicate unexpected good performance. Management might wish to consider how this good performance can be maintained in the future.

Variances might be reported in a statement for the accounting period that reconciles the budgeted profit with the actual profit for the period. This statement is known as an **operating statement**.

2 Direct materials VARIANCES

Section overview

Direct materials: total cost variance
Direct materials price variance
Direct materials usage variance
Alternative calculations
Direct materials: possible causes of variances

2.1 Direct materials: total cost variance

The total direct material cost variance is the difference between the actual material cost in producing units in the period and the standard material cost of producing those units.



Illustration: Direct materials – total cost variance

	₦
Standard material cost of actual production:	
Actual units produced × Standard kgs per unit × Standard price per kg	X
Actual material cost of actual production:	
Actual units produced × Actual kgs per unit × Actual price per kg	(X)
	<u>X</u>

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.



Example: Direct material – Total cost variance (Lagos Manufacturing Limited)

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

Direct materials total cost variance is calculated as follows:

	₦'000
Standard: 1,000 units should cost (@ ₦5,000 per unit)	5,000
Actual: 1,000 units did cost	(4,608)
Total cost variance (F)	<u>392</u>

The direct materials total cost variance can be analysed into a price variance and a usage variance.

A price variance measures the difference between the actual price paid for materials

and the price that should have been paid (the standard price).

A usage variance measures the difference between the materials that were used in production and the materials that should have been used (the standard usage).



Practice question

1



A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre. The standard direct material cost per unit of Product 123 is therefore ₦15.

In a particular month, 2,000 units of Product 123 were manufactured. These used 10,400 litres of Material A, which cost ₦33,600.

Calculate the total direct material cost variance.

2.2 Direct materials price variance

The price variance may be calculated for the materials purchased or materials used. Usually it is calculated at the point of purchase as this allows the material inventory to be carried at standard cost.



Illustration: Direct materials – price variance

	₦
Standard material cost of actual production:	
Actual kgs purchased × Standard price per kg	X
Actual material cost of actual purchases	
Actual kgs purchased × Actual price per kg	(X)
	X
	X



Example: Direct materials – price variance (Lagos Manufacturing Limited)

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

Direct materials price variance is calculated as follows:

	₦'000
Standard: 4,850 kgs should cost (@ ₦1,000 per kg)	4,850
Actual: 4,850 kgs did cost	(4,608)
	242
Materials price variance (F)	242

If there are two or more direct materials, a price variance is calculated separately for each material.



Practice question

2



A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre. The standard direct material cost per unit of Product 123 is therefore ₦15. In a particular month, 2,000 units of Product 123 were manufactured. These used 10,400 litres of Material A, which cost ₦33,600.

Calculate the direct material price variance.

2.3 Direct materials usage variance

The usage variance is calculated by comparing the actual quantity of material used to make the actual production to the standard quantity that should have been used to produce those units. In other words, the actual usage of materials is compared with the standard usage for the actual number of units produced,

The difference is the usage variance, measured as a quantity of materials. This is converted into a money value at the standard price for the material.



Illustration: Direct materials – Usage variance

	kgs..
Standard quantity of material needed to make the actual production	X
Actual quantity of material used to make the actual production	(X)
Usage variance (kgs)	<u>X</u>
Standard cost per kg (multiply by)	X
Usage variance (₦)	<u>X</u>



Example: Direct materials – Usage variance (Lagos Manufacturing Limited)

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

Direct materials usage variance is calculated as follows:

	Kgs
Standard:	
Making 1,000 units should have used (@ 5 kgs per unit)	5,000
Actual: Making 1,000 units did use	<u>(4,850)</u>
Usage variance (kgs) (F)	150
Standard cost per kg	<u>₦1,000</u>
Usage variance (₦) (F)	<u>₦150,000</u>



Practice question

3



A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre.

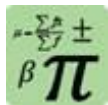
The standard direct material cost per unit of Product 123 is therefore ₦15. In a particular month, 2,000 units of Product 123 were manufactured.

These used 10,400 litres of Material A, which cost ₦33,600.

Calculate the direct materials usage variance.

2.4 Alternative calculations

Variances can be calculated in a number of ways. A useful approach is the following line by line approach.



Formula: Alternative method for calculating material variances

AQ _{purchased} × AC	X	}	X	Price variance
AQ _{purchased} × SC	X			
AQ _{used} × SC	X	}	X	Inventory movement
SQ _{used} × SC	X			
		}	X	usage variance

Where:

AQ = Actual quantity

AC = Actual cost per kg

SC = Standard cost per kg

SQ = Standard quantity needed to make actual production



Example: Alternative method for calculating material variances (Lagos Manufacturing Limited)

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

	₦'000	₦'000
AQ _{purchased} × AC		
4,850 kgs × ₦X per kg	4,608	} 242 (F) Price variance
AQ _{purchased} × SC		
4,850 kgs × ₦1,000 per kg	4,850	} nil inventory movement
AQ _{used} × SC		
4,850 kgs × ₦1,000 per kg	4,850	} 150 (F) Usage variance
SQ _{used} × SC		
5,000 kgs × ₦1,000 per kg	5,000	

SQ = 1,000 units × 5 kgs per unit = 5,000 kgs



Practice question

4



A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre.

The standard direct material cost per unit of Product 123 is therefore ₦15. In a particular month, 2,000 units of Product 123 were manufactured.

These used 10,400 litres of Material A, which cost ₦33,600.

Calculate the direct materials price and usage variances using the alternative approach.

2.5 Direct materials: possible causes of variances

When variances occur and they appear to be significant, management should investigate the reason for the variance. If the cause of the variance is something within the control of management, control action should be taken. Some of the possible causes of materials variances are listed below.

Materials price variance: causes

Possible causes of favourable materials price variances include:

Different suppliers were used and they charged a lower price (favourable price variance) than the usual supplier;

Materials were purchased in sufficient quantities to obtain a bulk purchase discount (a quantity discount), resulting in a favourable price variance; and

Materials bought were of lower quality than standard and so cheaper than expected.

Possible causes of adverse materials price variances include:

Different suppliers were used and they charged a higher price (adverse price variance) than the usual supplier;

Suppliers increased their prices by more than expected. (Higher prices might be caused by an unexpected increase in the rate of inflation);

There was a severe shortage of the materials, so that prices in the market were much higher than expected; and

Materials bought were of better quality than standard and more expensive than expected.

Materials usage variance: causes

Possible causes of favourable materials usage variances include:

Wastage rates were lower than expected; and

Improvements in production methods resulted in more efficient usage of materials (favourable usage variance).

Possible causes of adverse materials usage variances include:

Wastage rates were higher than expected;

Poor materials handling resulted in a large amount of breakages (adverse usage variance). Breakages mean that a quantity of materials input to the production process are wasted; and

Materials used were of cheaper quality than standard, with the result that more materials had to be thrown away as waste.

3 DIRECT LABOUR VARIANCES

Section overview

Direct labour: total cost variance
 Direct labour rate variance
 Direct labour efficiency variance
 Idle time variance
 Alternative calculations
 Idle time variance where idle time is included in standard cost
 Direct labour: possible causes of variances

3.1 Direct labour: total cost variance

The total direct labour cost variance is the difference between the actual labour cost in producing units in the period and the standard labour cost of producing those units.



Illustration: Direct labour – total cost variance

	₦
Standard labour cost of actual production:	
Actual units produced × Standard hrs per unit × Standard rate per hr	X
Actual labour cost of actual production:	
Actual units produced × Actual hours per unit × Actual rate per hour	(X)
	<u>X</u>

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.



Example: Direct labour – Total cost variance (Lagos Manufacturing Limited)

Standard labour cost per unit: (4 hrs × ₦500 per hr) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour total cost variance is calculated as follows:

	₦'000
Standard: 1,000 units should cost (@ ₦2,000 per unit)	2,000
Actual: 1,000 units did cost	(2,121)
Total cost variance (A)	<u>(121)</u>

The direct labour total cost variance can be analysed into a rate variance and an efficiency variance. These are calculated in a similar way to the direct materials price and usage variances.

A rate variance measures the difference between the actual wage rate paid per labour hour and the rate that should have been paid (the standard rate of pay).

An efficiency variance (or productivity variance) measures the difference between the time taken to make the production output and the time that should have been taken (the standard time).

3.2 Direct labour rate variance

The direct labour rate variance is calculated for the actual number of hours paid for.

The actual labour cost of the actual hours paid for is compared with the standard cost for those hours. The difference is the labour rate variance.



Illustration: Direct labour – rate variance

	₦
Standard labour cost of actual production:	
Actual hours paid for × Standard rate per hour	X
Actual labour cost of actual production	
Actual hours paid for × Actual rate per hour	(X)
	<u>X</u>



Example: Direct labour – rate variance (Lagos Manufacturing Limited)

Standard labour cost per unit: (4 hrs × ₦500 per hour) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour rate variance is calculated as follows:

	₦'000
Standard: 4,200 hours should cost (@ ₦500 per hour)	2,100
Actual: 4,200 hours did cost	(2,121)
	<u>(21)</u>
Labour rate variance (A)	<u>(21)</u>

If there are two or more different types or grades of labour, each paid a different standard rate per hour, a rate variance is calculated separately for each labour grade.

3.3 Direct labour efficiency variance

The direct labour efficiency variance is calculated for the hours used on the units produced.

For the actual number of standard units produced, the actual hours worked is compared with the standard number of hours that should have been worked to produce the actual output. The difference is the efficiency variance, measured in hours. This is converted into a money value at the standard direct labour rate per hour.



Illustration: Direct labour – Efficiency variance

	Hours
Standard labour hours needed to make the actual production	X
Actual labour hours used to make the actual production	(X)
Efficiency variance (hours)	<u>X</u>
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	<u><u>X</u></u>



Example Direct labour – Efficiency variance (Lagos Manufacturing Limited)

Standard labour cost per unit: (4 hrs × ₦500 per hour) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour efficiency variance is calculated as follows:

	Hours
Standard: Making 1,000 units should have used (@ 4 hours per unit)	4,000
Actual: Making 1,000 units did use	<u>(4,200)</u>
Efficiency variance (hours) (A)	(200)
Standard rate per hour	<u>₦500</u>
Efficiency variance (₦) (A)	<u><u>(₦100,000)</u></u>



Practice question

5



Product P234 has a standard direct labour cost per unit of:

0.5 hours × ₦12 per direct labour hour = ₦6 per unit.

During a particular month, 3,000 units of Product 234 were manufactured. These took 1,400 hours to make and the direct labour cost was ₦16,200.

Calculate the total direct labour cost variance, the direct labour rate variance and the direct labour efficiency variance for the month.

3.4 Idle time variance

Idle time was explained in the previous chapter. Part of this explanation is repeated here for your convenience.

Idle time occurs when the direct labour employees are being paid but have no work to do. The causes of idle time may be:

A breakdown in production, for example a machine breakdown that halts the production process;

Time spent waiting for work due to a bottleneck or hold-up at an earlier stage in the production process;

Running out of a vital direct material, and having to wait for a new delivery of the materials from a supplier; and

A lack of work to do due to a lack of customer orders.

A feature of idle time is that it is recorded, and the hours 'lost' due to idle time are measured. Idle time variance is part of the efficiency variance.

Sometimes idle time might be a feature of a production process for example where there may be bottlenecks in a process that might lead to idle time on a regular basis. In this case the expected idle time might be built into the standard cost.

If idle time is not built into the standard cost the idle time variance is always adverse.

If it is built into the standard cost the idle time variance might be favourable or adverse depending on whether the actual idle time is more or less than the standard idle time for that level of production.

Idle time not part of standard cost

As stated above if the idle time is not included in the standard cost, any idle time is unexpected and leads to an adverse variance.



Illustration: Direct labour – idle time variance

	Hours
Actual hours paid for	X
Actual hours worked	(X)
Idle time (hours)	<u>X</u>
Standard rate per hour (multiply by)	X
Idle time (₦)	<u><u>X</u></u>

Calculating the idle time variance will affect the calculation of the direct labour efficiency variance. If idle time occurs but not recorded, the idle time variance is part of the direct labour efficiency variance.



Example: Direct labour – idle time variance (Lagos Manufacturing Limited)

Standard labour cost per unit: (4 hours × ₦500 per kg) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Labour hours worked: 4,100 hours

Direct labour idle time variance is calculated as follows:

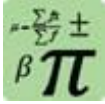
	Hours
Actual hours paid for	4,200
Actual hours worked	(4,100)
	<hr/>
Idle time (hours) (A)	(100)
Standard rate per hour	₦500
	<hr/>
Idle time (₦) (A)	<u>(₦50,000)</u>

Direct labour efficiency variance is calculated as follows:

	Hours
Standard:	
Making 1,000 units should have used (@ 4 hours per unit)	4,000
Actual: Making 1,000 units did use	(4,100)
	<hr/>
Efficiency variance (hours) (A)	(100)
Standard rate per hour	₦500
	<hr/>
Efficiency variance (₦) (A)	<u>(₦50,000)</u>

3.5 Alternative calculations

The following shows the line by line approach for labour variances.



Formula: Alternative method for calculating labour variances

$AH_{\text{paid for}} \times AR$	X		
$AH_{\text{paid for}} \times SR$	X	}	
$AH_{\text{worked}} \times SR$	X	}	
$SH_{\text{worked}} \times SR$	X	}	
		X	Rate variance
		X	Idle time variance
		X	Efficiency variance

Where:

- AH = Actual hours
- AR = Actual rate per hour
- SR = Standard rate per hour
- SH = Standard hours needed to make actual production



Example: Alternative method for calculating labour variances (Lagos Manufacturing Limited)

Standard labour cost per unit: (4 hours \times ~~N~~500 per kg) = ~~N~~2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ~~N~~2,121,000

Labour hours worked: 4,100 hours

	N'000	N'000	
$AH_{\text{paid for}} \times AR$			
4,200 hours \times N X per hour	2,121		
$AH_{\text{paid for}} \times SR$			}
4,200 hours \times N 500 per hour	2,100		21 (A) Price variance
$AH_{\text{worked}} \times SR$			}
4,100 hours \times N 500 per hour	2,050		50 (A) Idle time
$SH_{\text{worked}} \times SR$			}
4,000 hours \times N 500 per hour	2,000		50 (A) Efficiency

SQ = 1,000 units \times 4 hours per unit = 4,000 hours



Practice question

6



Product P234 has a standard direct labour cost per unit of:

0.5 hours × ~~₦12~~ per direct labour hour = ~~₦6~~ per unit.

During a particular month, 3,000 units of Product 234 were manufactured. These took 1,400 hours to make and the direct labour cost was ~~₦16,200~~.

Calculate the direct labour rate variance and the direct labour efficiency variance for the month using the alternative approach.

3.6 Idle time variance where idle time is included in standard cost

Methods of including idle time in standard costs

There are different ways of allowing for idle time in a standard cost.

Method 1. Include idle time as a separate element of the standard cost, so that the standard cost of idle time is a part of the total standard cost per unit.

Method 2. Allow for a standard amount of idle time in the standard hours per unit for each product. The standard hours per unit therefore include an allowance for expected idle time.



Example: Idle time in standard (Lagos Manufacturing Limited)

Standard labour rate = ~~₦500~~ per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.

4 hours must be paid for (3.6/90%) to make 1 unit).

Expected idle time is 0.4 hours (10% of 4 hours).

Idle time can be built into the standard as follows:

Method 1		₦
Labour	3.6 hours × ₦500 per hour	1,800
Idle time	0.4 hours × ₦500 per hour	200
		<hr/> 2,000 <hr/>
Method 2		₦
Labour	4 hours × ₦500 per hour	<hr/> 2,000 <hr/>

The two methods will result in the identification of the same overall variance for idle time plus labour efficiency but the split of the number may differ.



Example: Method 1 – idle time variance (Idle time included in standard as a separate element) (Lagos Manufacturing Limited)

Standard labour rate = ₦500 per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.

4 hours must be paid for (3.6/90%) to make 1 unit).

Expected idle time is 0.4 hours (10% of 4 hours).

Idle time can be built into the standard as follows:

Method 1		₦
Labour	3.6 hours × ₦500 per hour	1,800
Idle time	0.4 hours × ₦500 per hour	200
		2,000

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Labour hours worked: 4,100 hours

Direct labour idle time variance is calculated as follows:

	Hours	
Expected idle time (1,000 units × 0.4 hours per unit)	400	
Actual idle time (4,200 hours – 4,100 hours)	(100)	
	300	F
Idle time (hours)		
Standard rate per hour (multiply by)	₦500	
Idle time (₦)	₦150,000	F

Direct labour efficiency variance is calculated as follows:

	Hours	
Standard: Making 1,000 units should have used (@ 3.6 hours per unit)	3,600	
Actual: Making 1,000 units did use	(4,100)	
	(500)	A
Efficiency variance (hours)		
Standard rate per hour	₦500	
Efficiency variance (₦)	(₦250,000)	A



Example: Method 2 – idle time variance (Idle time allowed for as a standard amount of idle time in the standard hours per unit for each product) (Lagos Manufacturing Limited)

Standard labour rate = ₦500 per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.

4 hours must be paid for (3.6/90%) to make 1 unit).

Expected idle time is 0.4 hours (10% of 4 hours).

Idle time can be built into the standard as follows:

	₦
Labour	4 hours × ₦500 per hour
	<u>2,000</u>

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Labour hours worked: 4,100 hours

Direct labour idle time variance is calculated as follows:

	Hours	
Expected idle time (10% of 4,200 hours paid for)	420	
Actual idle time (4,200 hours – 4,100 hours)	(100)	
Idle time (hours)	<u>320</u>	F
Standard rate per hour (multiply by)	<u>₦500</u>	
Idle time (₦)	<u>₦160,000</u>	F

Direct labour efficiency variance is calculated as follows:

	Hours	
Standard: Making 1,000 units should have used (4 hours per unit less 10% of the hours paid for = 4,000 – (10% of 4,200))	3,580	
Actual: Making 1,000 units did use	(4,100)	
Efficiency variance (hours)	<u>(520)</u>	A
Standard rate per hour	<u>₦500</u>	
Efficiency variance (₦)	<u>(₦260,000)</u>	A

In summary the idle time variance is part of the efficiency variance. Different methods result in a different split of the idle time variance and efficiency variance but the figures always sum to the same total.

Revisiting the previous examples:



Example: Sum of idle time and efficiency variances (Lagos Manufacturing Limited)

	Idle time variance	Efficiency variance	Total
Idle time not recorded	–	100 (A)	100 (A)
Idle time recorded:			
not part of standard cost	50 (A)	50 (A)	100 (A)
part of standard cost (method 1)	150 (F)	250 (A)	100 (A)
part of standard cost (method 2)	160 (F)	260 (A)	100 (A)

3.7 Direct labour: possible causes of variances

When labour variances appear significant, management should investigate the reason why they occurred, and take control measures where appropriate to improve the situation in the future. Possible causes of labour variances include the following. Possible causes of favourable labour rate variances include:

Using direct labour employees who were relatively inexperienced and new to the job (favourable rate variance, because these employees would be paid less than 'normal'); and

Actual pay increase turning out to be less than expected.

Possible causes of adverse labour rate variances include:

An increase in pay for employees;

Working overtime hours paid at a premium above the basic rate; and

Using direct labour employees who were more skilled and experienced than the 'normal' and who are paid more than the standard rate per hour (adverse rate variance).

Possible causes of favourable labour efficiency variances include:

More efficient methods of working;

Good morale amongst the workforce and good management with the result that the work force is more productive;

If incentive schemes are introduced to the workforce, this may encourage employees to work more quickly and therefore give rise to a favourable efficiency variance; and

Using employees who are more experienced than 'standard', resulting in favourable efficiency variances as they are able to complete their work more quickly than less-experienced colleagues.

Possible causes of adverse labour efficiency variances include:

Using employees who are less experienced than 'standard', resulting in adverse efficiency variances; and

An event causing poor morale.

4 VARIABLE PRODUCTION OVERHEAD VARIANCES

Section overview

Variable production overhead: total cost variance
 Variable production overhead expenditure variance
 Variable production overhead efficiency variance
 Alternative calculations
 Variable production overheads: possible causes of variances

4.1 Variable production overhead: total cost variance

The total variable production overhead cost variance is the difference between the actual variable production overhead cost in producing units in the period and the standard variable production overhead cost of producing those units.



Illustration: Variable production overhead – total cost variance

	₦
Standard variable production overhead cost of actual production:	
Actual units produced × Standard hrs per unit × Standard rate per hr	X
Actual variable production overhead cost of actual production:	
Actual units produced × Actual hours per unit × Actual rate per hour	(X)
	X

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.



Example: Variable production overhead – Total cost variance (Lagos Manufacturing Limited)

Standard variable production overhead cost per unit: (4 hrs × ₦200 per hr) = ₦800 per unit

Actual production in period = 1,000 units.

Variable production overhead = ₦945,000.

Labour hours paid for: 4,200 hours

Direct variable production overhead total cost variance is calculated as follows:

	₦'000
Standard: 1,000 units should cost (@ ₦800 per unit)	800
Actual: 1,000 units did cost	(945)
Total cost variance (A)	(145)

The variable production overhead total cost variance can be analysed into an expenditure variance (spending rate per hour variance) and an efficiency variance.

The expenditure variance is similar to a materials price variance or a labour rate variance. It is the difference between actual variable overhead spending in the hours worked and what the spending should have been (the standard rate).

The variable overhead efficiency variance in hours is the same as the labour efficiency variance in hours (excluding any idle time variance), and is calculated in a very similar way. It is the variable overhead cost or benefit from adverse or favourable direct labour efficiency variances.

4.2 Variable production overhead expenditure variance

It is normally assumed that variable production overheads are incurred during hours actively worked, but not during any hours of idle time.

The variable production overhead expenditure variance is calculated by taking the actual number of hours worked.

The actual variable production overhead cost of the actual hours worked is compared with the standard cost for those hours. The difference is the variable production overhead expenditure variance.

A variable production overhead expenditure variance is calculated as follows. Like the direct labour rate variance, it is calculated by taking the actual number of labour hours worked, since it is assumed that variable overhead expenditure varies with hours worked.



Illustration: Variable production overhead expenditure variance

	₦
Standard variable production overhead cost of actual production:	
Actual hours worked × Standard rate per hour	X
Actual variable production overhead cost of actual production	
Actual hours worked × Actual rate per hour	(X)
	X
	X



Example: Variable production overhead expenditure variance (Lagos Manufacturing Limited)

Standard variable production overhead cost per unit: (4 hrs × ₦200 per hr) = ₦800 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100 hours at a variable overhead cost of ₦945,000.

Variable production overhead rate variance is calculated as follows:

	₦'000
Standard: 4,100 hours should cost (@ ₦200 per hour)	820
Actual: 4,100 hours did cost	(945)
	<hr/>
Labour rate variance (A)	<u>(125)</u>

4.3 Variable production overhead efficiency variance

The variable production overhead efficiency variance in hours is exactly the same as the direct labour efficiency variance in hours.

It is converted into a money value at the standard variable production overhead rate per hour.



Illustration: Variable production overhead – Efficiency variance

	Hours
Standard hours used to make the actual production	X
Actual hours needed to make the actual production	(X)
Efficiency variance (hours)	<hr/> X
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	<hr/> <u>X</u>



Example Variable production overhead efficiency variance (Lagos Manufacturing Limited)

Standard variable production overhead cost per unit: (4 hrs × ₦200 per kg) = ₦800 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100 hours at a variable overhead cost of ₦945,000.

Variable production overhead efficiency variance is calculated as follows:

	Hours
Standard:	
Making 1,000 units should have used (@ 4 hours per unit)	4,000
Actual: Making 1,000 units did use	(4,100)
	<hr/>
Efficiency variance (hours) (A)	(100)
Standard rate per hour	₦200
	<hr/>
Efficiency variance (₦) (A)	<u>(₦20,000)</u>



Practice question

7



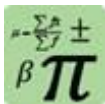
Product P123 has a standard variable production overhead cost per unit of: 1.5 hours × ₦2 per direct labour hour = ₦3 per unit.

During a particular month, 2,000 units of Product 123 were manufactured. These took 2,780 hours to make and the variable production overhead cost was ₦6,550.

Calculate the total variable production overhead cost variance, the variable production overhead expenditure variance and the variable production overhead efficiency variance for the month.

4.4 Alternative calculations

The following shows the line by line approach for variable production overhead variances.



Formula: Alternative method for calculating variable production overhead variances

$AH_{\text{worked}} \times AR$	X	}	X	Rate variance
$AH_{\text{worked}} \times SR$	X			
$SH_{\text{worked}} \times SR$	X	}	X	Efficiency variance

Where:

AH = Actual hours

AR = Actual rate per hour

SR = Standard rate per hour

SH = Standard hours needed to make actual production



Example: Alternative method for calculating variable production overhead variances (Lagos Manufacturing Limited)

Standard variable production overhead cost per unit: (4 hrs \times ₦200 per kg) = ₦800 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100 hours at a variable overhead cost of ₦945,000.

	₦'000		₦'000
$AH_{\text{worked}} \times AR$			
4,100 hours \times ₦X per hour	945	}	125 (A) Expenditure
$AH_{\text{worked}} \times SR$			
4,100 hours \times ₦200 per hour	820	}	20 (A) Efficiency
$SH_{\text{worked}} \times SR$			
4,000 hours \times ₦200 per hour	800		

$SH = 1,000 \text{ units} \times 4 \text{ hours per unit} = 4,000 \text{ hours}$



Practice question

8

Product P123 has a standard variable production overhead cost per unit of: 1.5 hours × ₦2 per direct labour hour = ₦3 per unit.

During a particular month, 2,000 units of Product 123 were manufactured. These took 2,780 hours to make and the variable production overhead cost was ₦6,550.

Calculate the variable production overhead expenditure variance and the variable production overhead efficiency variance for the month using the alternative approach.

4.5 Variable production overhead: possible causes of variances

Possible causes of favourable variable production overhead expenditure variances include:

Forecast increase in costs not materialising.

Possible causes of adverse variable production overhead variances include:

Unexpected increases in energy prices.

Anything that causes labour efficiency variance will have an impact on variable production overhead efficiency variances as variable production overhead is incurred as the labour force carries out production.

Possible causes of favourable variable production overhead efficiency variances include:

More efficient methods of working;

Good morale amongst the workforce and good management with the result that the work force is more productive;

If incentive schemes are introduced to the workforce, this may encourage employees to work more quickly and therefore give rise to a favourable efficiency variance; and

Using employees who are more experienced than 'standard', resulting in favourable efficiency variances as they are able to complete their work more quickly than less-experienced colleagues.

Possible causes of adverse variable production overhead efficiency variances include:

Using employees who are less experienced than 'standard', resulting in adverse efficiency variances; and

An event causing poor morale.

5 FIXED PRODUCTION OVERHEAD COST VARIANCES: ABSORPTION COSTING

Section overview

Over/under absorption
Total fixed production overhead cost variance
Fixed production overhead expenditure variance
Fixed production overhead volume variance
Fixed production overhead efficiency and capacity variances
Fixed production overheads: possible causes of variances

5.1 Over/under absorption

Variances for fixed production overheads are different from variances for variable costs.

With standard absorption costing, the standard cost per unit is a full production cost, including an amount absorbed as fixed production overhead. Every unit produced is valued at standard cost.

This means that production overheads are absorbed into production costs at a standard cost per unit produced. This standard fixed cost per unit is derived as a standard number of direct labour hours per unit at a fixed overhead rate per hour.

The total fixed overhead cost variance is the total amount of under-absorbed or over-absorbed overheads, where overheads are absorbed at the standard fixed overhead cost per unit.

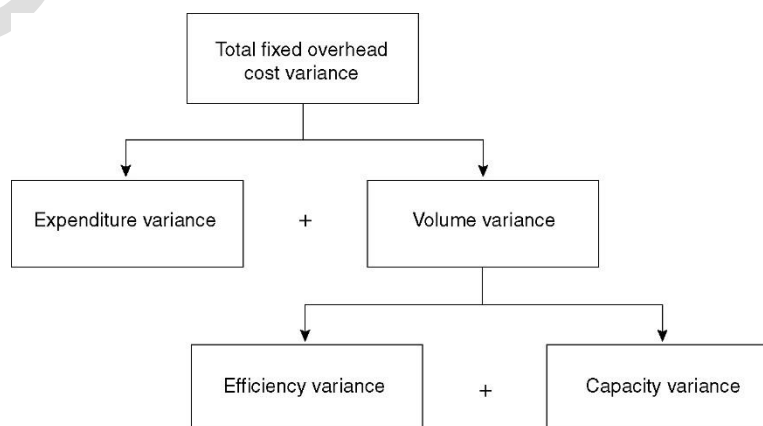
It was explained in an earlier chapter that the total under- or over-absorption of fixed overheads can be analysed into an expenditure variance and a volume variance.

The total volume variance can be analysed even further in standard absorption costing, into a fixed overhead capacity variance and a fixed overhead efficiency variance.

Fixed overhead variances are as follows:



Illustration: Analysis of fixed production overhead variances



5.2 Total fixed production overhead cost variance

The total fixed overhead cost variance is the amount of:

under-absorbed fixed production overhead (= adverse variance) or

over-absorbed fixed production overhead (= favourable variance).

Overheads are absorbed at a standard fixed cost per unit produced, not at standard rate per hour.



Illustration: Fixed production overhead – total cost variance (over/under absorption)

	₦
Fixed production overhead absorbed in the period:	
Actual units produced × Fixed production overhead per unit	X
Actual fixed production overhead incurred in the period	<u>(X)</u>
Total fixed production overhead variance (Over/(under) absorption)	<u><u>X</u></u>

The total fixed production overhead cost variance can be analysed into an expenditure variance and a volume variance. Together, these variances explain the reasons for the under- or over-absorption.



Example: Fixed production overhead – total cost variance (over/under absorption) (Lagos Manufacturing Limited)

Budgeted fixed production overhead	₦2,880,000
Budgeted production hours:	
= Budgeted production volume × Standard hours per unit	
= 1,200 units × 4 hours per unit	4,800 hours
Overhead absorption rate $\frac{₦2,880,000}{4,800 \text{ hours}}$	₦600 per hour
Standard fixed production overhead per unit	
= 4 hours × ₦600 per hour	₦2,400 per unit
Actual fixed production overhead	₦2,500,000
Actual production	1,000 units

The total cost variance for fixed production overhead (over/under absorption) is calculated as follows:

	₦'000
Fixed production overhead absorbed in the period:	
= Actual units produced × Fixed production overhead per unit	
= 1,000 units × ₦2,400 per unit	2,400
Actual fixed production overhead incurred in the period	<u>(2,500)</u>
Under absorption (adverse cost variance)	<u><u>(100)</u></u>

The amount of fixed production overhead absorption rate is a function of the budgeted fixed production overhead expenditure and the budgeted production volume.

The total variance can be explained in these terms.

5.3 Fixed production overhead expenditure variance

A fixed production overhead expenditure variance is very easy to calculate. It is simply the difference between the budgeted fixed production overhead expenditure and actual fixed production overhead expenditure.



Illustration: Fixed production overhead – expenditure variance

	₦
Budgeted fixed production overhead	X
Actual fixed production overhead incurred	(X)
Fixed production overhead expenditure variance	<u>X</u>

An adverse expenditure variance occurs when actual fixed overhead expenditure exceeds the budgeted fixed overhead expenditure.

A favourable expenditure variance occurs when actual fixed overhead expenditure is less than budget.



Example: Fixed production overhead – expenditure variance (Lagos Manufacturing Limited)

	₦'000
Budgeted fixed production overhead	2,880
Actual fixed production overhead	(2,500)
Fixed production overhead expenditure variance (F)	<u>380</u>

Fixed overhead expenditure variances can be calculated, for control reporting, for other overheads as well as production overheads. For example:

an administration fixed overheads expenditure variance is the difference between budgeted and actual fixed administration overhead costs

a sales and distribution fixed overhead expenditure variance is the difference between budgeted and actual fixed sales and distribution overhead costs

5.4 Fixed production overhead volume variance

The fixed production overhead volume variance measures the amount of fixed overheads under- or over-absorbed because of the fact that actual production volume differs from the budgeted production volume.

The volume variance is measured first of all in either units of output or standard hours of the output units.

The volume variance in units (or standard hours of those units) is converted into a money value, as appropriate, at the standard fixed overhead cost per unit (or the standard fixed overhead rate per standard hour produced).

**Illustration: Fixed production overhead – volume variance**

	Units
Actual number of units produced	X
Budgeted production	<u>(X)</u>
Fixed production overhead volume variance (units)	X
Standard absorption rate per unit	<u>X</u>
Fixed production overhead volume variance(₦)	<u><u>X</u></u>

**Example Fixed production overhead – volume variance (Lagos Manufacturing Limited)**

Budgeted fixed production overhead	₦2,880,000
Budgeted production hours:	
= Budgeted production volume × Standard hours per unit	
= 1,200 units × 4 hours per unit	4,800 hours
Overhead absorption rate $\frac{₦2,880,000}{4,800 \text{ hours}}$	₦600 per hour
Standard fixed production overhead per unit	
= 4 hours × ₦600 per hour	₦2,400 per unit
Actual fixed production overhead	₦2,500,000
Actual production	1,000 units

The volume variance is calculated as follows:

	Units
Actual number of units produced	1,000
Budgeted production	<u>(1,200)</u>
Fixed production overhead volume variance(units) (A)	(200)
Fixed production overhead per unit	<u>₦2,400</u>
Fixed production overhead volume variance(₦) (A)	<u><u>(₦480,000)</u></u>



Practice questions

9

A company budgeted to make 5,000 units of a single standard product in Year 1.

Budgeted direct labour hours are 10,000 hours.

Budgeted fixed production overhead is ₦40,000.

Actual production in Year 1 was 5,200 units, and fixed production overhead was ₦40,500.

Calculate the total fixed production overhead cost variance, the fixed overhead expenditure variance and the fixed overhead volume variance for the year.

5.5 Fixed production overhead efficiency and capacity variances

Any volume variance might be due to two reasons.

The company has worked a different number of hours than budgeted. They have operated at a different capacity.

During the hours worked the company has operated at a different level of efficiency to that budgeted.

The fixed production overhead volume variance can be analysed into a fixed overhead efficiency variance and a fixed overhead capacity variance.

Fixed production overhead efficiency variance

This is exactly the same, in hours, as the direct labour efficiency variance and the variable production overhead efficiency variance.

It is converted into a money value at the standard fixed overhead rate per hour.



Illustration: Fixed production overhead – Efficiency variance

	Hours
Standard hours used to make the actual production	X
Actual hours used to make the actual production	(X)
Efficiency variance (hours)	<u>X</u>
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	<u><u>X</u></u>



Example: Fixed production overhead efficiency variance (Lagos Manufacturing Limited)

Standard fixed production overhead cost per unit: (4 hrs × ₦600 per hr) = ₦2,400 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100

Fixed production overhead efficiency variance is calculated as follows:

	Hours
Standard:	
Making 1,000 units should have used (@ 4 hours per unit)	4,000
Actual: Making 1,000 units did use	(4,100)
	100
Efficiency variance (hours) (A)	100
Standard rate per hour	₦600
	₦60,000
Efficiency variance (₦) (A)	

Fixed production overhead capacity variance

This is the difference between the budgeted and actual hours worked (excluding any idle time hours). It is converted into a money value at the standard fixed overhead rate per hour.



Illustration: Fixed production overhead – Capacity variance

	Hours
Actual number of hours worked	X
Budgeted hours to be worked	(X)
	X
Capacity variance (hours)	X
Standard rate per hour (multiply by)	X
	X
Capacity variance (₦)	



Example: Fixed production overhead capacity variance (Lagos Manufacturing Limited)

Budgeted fixed production overhead	₦2,880,000
Budgeted production hours:	
= Budgeted production volume × Standard hours per unit	
= 1,200 units × 4 hours per unit	4,800 hours
Overhead absorption rate $\frac{₦2,880,000}{4,800 \text{ hours}}$	₦600 per hour
Standard fixed production overhead per unit	
= 4 hours × ₦600 per hour	₦2,400 per unit
Actual fixed production overhead	₦2,500,000
Actual production	1,000 units

The fixed production overhead capacity variance is calculated as follows:

	Hours
Actual number of hours worked	4,100
Budgeted hours to be worked	(4,800)
	700

Capacity variance (hours) (A)	700
Standard rate per hour (multiply by)	N600
Capacity variance (N) (A)	<u>N420,000</u>



Practice questions

10



A company budgeted to make 5,000 units of a single standard product in Year 1.

Budgeted direct labour hours are 10,000 hours.

Budgeted fixed production overhead is N40,000.

Actual production in Year 1 was 5,200 units in 10,250 hours of work, and fixed production overhead was N40,500.

Calculate the fixed overhead efficiency variance and the fixed overhead capacity variance for the year.

5.6 Fixed production overheads: possible causes of variances

Some of the possible causes of fixed production overhead variances include the following.

Fixed overhead expenditure variance

Poor control over overhead spending (adverse variance) or good control of overhead spending (favourable variance).

Poor budgeting for overhead spending. If the budget for overhead expenditure is unrealistic, there will be an expenditure variance due to poor planning rather than poor expenditure control.

Unplanned increases or decreases in items of expenditure for fixed production overheads, for example, an unexpected increase in factory rent.

Fixed overhead volume variance

A fixed overhead volume variance can be explained by anything that made actual output volume different from the budgeted volume. The reasons could be:

Efficient working by direct labour: a favourable labour efficiency variance results in a favourable fixed overhead efficiency variance;

Working more hours or less hours than budgeted (capacity variance);

An unexpected increase or decrease in demand for a product, with the result that longer hours were worked (adverse capacity variance).; Strike action by the workforce, resulting in a fall in output below (adverse capacity variance); and

Extensive breakdowns in machinery, resulting in lost production (adverse capacity variance).

6 SALES VARIANCES

Section overview

Sales variances: Introduction
Sales price variance
Sales volume variance
Sales: possible causes of variances

6.1 Sales variances: Introduction

Sales variances, unlike cost variances, are not recorded in a standard costing system of cost accounts (in the cost ledger). However, sales variances are included in variance reports to management.

They help to reconcile actual profit with budgeted profit.

They help management to assess the sales performance.

There are two sales variances:

a sales price variance; and

a sales volume variance

6.2 Sales price variance

A sales price variance shows the difference between:

the actual sales prices achieved for items that were sold; and

their standard sales price

To calculate this variance, you should take the **actual items sold**, and compare the actual sales revenue with the standard selling prices for the items. This compares the revenue actually generated to the revenue that should have been generated if the items were sold at the standard selling price per unit.



Illustration: Sales price variance

	₦
Standard revenue for actual sales	
Actual sales × Standard selling price per unit	X
Actual revenue	
Actual sales × Actual selling price per unit	(X)
	<u>X</u>

There is a favourable sales price variance if units were sold for more than their standard sales price, and an adverse variance if sales prices were below the standard price.



Example: Sales price variance (Lagos Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦15,000
Actual sales volume	900 units
Actual revenue	₦12,600,000

Sales price variance is calculated as follows:

	₦'000
Standard revenue for actual sales	
900 units × ₦15,000 per unit	13,500
Actual revenue	
Actual sales × Actual selling price per unit	(12,600)
Sales price variance (A)	<u>900</u>

6.3 Sales volume variance

A sales volume variance shows the effect on profit of the difference between the actual sales volume and the budgeted sales volume.

In a **standard absorption costing system**, the sales volume variance might be called a sales volume **profit** variance.

The variance is calculated by comparing the actual number of units sold (actual sales volume) to the number of units expected to be sold when the original budget was drafted (budgeted sales volume).

This is then expressed as a money value by multiplying it by the standard profit per unit.



Illustration: Sales volume variance

	Unit
	s
Budgeted sales volume	X
Actual sales volume	<u>(X)</u>
Sales volume variance (units)	X
Standard profit per unit (multiply by)	<u>X</u>
Sales volume variance (₦)	<u>X</u>



Example: Sales volume variance (Lagos Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦15,000
Standard cost per unit (from the standard cost card)	₦10,200
Therefore, standard profit per unit	₦4,800

Actual sales volume	900 units
Actual revenue	₦12,600,000

Sales volume variance is calculated as follows:

	Units
Budgeted sales volume	1,000
Actual sales volume	900
Sales volume variance (units) (A)	100
Standard profit per unit (multiply by)	₦4,800
Sales volume variance (A)	₦480,000

The volume variance is favourable if actual sales volume is higher than the budgeted volume and adverse if the actual sales volume is below budget.

There is an alternative method of calculating the sales volume variance, which produces exactly the same figure for the variance.



Practice question

11

A company budgets to sell 7,000 units of Product P456. It uses a standard absorption costing system. The standard sales price of Product P456 is ₦50 per unit and the standard cost per unit is ₦42.

Actual sales were 7,200 units, which sold for ₦351,400.

Calculate the sales price variance and sales volume variance.

6.4 Sales: possible causes of variances

Possible causes of sales variances include the following:

Sales price variance

Actual increases in prices charged for products were higher or less than expected due to market conditions.

Actual sales prices were less than standard because major customers were given an unplanned price discount.

Competitors reduced their prices, forcing the company to reduce the prices of its own products.

Sales volume variance

Actual sales demand was more or less than expected.

The sales force worked well and achieved more sales than budgeted.

An advertising campaign had more success than expected.

A competitor went into liquidation, and the company attracted some of the former competitor's customers.

The products that the company makes and sells are going out of fashion earlier than expected; therefore, the sales volume variance was adverse.

7 INTERRELATIONSHIPS BETWEEN VARIANCES

Section overview

The nature of interrelationships between variances

Sales price and sales volume

Materials price and usage

Labour rate and efficiency

Labour rate and variable overhead efficiency

Capacity and efficiency

Footnote: the importance of reliable standard costs

7.1 The nature of interrelationships between variances

Some causes of individual variances have already been listed.

The reasons for variances might also be connected, and two or more variances might arise from the same cause. This is known as an interrelationship between two variances.

For example, one variance might be favourable and another variance might be adverse. Taking each variance separately, the favourable variance might suggest good performance and the adverse variance might suggest bad performance. However, the two variances might be inter-related, and the favourable variance and the adverse variance might have the same cause. When this happens, management should look at the two variances together, in order to assess their significance and decide whether control action is needed.

Examples of interrelationships between variances are given below.

7.2 Sales price and sales volume

A favourable sales price variance and an adverse sales volume variance might have the same cause. If a company increases its selling prices above the standard price, the sales price variance will be favourable, but sales demand might fall and the sales volume variance would be adverse.

Similarly, in order to sell more products a company might decide to reduce its selling prices. There would be an adverse sales price variance due to the reduction in

selling prices, but there should also be an increase in sales and a favourable sales volume variance.

7.3 Materials price and usage

A materials price variance and usage variance might be inter-related. For example, if a company decides to use a material for production that is more expensive than the normal or standard material, but easier to use and better in quality, there will be an adverse price variance. However a consequence of using better materials might be lower wastage. If there is less wastage, there will be a favourable material usage variance. Therefore, using a different quality of material can result in an adverse price variance and a favourable usage variance.

7.4 Labour rate and efficiency

If there is a change in the grade of workers used to do some work, both the rate and efficiency variances may be affected.

For example, if a lower grade of labour is used instead of the normal higher grade: there should be a favourable rate variance because the workers will be paid less than the standard rate; and

however, the lower grade of labour may work less efficiently and take longer to produce goods than the normal higher grade of labour would usually take. If the lower grade of labour takes longer, then this will give rise to an adverse efficiency variance.

Therefore the change in the grade of labour used results in two 'opposite' variances, an adverse efficiency variance and a favourable rate variance.

When inexperienced employees are used, they might also waste more materials than more experienced employees would, due to mistakes that they make in their work. The result might not be only adverse labour efficiency, but also adverse materials usage.

7.5 Labour rate and variable overhead efficiency

When a production process operates at a different level of efficiency, the true cost of the difference is the sum of any costs associated with labour hours. Therefore, the issues described above also affect the variable overhead efficiency variance.

7.6 Capacity and efficiency

If a production process operates at a higher level of efficiency, there is probability that it might not have to operate for as long as budgeted to produce the budgeted production volume. The favourable fixed production overhead efficiency variance would cause an adverse fixed production overhead capacity variance.

The reverse is also true. If a production process operates at a lower level of efficiency, there is probability that it might operate for more hours than budgeted. The adverse efficiency fixed production overhead variance would cause a favourable fixed production overhead capacity variance.

7.7 Footnote: the importance of reliable standard costs

It is important to remember that the value of variances as control information for management depends on the reliability and accuracy of the standard costs. If the standard costs are inaccurate, comparisons between actual cost and standard cost will have no meaning. Adverse or favourable variances might be caused by inaccurate standard costs rather than by inefficient or efficient working.

8 RECONCILING BUDGETED AND ACTUAL PROFIT: STANDARD ABSORPTION COSTING

Section overview

Purpose of an operating statement

Format of an operating statement

8.1 Purpose of an operating statement

A management report called an operating statement might be prepared, showing how the difference between budgeted and actual profit is explained by the sales variances and cost variances. An operating statement reconciles the profit that was expected in the budget with the actual profit that was achieved.

The purpose of an operating statement is to report all variances to management so that management can assess the effect they are having on profitability. Senior management can also use an operating statement to assess the success of junior managers in controlling costs and achieving sales.

8.2 Format of an operating statement

In a standard absorption costing system, an operating statement can be set out as follows.

This is best demonstrated with an example. The variances calculated for Lagos Manufacturing Limited will be used.



Example: Operating statement for Lagos Manufacturing Limited (standard total absorption costing)

	₦'000	₦'000	₦'000
Budgeted profit			4,800
Sales price variance		(900)	(A)
Sales volume variance		(480)	(A)
			<u>3,420</u>
Cost variances	(F)	(A)	
Direct materials price	242		
Direct materials usage	150		
Direct labour rate		21	
Direct labour efficiency		50	
Direct labour idle time		50	
Variable production overhead expenditure		125	
Variable production overhead efficiency		20	

Fixed production overhead expenditure	380		
Fixed production overhead efficiency		60	
Fixed production overhead capacity		<u>420</u>	
Total cost variances	<u>772</u>	<u>746</u>	26 F
Actual profit			<u>3,446P</u>

Note: Other overhead expenditure variances, assuming administration overheads and selling and distribution overheads are all fixed costs, are the difference between:

other budgeted overheads expenditure, and

other actual overheads expenditure.

In a system of absorption costing:

The operating statement begins with the budgeted profit.

The sales variances are shown next. These are added to the budgeted profit (favourable variances) or subtracted from the budgeted profit (adverse variances), and the resulting figure is shown as a sub-total. This figure is the actual sales revenue in the period minus the standard production cost of sales.

The cost variances are listed next. They can be listed in any format, but showing separate columns for favourable variances and adverse variances helps to make the statement clear to the reader. Adverse variances reduce the profit and favourable variances add to profit.

The cost variances are added up and then shown as a total.

The actual profit is shown as the final figure, at the bottom of the operating statement.

9 STANDARD MARGINAL COSTING

Section overview

Standard marginal costing
Standard marginal costing variances
Standard marginal costing operating statement

9.1 Standard marginal costing

The Lagos Manufacturing Limited example used in the earlier sections was based on the company using standard total absorption costing.

This sections looks at what happens when a company uses standard marginal costing instead.

Under marginal costing units produced and finished goods inventory are valued at standard variable production cost, not standard full production cost. This means that

the budgeted profit will differ from that found for the same scenario under total absorption costing.

Marginal costing variances are calculated exactly as before with two important differences:

the sales volume variance is expressed as a monetary amount by multiplying the volume variance expressed in units by the standard contribution per unit rather than the standard profit per unit; and

there is no fixed overhead volume variance.

The Lagos Manufacturing Limited example will be used to illustrate the approach.



Example: Standard cost card (Lagos Manufacturing Limited)

		₦
Direct materials	5 kg @ ₦1,000 per kg	5,000
Direct labour	4 hours @ ₦500 per hour	2,000
Variable overhead	4 hours @ ₦200 per hour	800
Marginal production cost		7,800

Fixed budget

Here is the flexed budget to show the detailed calculation of the budgeted profit.



Example: Flexed budget for a period

Lagos Manufacturing Limited has budgeted to make 1,200 units and sell 1,000 units in January.

The selling price per unit is budgeted at ₦15,000.

The standard costs of production are as given in the previous example.

The budget prepared for January is as follows:

Unit sales		1,000
Unit production		1,200
Budget		₦'000
Sales	(1,000 units × 15,000)	15,000
Cost of sales:		
Materials	(1,200 units × ₦5,000 per unit)	6,000
Labour	(1,200 units × ₦2,000 per unit)	2,400
Variable overhead	(1,200 units × ₦800 per unit)	960
		9,360
Closing inventory	(200 units × ₦7,800 per unit)	(1,560)
Cost of sales	(1,000 units × ₦7,800 per unit)	(7,800)
		7,200
Fixed overhead		(2,880)
Profit		4,320

This figure could have been calculated more easily as follows:



Example: Fixed budget for a period

	N'000
Budgeted contribution	
(1,000 units × (N15,000 – N7,800))	7,200
Less: Budgeted fixed production overhead	(2,880)
Profit	4,320

Flexed budget

Here are profit statements redrafted to marginal cost basis.



Example: Fixed budget, flexed budget and actual results for a period. (Lagos Manufacturing Limited)

	Fixed budget	Flexed budget	Actual
Unit sales	1,000	900	900
Unit production	1,200	1,000	1,000

Budget	Budget N'000	Actual N'000	Actual N'000
Sales	15,000	13,500	12,600
Cost of sales:			
Materials	6,000	5,000	4,608
Labour	2,400	2,000	2,121
Variable overhead	960	800	945
	9,360	7,800	7,674
Closing inventory	(1,560)	(780)	(780)
Cost of sales	(10,200)	(7,020)	(6,894)
		6,480	5,706
Fixed overhead	(2,880)	(2,400)	(2,500)
Profit	4,800	4,080	3,206

Note:

The actual closing inventory of 100 units is measured at the standard marginal production cost of N7,800 per unit. This is what happens in standard costing systems.

9.2 Standard marginal costing variances

Identical variances

All variable cost variances are the same under standard total absorption costing and standard marginal costing.

Sales price variance is the same under standard total absorption costing and standard marginal costing.

Fixed overhead variances

Only the fixed production overhead expenditure variance is relevant and this is calculated in the same way as seen previously.

There is no fixed production overhead volume variance

Sales volume variance

The sales volume variance shows the effect on contribution of the difference between the actual sales volume and the budgeted sales volume.

The variance is calculated by comparing the actual number of units sold (actual sales volume) to the number of units expected to be sold when the original budget was drafted (budgeted sales volume).

This is then expressed as a money value by multiplying it by the standard contribution per unit.



Illustration: Sales volume variance (marginal costing)

	Units
Budgeted sales volume	X
Actual sales volume	(X)
Sales volume variance (units)	<u>X</u>
Standard contribution per unit (multiply by)	₦ X
Sales volume variance (₦)	<u>X</u>



Example: Sales volume variance (Lagos Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦15,000
Standard cost per unit (from the standard cost card)	₦7,800
Therefore, standard contribution per unit	₦7,200

Sales volume variance is calculated as follows:

	Units
Budgeted sales volume	1,000
Actual sales volume	900
Sales volume variance (units) (A)	<u>100</u>
Standard contribution per unit (multiply by)	₦7,200
Sales volume variance (A)	<u>₦720,000</u>

9.3 Standard marginal costing operating statement

With standard marginal costing, an operating statement is presented in a different way from an operating statement with standard absorption costing.

Budgeted contribution is reconciled with actual contribution, by means of the sales price variance, sales volume variance and variable cost variances.

Fixed cost expenditure variances are presented in a separate part of the operating statement.



Example: Operating statement for Lagos Manufacturing Limited (standard marginal costing)

	₦'000	₦'000	₦'000	
Budgeted contribution			7,200	
Sales price variance			(900)	(A)
Sales volume variance			(720)	(A)
			<u>5,580</u>	
Cost variances	(F)	(A)		
Direct materials price	242			
Direct materials usage	150			
Direct labour rate		21		
Direct labour efficiency		50		
Direct labour idle time		50		
Variable production o'head expenditure		125		
Variable production o'head efficiency		20		
Total cost variances	<u>392</u>	<u>266</u>	126	F
			5,706P	
Budgeted fixed production overhead		2,880		
Fixed production overhead expenditure variance (F)		<u>(380)</u>		
Less: Actual fixed production overheads			<u>(2,500)</u>	
			<u>3,206</u>	

10 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain standard costing using examples;

Explain and construct a flexed budget;

Calculate sales volume variance;

Calculate, analyse and interpret various variances relating to material, labour and factory overhead(both variable and fixed); and

Prepare an operating statement (TAC and MC) to reconcile budgeted profit to actual profit.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1

The total direct material cost variance is calculated as follows:

	₦
2,000 units of output should cost (×₦15)	30,000
They did cost	<u>33,600</u>
Total direct materials cost variance	<u>3,600 (A)</u>

The variance is adverse, because actual costs were higher than the standard cost.

Solutions

2

The price variance is calculated on the quantity of materials purchased/used.

Materials price variance:

	₦
10,400 litres of materials should cost (×₦3)	31,200
They did cost	<u>33,600</u>
Material price variance	<u>2,400 (A)</u>

The price variance is adverse because the materials cost more to purchase than they should have done (i.e. actual cost was higher than the standard or expected cost).

Solutions**3****Materials usage variance**

	litres	
2,000 units of Product P123 should use (× 5 litres)	10,000	
They did use	10,400	
	<hr/>	
Material usage variance in litres	400	(A)
Standard price per litre of Material A	₦3	
Material usage variance in ₦	<hr/>	₦1,200 (A)

The usage variance is adverse because more materials were used than expected, which has added to costs.

Solutions**4**

	₦	₦	
AQ _{purchased} × AC			
10,400 litres × ₦3 per kg	33,600		
AQ _{purchased} × SC			2,400 (A) Price variance
10,400 litres × ₦3 per kg	31,200		
AQ _{used} × SC			nil inventory movement
10,400 litres × ₦3 per kg	31,200		
SQ _{used} × SC			1,200 (A) Usage variance
10,000 litres × ₦3 per kg	30,000		
SQ = 2,000 units × 5 litres per unit = 10,000 litres			

Solutions**5**

Total direct labour cost variance	₦
3,000 units of output should cost ($\times \text{₦}6$)	18,000
They did cost	<u>16,200</u>
Direct labour total cost variance	<u>1,800 (F)</u>

The variance is favourable, because actual costs were less than the standard cost.

The direct labour rate variance is calculated by taking the actual number of hours worked (and paid for).

Direct labour rate variance	₦
1,400 hours should cost ($\times \text{₦}12$)	16,800
They did cost	<u>16,200</u>
Direct labour rate variance	<u>600 (F)</u>

The rate variance is favourable because the labour hours worked cost less than expected.

The labour efficiency variance, like a materials usage variance, is calculated for the actual number of units produced. The variance in hours is converted into a money value at the standard rate of pay per hour.

Direct labour efficiency variance	hours
3,000 units of Product P234 should take ($\times 0.5$ hours)	1,500
They did take	<u>1,400</u>
Efficiency variance in hours	<u>100 (F)</u>
Standard direct labour rate per hour	₦12
Direct labour efficiency variance in ₦	<u>₦1,200 (F)</u>

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Labour cost variances: summary	₦
Labour rate variance	600 (F)
Labour efficiency variance	<u>1,200 (F)</u>
Total direct labour cost variance	<u>1,800 (F)</u>

Solutions

6

	N'000	N'000
AH _{paid for} AR		
1,400 hours × N X per hour	16,200	} 600 (F) Price variance
AH _{paid for} SR		
1,400 hours × N 12 per hour	16,800	} zero idle time
AH _{worked} SR		
1,400 hours × N 12 per hour	16,800	} 1,200 (F) Efficiency
SH _{worked} SR		
1,500 hours × N 12 per hour	18,000	

SQ = 3,000 units × 0.5 hours per unit = 1,500 hours

Solutions

7

Total variable production overhead cost variance	N
2,000 units of output should cost (× N 3)	6,000
They did cost	<u>6,550</u>
Total variable production overhead cost variance	<u>550</u> (A)

Variable production overhead expenditure variance	N
2,780 hours should cost (× N 2)	5,560
They did cost	<u>6,550</u>
Variable production overhead expenditure variance	<u>990</u> (A)

The expenditure variance is adverse because the expenditure on variable overhead in the hours worked was more than it should have been.

Variable production overhead efficiency variance	hours
2,000 units of Product P123 should take (× 1.5 hours)	3,000
They did take	<u>2,780</u>
Efficiency variance in hours	<u>220</u> (F)

Standard variable production overhead rate per hour	N 2
Variable production overhead efficiency variance in	<u>N</u> 440 (F)

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Variable production overhead cost variances: summary

	N
Variable production overhead expenditure variance	990 (A)
Variable production overhead efficiency variance	<u>440</u> (F)
Total variable production overhead cost variance	<u>550</u> (A)

Solutions

8

	N'000	N'000	
AH _{worked} × AR			
2,780 hours × N1 per hour	6,550		} 990 (A) Expenditure
AH _{worked} × SR			
2,780 hours × N2 per hour	5,560		} 440 (F) Efficiency
SH _{worked} × SR			
3,000 hours × N2 per hour	6,000		

SH = 2,000 units × 1.5 hours per unit = 3,000 hours

Solutions

9

Standard fixed overhead cost per unit = N8 (N40,000/N5,000 units)

Fixed production overhead total cost variance

	N
5,200 units @ standard fixed cost (×N8) = fixed overhead absorbed	41,600
Actual fixed overhead cost expenditure	<u>40,500</u>
Fixed production overhead total cost variance	<u>1,100 (F)</u>

The variance is favourable, because fixed overhead costs have been over absorbed.

Fixed overhead expenditure variance

	N
Budgeted fixed production overhead expenditure	40,000
Actual fixed production overhead expenditure	<u>40,500</u>
Fixed overhead expenditure variance	<u>500 (A)</u>

This variance is adverse because actual expenditure exceeds the budgeted expenditure.

Fixed overhead volume variance

	units of production	
Budgeted production volume in units	5,000	
Actual production volume in units	<u>5,200</u>	
Fixed overhead volume variance in units	<u>200 (F)</u>	

Standard fixed production overhead cost per unit N8

Fixed overhead volume variance in N N1,600 (F)

This variance is favourable because actual production volume exceeded the budgeted volume.

Summary

	N
Fixed overhead expenditure variance	500 (A)
Fixed overhead volume variance	<u>1,600 (F)</u>
Fixed overhead total cost variance	<u>1,100 (F)</u>

Solutions**10**

The standard direct labour hours per unit = 10,000 hours/5,000 units = 2 hours per unit.

The standard fixed overhead rate per hour = $\text{N}40,000/10,000 \text{ hours} = \text{N}4$ per hour.

The standard fixed overhead cost per unit is 2 hours $\times \text{N}4$ per hour = $\text{N}8$ (or $\text{N}40,000/5,000$ units).

Fixed overhead efficiency variance

	hours	
5,200 units should take ($\times 2$ hours)	10,400	
They did take	<u>10,250</u>	
Efficiency variance in hours	150	(F)
Standard fixed overhead rate per hour	<u>$\text{N}4$</u>	
Fixed overhead efficiency variance in N	<u>$\text{N}600$</u>	(F)

Fixed overhead capacity variance

	hours	
Budgeted hours of work	10,000	
Actual hours of work	<u>10,250</u>	
Capacity variance in hours	250	(F)
Standard fixed overhead rate per hour	<u>$\text{N}4$</u>	
Fixed overhead capacity variance in N	<u>$\text{N}1,000$</u>	(F)

The capacity variance is favourable because actual hours worked exceeded the budgeted hours (therefore more units should have been produced).

Summary	N
Fixed overhead efficiency variance	600 (F)
Fixed overhead capacity variance	<u>1,000 (F)</u>
Fixed overhead volume variance	<u>1,600 (F)</u>

Solutions**11**

The sales price variance and sales volume variance are calculated as follows.

Sales price variance	₦
7,200 units should sell for (× ₦50)	360,000
They did sell for	<u>351,400</u>
Sales price variance	<u>8,600 (A)</u>

The sales price variance is adverse because actual sales revenue from the units sold was less than expected.

Sales volume variance:

Actual sales volume (units)	7,200
Budgeted sales volume (units)	<u>7,000</u>
Sales volume variance in units	200 (F)
Standard profit per unit (₦50 – ₦42 = ₦8)	₦8
Sales volume variance (profit variance)	<u>₦1,600 (F)</u>

The sales volume variance is favourable because actual sales exceeded budgeted sales.

Cost-volume-profit (CVP) analysis

Contents

- 1 The nature of CVP analysis
- 2 Break-even analysis
- 3 Break-even charts and profit-volume charts
- 4 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making	
	4	Cost-Volume-Profit (CVP) analysis
	a	Explain the concept of cost-volume-profit analysis.
	a	Calculate break-even point, margin of safety and target profit for a single product.
	c	Prepare and explain break-even chart (traditional approach, contribution approach, profit/volume approach).
	d	Explain the limitations of cost-volume-profit analysis.

Exam context

This chapter explains how to estimate the break-even point in terms of the number of units sold and in terms of the revenue earned. It also explains how to calculate the margin of safety and how to calculate the number of units that must be sold or revenue to be earned to achieve a target profit.

By the end of this chapter you should be able to calculate the:

- Number of units that must be sold to achieve break-even;
- Revenue that must be earned to achieve break-even;
- Margin of safety associated with a given level of production in terms of the number of units sold or revenue earned;
- Number of units that must be sold to achieve a target profit; and
- Revenue that must be earned to achieve a target profit.

1 THE NATURE OF CVP ANALYSIS

Section overview

Introduction to CVP analysis
Assumptions in CVP analysis
Contribution

1.1 Introduction to CVP analysis

CVP analysis stands for **cost-volume-profit analysis**. It is used to show how costs and profits change with changes in the volume of activity. CVP analysis is an application of marginal costing concepts.

This chapter explains CVP analysis and some of its applications.

1.2 Assumptions in CVP analysis

Costs are either fixed or variable. The variable cost per unit is the same at all levels of activity (output and sales). Total fixed costs are constant in each period.

Fixed costs are normally assumed to remain unchanged at all levels of output.

The contribution per unit is constant for each unit sold (of the same product).

The sales price per unit is constant for every unit of product sold; therefore the contribution to sales ratio is also a constant value at all levels of sales.

If sales price per unit, variable cost per unit and fixed costs are not affected by volume of activity, sales and profits are maximised by maximising total contribution.

1.3 Contribution

Contribution is a key concept. Contribution is measured as sales revenue less variable costs.

Profit is measured as contribution minus fixed costs.



Illustration:

	₦
Sales(Units sold × sales price per unit)	X
Variable costs(Units sold × variable cost price per unit)	(X)
Contribution	<u>X</u>
Fixed costs	(X)
Profit	<u>X</u>

Total contribution = Contribution per unit × Number of units sold.

Many problems solved using CVP analysis use either contribution per unit (CPU) or the CS (Contribution/Sales) ratio.

Contribution per unit

It is assumed that contribution per unit (sales price minus variable cost) is a constant amount over all sales volumes.



Example:

A company makes and sells a single product. The product has a variable production cost of ₦8 per unit and a variable selling cost of ₦1 per unit.

Total fixed costs (production, administration and sales and distribution fixed costs) are expected to be ₦500,000.

The selling price of the product is ₦16.

The profit at sales volumes of 70,000, 80,000 and 90,000 units can be calculated as follows

	70,000 units	80,000 units	90,000 units
	₦	₦	₦
Sales revenue (₦16/unit)	1,120,000	1,280,000	1,440,000
Variable cost (₦9/unit)	(630,000)	(720,000)	(810,000)
Contribution (₦7/unit)	490,000	560,000	630,000
Fixed costs	(500,000)	(500,000)	(500,000)
Profit/(loss)	(10,000)	60,000	130,000

Notes

A loss is incurred at 70,000 units of sales because total contribution is not large enough to cover fixed costs. Profit increases as sales volume increases, and the increase in profit is due to the increase in total contribution as sales volume increases.

Somewhere between 70,000 and 80,000 there is a number of units, which if sold would result in neither a profit nor a loss. This is known as the break-even position.

The contribution line could have been completed without calculating the sales and variable costs by simply multiplying the quantity sold by the CPU.



Example:

Facts as before but calculating total contribution as the number of units × contribution per unit.

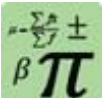
Contribution per unit

	₦
Sales price per unit	16
Variable production cost per unit	(8)
Variable selling cost per unit	<u>(1)</u>
Contribution per unit	<u>7</u>

	70,000 units	80,000 units	90,000 units
	₦	₦	₦
70,000 × ₦7 per unit	490,000		
80,000 × ₦7 per unit		560,000	
90,000 × ₦7 per unit			630,000
Fixed costs	<u>(500,000)</u>	<u>(500,000)</u>	<u>(500,000)</u>
Profit/(loss)	<u>(10,000)</u>	<u>60,000</u>	<u>130,000</u>

CS (Contribution/Sales) ratio

The sales revenue in each case could be calculated by dividing the total contribution for a given level of activity by the CS ratio.



Formula: CS ratio (contribution to sales ratio)

$$\frac{\text{Contribution per unit}}{\text{Selling price per unit}}$$



Example: C/S ratio

Contribution to sales ratio:

$$\text{Contribution per unit} / \text{Selling price per unit} = 7 / 16 = 0.4375$$

	70,000 units	80,000 units	90,000 units
	₦	₦	₦
Contribution (₦7/unit)	490,000	560,000	630,000
CS ratio	<u>÷0.4375</u>	<u>÷0.4375</u>	<u>÷0.4375</u>
Sales revenue	<u>1,120,000</u>	<u>1,280,000</u>	<u>1,440,000</u>

Notes

This may seem a little pointless here as the sales figures were obtained more easily in the first place by multiplying the numbers of units sold by the selling price per unit.

However, we have taken this opportunity to demonstrate this relationship.

2 BREAK-EVEN ANALYSIS

Section overview

Break-even analysis
Calculating the break-even point
Margin of safety
Target profit

2.1 Break-even analysis

CVP analysis can be used to calculate a break-even point for sales.

Break-even point is the volume of sales required in a period (such as the financial year) to 'break even' and make neither a profit nor a loss. At the break-even point, profit is 0.

Management might want to know what the break-even point is in order to:
identify the minimum volume of sales that must be achieved in order to avoid a loss, or
assess the amount of risk in the budget, by comparing the budgeted volume of sales with the break-even volume.

2.2 Calculating the break-even point

The break-even point can be calculated using simple CVP analysis.

At the break-even point, the profit is zero. If the profit is zero, **total contribution is exactly equal to total fixed costs.**

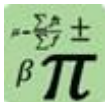
We therefore need to establish the volume of sales at which fixed costs and total contribution are the same amount.

Two methods of calculating the break-even point

There are a number of methods of calculating the break-even point when the total fixed costs for the period are known:

Method 1: Break-even point expressed as a number of units.

The first method is to calculate the break-even point using the contribution per unit. This method can be used where a company makes and sells just one product.



Formula: Break-even point expressed as a number of units

$$\text{Break-even point in sales units} = \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Total fixed costs are the same as the total contribution required to break even, and the break-even point can therefore be calculated by dividing the total contribution required (total fixed costs) by the contribution per unit.

Remember to include any variable selling and distribution costs in the calculation of the variable cost per unit and contribution per unit.

Once the break-even point is calculated as a number of units it is easy to express it in terms of revenue by multiplying the number of units by the selling price per item.



Example: Break-even point as number of units

A company makes a single product that has a variable cost of sales of ₦12 and a selling price of ₦20 per unit. Budgeted fixed costs are ₦600,000.

What volume of sales is required to break even?

Method 1

$$\text{Break-even point in sales units} = \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Contribution per unit = ₦20 – ₦12 = ₦8.

Therefore break-even point:

In units: ₦600,000 / ₦8 per unit = 75,000 units of sales.

In sales revenue: 75,000 units × ₦20 per unit = ₦1,500,000 of sales.

Method 2: Break-even point expressed in sales revenue

The second method calculates the break-even point in sales revenue.



Formula: Break-even point expressed in sales revenue

$$\text{Break-even point in revenue} = \frac{\text{Fixed costs}}{\text{Contribution to sales ratio}}$$

Once the break-even point is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.



Example: Break-even point as revenue

A company makes a single product that has a variable cost of sales of ₦12 and a selling price of ₦20 per unit. Budgeted fixed costs are ₦600,000.

What volume of sales is required to break even?

Method 2

$$\text{Break-even point in revenue} = \frac{\text{Total fixed costs}}{\text{C/S ratio}}$$

C/S ratio = ₦8/₦20 = 40%

Therefore break-even point:

In sales revenue = ₦600,000 / 0.40 = ₦1,500,000 in sales revenue.

In units = ₦1,500,000 ÷ ₦20 (sales price per unit) = 75,000 units.

2.3 Margin of safety

The margin of safety is the difference between:
the budgeted sales (in units or ₦) and
the break-even sales (in units or ₦).

It is usually expressed as a **percentage of the budgeted sales**. However, it may also be measured as:

a quantity of units (= the difference between the budgeted sales volume in units and the break-even sales volume); or

an amount of sales revenue (= the difference between the budgeted sales revenue and the total sales revenue required to break even).

It is called the margin of safety because it is the maximum amount by which actual sales can be lower than budgeted sales without incurring a loss for the period. A high margin of safety therefore indicates a low risk of making a loss.



Example:

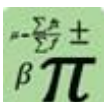
A company budgets to sell 25,000 units of its product. This has a selling price of ₦16 and a variable cost of ₦4. Fixed costs for the period are expected to be ₦240,000.

The break-even point = $\text{₦}240,000 / (\text{₦}16 - 4) = 20,000$ units.

The budgeted sales are 25,000 units.

Margin of safety = Budgeted sales – break-even sales
= 25,000 – 20,000 = 5,000 units

The margin of safety is often expressed as a percentage of budgeted sales.



Formula: Margin of safety ratio

Margin of safety ratio = $\frac{\text{Margin of safety (units)}}{\text{Budgeted sales (units)}}$

Margin of safety ratio = $\frac{\text{Margin of safety (revenue)}}{\text{Budgeted revenue}}$



Example: Margin of safety ratio

Returning to the previous example where the margin of safety was 5,000 units and budgeted sales were 25,000 units.

Margin of safety ratio $\frac{5,000 \text{ units}}{25,000 \text{ units}} = 20\%$ of budgeted sales

This means that sales volume could be up to 20% below budget, and the company should still expect to make a profit.

2.4 Target profit

Management might want to know what the volume of sales must be in order to achieve a target profit. CVP analysis can be used to calculate the volume of sales required.

The volume of sales required must be sufficient to earn a total contribution that covers the fixed costs and makes the target amount of profit. In other words, the contribution needed to earn the target profit is the target profit plus the fixed costs.

The sales volume that is necessary to achieve this is calculated by dividing the target profit plus fixed costs by the contribution per unit in the usual way.



Formula: Volume target expressed in units

$$\text{Target volume (units)} = \frac{\text{Total fixed costs} + \text{target profit}}{\text{Contribution per unit}}$$

Once the target volume is calculated as a number of units, it is easy to express it in terms of revenue by multiplying the number of units by the selling price per item.

Similarly the sales revenue that would achieve the target profit is calculated by dividing the target profit plus fixed costs by the C/S ratio.



Formula: Target volume expressed in sales revenue

$$\text{Volume target in revenue} = \frac{\text{Total fixed costs} + \text{target profit}}{\text{Contribution to sales ratio}}$$

Once the target volume is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.

**Example:**

A company makes and sells a product that has a variable cost of ₦5 per unit and sells for ₦9 per unit.

Budgeted fixed costs are ₦600,000 for the year, and the company wishes to make a profit of at least ₦100,000.

The sales volume required to achieve the target profit can be found as follows:

The total contribution must cover fixed costs and make the target profit.

	₦
Fixed costs	600,000
Target profit	<u>100,000</u>
Total contribution required	<u>700,000</u>

Contribution per unit = ₦9 – ₦5 = ₦4.

Sales volume required to make a profit of ₦100,000:

$$\frac{₦700,000}{₦4 \text{ per unit}} = 175,000 \text{ units.}$$

Therefore the sales revenue required to achieve target profit

$$175,000 \text{ units} \times ₦9 = ₦1,575,000$$

Alternatively:

C/S ratio = 4/9

Sales revenue required to make a profit of ₦100,000

$$= ₦700,000 \div (4/9) = ₦1,575,000.$$

Therefore the number of units required to achieve target profit

$$₦1,575,000 \div ₦9 = 175,000 \text{ units}$$



Practice questions

1

- 1 A company makes a single product that it sells at ₦80 per unit. The total fixed costs are ₦360,000 for the period and the contribution/sales ratio is 60%. Budgeted production and sales for the period is 8,000 units.

Required

Calculate the margin of safety for the period, as a percentage of the budgeted sales.

- 2 A company makes and sells a single product. The following data relates to the current year's budget.

Sales and production (units):	8,000
Variable cost per unit:	₦20
Fixed cost per unit:	₦25
Contribution/sales ratio:	60%

The selling price next year will be 6% higher than the price in the current year budget and the variable cost per unit will be 5% higher than in the current year budget. Budgeted fixed costs next year will be 10% higher than budgeted fixed costs in the current year.

Required

- (a) For the current year, calculate:
- the budgeted contribution per unit
 - the budgeted total profit
- (b) For next year, calculate the number of units that will have to be sold in order to achieve a total profit that is equal to the budgeted profit in the current year.
- 3 (a) Entity D makes a single product which it sells for ₦10 per unit. Fixed costs are ₦48,000 each month and the product has a contribution/sales ratio of 40%.

Required

If budgeted sales for the month are ₦140,000, what is the margin of safety in units?

- (b) Entity E has monthly sales of ₦128,000, but at this level of sales, its monthly profit is only ₦2,000 and its margin of safety is 6.25%.

Required

Calculate:

- the monthly fixed costs
- the level of monthly sales needed to increase the monthly profit to ₦5,000.

3 BREAK-EVEN CHARTS AND PROFIT-VOLUME CHARTS

Section overview

Break-even charts

Profit/volume chart

3.1 Break-even chart

A break-even chart is a chart or graph showing, for all volumes of output and sales:

Total costs, analysed between variable costs and fixed costs;

Sales;

Profit (= the difference between total sales and total costs); and

The break-even point (where total costs = total sales revenue, and profit = 0).

The concept of a break-even chart is similar to a cost behaviour chart, but with sales revenue shown as well.

If the chart also indicates the budgeted volume of sales, the margin of safety can be shown as the difference between the budgeted volume and the break-even volume of sales.

Two examples of break-even charts are shown below. The only difference between them is the way in which variable costs and fixed costs are shown.

In the first diagram, variable costs are shown on top of fixed costs. Fixed costs are represented by the horizontal line of dashes. Fixed costs are the same amount at all volumes of sales. Variable costs are shown on top of fixed costs, rising in a straight line from zero sales. Total costs are shown as the sum of fixed costs and variable costs.

In the second diagram (a more unusual presentation), fixed costs are shown on top of variable costs. An advantage of this method of presentation is that total contribution is shown. This is the difference between the total sales line and the total variable costs line.

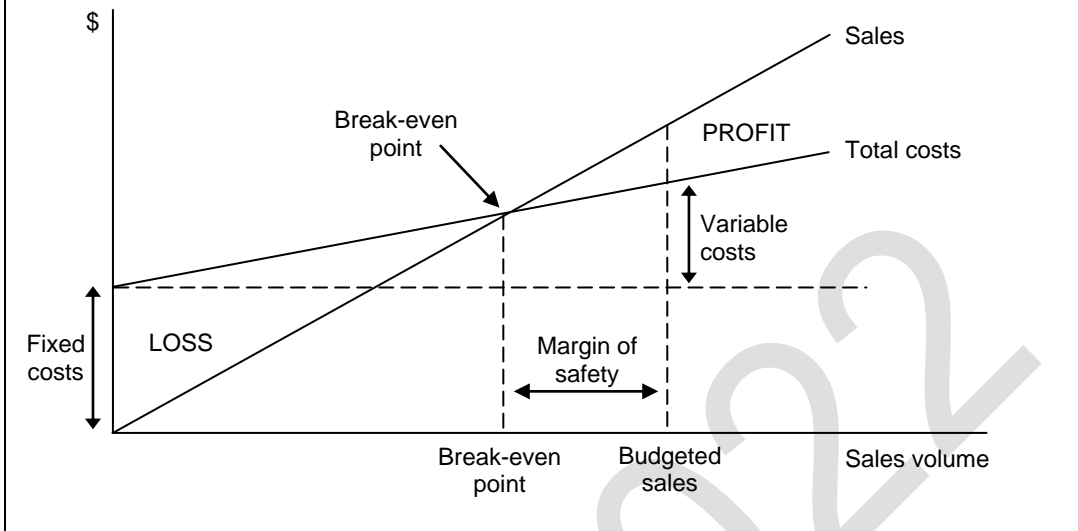
Total costs are exactly the same in both diagrams.

Because the sales price per unit is constant, the total sales revenue line rises in a straight line from the origin of the graph (i.e. from $x = 0, y = 0$).

First break-even chart: variable costs on top of fixed costs



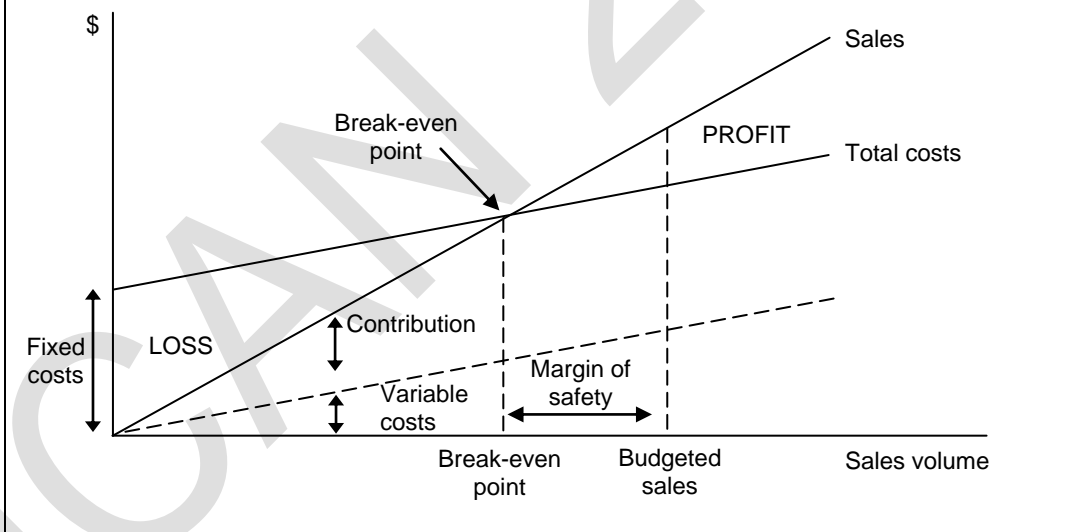
Illustration:



Second break-even chart: fixed costs on top of variable costs



Illustration:



Points to note

You should be able to identify the following points on these charts.

The break-even point is shown on both charts as the volume of sales at which total revenue equals total costs.

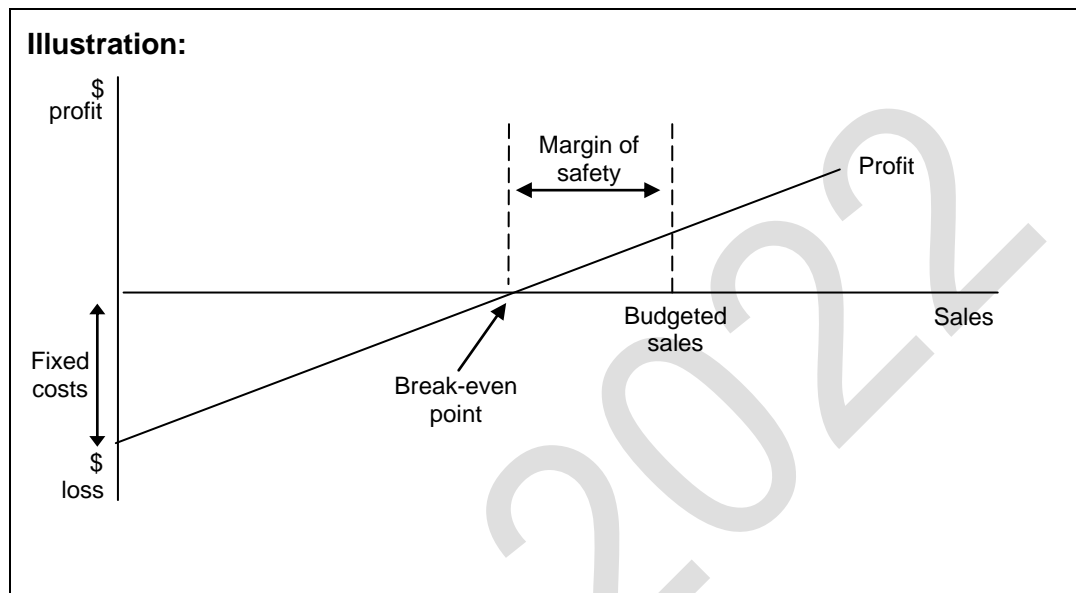
In the second chart, total contribution at the break-even point is shown as exactly equal to fixed costs.

If budgeted sales are shown on the chart, the margin of safety can also be shown, as the difference between budgeted sales and the break-even point.

3.2 Profit/volume chart (P/V chart)

A profit volume chart (or P/V chart) is an alternative to a break-even chart for presenting CVP information. It is a chart that shows the profit or loss at all levels of output and sales.

An example is shown below.



At zero sales, there is a loss equal to the total amount of fixed costs. The loss becomes smaller as sales volume increases, due to the higher contribution as sales volume increases. Break-even point is then reached and profits are made at sales volumes above the break-even point.

A line could also be drawn on the graph to show fixed costs. This line should be drawn parallel to the x axis, starting at the loss (= total fixed costs) at zero sales. By drawing this line for fixed costs, total contribution would be shown as the difference between the line showing the profit (or loss) and the line for the fixed costs.



Practice question

2

You are a management accountant for a business that develops specialist computers. You are consulted to investigate the viability of marketing a new type of hand-held computer.

With the help of the manager of research and development, the production manager, the buyer and the sales manager, you have made the following estimates of annual sales and profitability:

Sales	Profit/(loss)
units	₦
12,000	(30,000)
15,000	150,000
18,000	330,000

The selling price will be ₦150.

Required

- Prepare a traditional break-even chart using the information given above.
- Calculate the margin of safety if annual sales are expected to be 15,000 units.

4 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to calculate the:

- Number of units that must be sold to achieve break-even;
- Revenue that must be earned to achieve break-even;
- Margin of safety associated with a given level of production in terms of the number of units sold or revenue earned;
- Number of units that must be sold to achieve a target profit; and
- Revenue that must be earned to achieve a target profit.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1

- 1 Contribution per unit = $60\% \times \text{N}80 = \text{N}48$
 Fixed costs = $\text{N}360,000$
 Break-even point = $\text{N}360,000 / \text{N}48$ per unit = 7,500 units
 Budgeted sales = 8,000 units
 Margin of safety = $(8,000 - 7,500)$ units = 500 units
 As a percentage of budgeted sales, the margin of safety is $(500/8,000) \times 100\% = 6.25\%$.

- 2 (a) Contribution/sales ratio = 60%
 Therefore variable costs/sales ratio = 40%.
 Variable cost per unit = $\text{N}20$
 Therefore sales price per unit = $\text{N}20 / 0.40 = \text{N}50$.
 Contribution per unit = $\text{N}50 - \text{N}20 = \text{N}30$.

	₦
Budgeted contribution (8,000 × $\text{N}30$)	240,000
Budgeted fixed costs (8,000 × $\text{N}25$)	200,000
Budgeted profit, current year	40,000

- (b) Sales price next year = $\text{N}50 \times 1.06 = \text{N}53$ per unit
 Variable cost per unit next year = $\text{N}20 \times 1.05 = \text{N}21$
 Therefore contribution per unit next year = $\text{N}53 - \text{N}21 = \text{N}32$

	₦
Target profit next year	40,000
Fixed costs next year ($200,000 \times 1.10$)	220,000
Target contribution for same profit as in the current year	260,000

- Therefore target sales next year = $\text{N}260,000 / \text{N}32$ per unit = 8,125 units.

Solutions (continued)**1**

- 3 (a) Break-even point = $\text{N}48,000/0.40 = \text{N}120,000$ (sales revenue).
 Margin of safety (in sales revenue) = $\text{N}140,000 - \text{N}120,000 = \text{N}20,000$.
 Selling price per unit = $\text{N}10$.
 Margin of safety (in units) = $\text{N}20,000/\text{N}10 = 2,000$ units.

- (b) (i) The margin of safety is 6.25%. Therefore the break-even volume of sales = 93.75% of budgeted sales = $0.9375 \times \text{N}128,000 = \text{N}120,000$

	Budget	Break-even
	₦	₦
Sales	128,000	120,000
Profit	(2,000)	(0)
Total costs	<u>126,000</u>	<u>120,000</u>

This gives us the information to calculate fixed and variable costs, using high/low analysis.

	₦	₦	Cost
	Revenue		
High: Total cost at	128,000	=	126,000
Low: Total cost at	120,000	=	120,000
Difference: Variable cost of	<u>8,000</u>	=	<u>6,000</u>

Therefore variable costs = $\text{N}6,000/\text{N}8,000 = 0.75$ or 75% of sales revenue.

Substitute in high or low equation	Cost
	₦
Total cost at $\text{N}128,000$ revenue	126,000
Variable cost at $\text{N}128,000$ revenue ($\times 0.75$)	<u>96,000</u>
Therefore fixed costs	<u>30,000</u>

Solution (continued)**1****Alternative approach**

3 (ii) At sales of ~~₦~~128,000, profit is ~~₦~~2,000.

The contribution/sales ratio = $100\% - 75\% = 25\%$ or 0.25.

To increase profit by ~~₦~~3,000 to ~~₦~~5,000 each month, the increase in sales must be:

(Increase in profit and contribution) \div C/S ratio

= ~~₦~~3,000/0.25 = ~~₦~~12,000.

Sales must increase from ~~₦~~128,000 (by ~~₦~~12,000) to ~~₦~~140,000 each month.

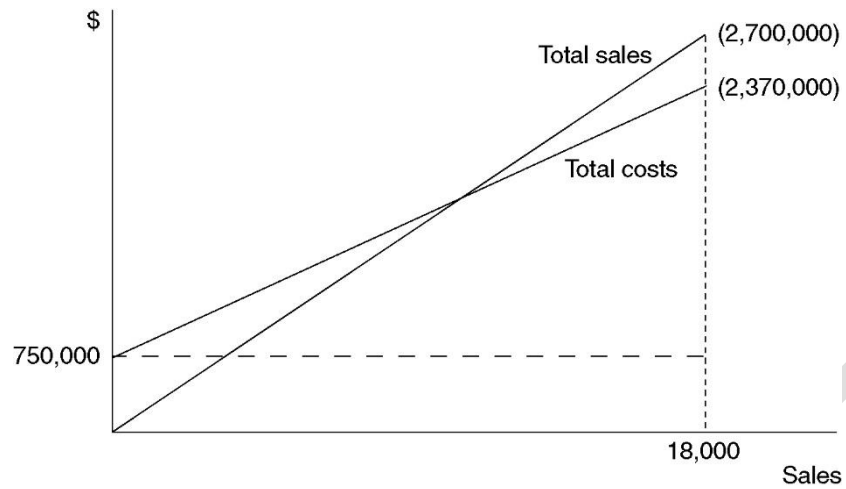
Alternative approach to the answer

	₦
Target profit	5,000
Fixed costs	<u>30,000</u>
Target contribution	<u>35,000</u>
C/S ratio	0.25
Therefore sales required (₦ 35,000/0.25)	<u>₦140,000</u>

Solutions

2

(a)



Workings

	Sales	Sales (at ₦150)	Profit
	units	₦	₦
	18,000	2,700,000	330,000
	12,000	1,800,000	(30,000)
Difference	6,000	900,000	360,000

An increase in sales from 12,000 units to 18,000 units results in an increase of ₦900,000 in revenue and ₦360,000 in contribution and profit.

From this, we can calculate that the contribution is ₦60 per unit (₦360,000/6,000) and the C/S ratio is 0.40 (₦360,000/₦900,000). Variable costs are therefore 0.6 or 60% of sales.

To draw a break-even chart, we need to know the fixed costs.

Substitute in high or low equation

When sales are 18,000 units:	₦
Sales (at ₦150 each)	2,700,000
Variable cost (sales × 60%)	1,620,000
Contribution (sales × 40%)	1,080,000
Profit	330,000
Therefore fixed costs	750,000

When sales are 18,000 units:	₦
Fixed costs	750,000
Variable cost (see above)	1,620,000
Total costs	2,370,000

Solution (continued)**2**

(b) Break-even point = Fixed costs ÷ C/S ratio

$$= \text{₦}750,000 / 0.40 = \text{₦}1,875,000$$

Break-even point in units = $\text{₦}1,875,000 / \text{₦}150$ per unit = 12,500 units.

If budgeted sales are 15,000 units, the margin of safety is 2,500 units.

This is 1/6 or 16.7% of the budgeted sales volume.

Relevant cost and revenue

Contents

- 1 The concept of relevant costing
- 2 Identifying relevant costs
- 3 Chapter review

INTRODUCTION

Aim

Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making	
	5	Decision making
	a	Explain the concept of relevant cost and revenue.

Exam context

This chapter explains the concept of relevant costs and revenue and how to identify and estimate them in order to provide information for making decisions.

By the end of this chapter, you should be able to:

- Explain the characteristics of relevant costs;
- Explain and differentiate between avoidable and unavoidable costs;
- Explain the meaning of incremental cost (revenue), differential costs (revenue), sunk costs and opportunity costs (revenue); and
- Measure relevant costs and revenue associated with a particular decision.

1 THE CONCEPT OF RELEVANT COSTING

Section overview

Information for decision-making
Marginal costing and decision-making
Relevant costs and decision-making
Terms used in relevant costing
Opportunity costs

1.1 Information for decision-making

Management make decisions about the future. When they make decisions for economic or financial reasons, the objective is usually to increase profitability or the value of the business, or to reduce costs and improve productivity.

When managers make a decision, they make a choice between different possible courses of action (options), and they need relevant and reliable information about the probable financial consequences of the different options available. A function of management accounting is to provide information to help managers to make decisions, by providing estimates of the consequences of selecting any option.

Traditionally, cost and management accounting information was derived from historical costs (a measurement of actual costs). For example, historical costs are used to assess the profitability of products, and control. Reporting typically involves a comparison of actual historical costs with a budget or standard costs.

Accounting information for decision-making is different, because decisions affect the future, not what has already happened in the past. Accounting information for decision-making should therefore be based on estimates of future costs and revenues.

Decisions affect the future, but cannot change what has already happened. Decision-making should therefore look at the future consequences of an action, and should not be influenced by historical events and historical costs.

Decisions should consider what can be changed in the future. They should not be influenced by what will happen in the future that is unavoidable, possibly due to commitments that have been made in the past.

Economic or financial decisions should be based on future cash flows, not future accounting measurements of costs or profits. Accounting conventions, such as the accruals concept of accounting and the depreciation of non-current assets, do not reflect economic reality. Cash flows, on the other hand, do reflect the economic reality of decisions. Managers should therefore consider the effect that their decisions will have on future cash flows, not reported accounting profits.

1.2 Marginal costing and decision-making

Marginal costing might be used for decision-making. (This will be explained in more detail in the next chapter).

It is appropriate to use marginal costing for decision-making when it can be assumed that future fixed costs will be the same, no matter what decision is taken, and that all variable costs represent future cash flows that will be incurred as a consequence of any decision that is taken.

These assumptions about fixed and variable costs are not always valid. When they are not valid, relevant costs should be used to evaluate the economic/financial consequences of a decision.

1.3 Relevant costs and decision-making

Relevant costs should be used for assessing the economic or financial consequences of any decision by management. Only relevant costs and benefits should be taken into consideration when evaluating the financial consequences of a decision.

A relevant cost is a future cash flow that will occur as a direct consequence of making a particular decision.

The key concepts in this definition of relevant costs are as follows:

Relevant costs are **costs that will occur in the future**. They cannot include any costs that have already occurred in the past;

Relevant costs of a decision are **costs that will occur as a direct consequence of making the decision**. Costs that will occur anyway, no matter what decision is taken, cannot be relevant to the decision; and

Relevant costs are **cash flows**. Therefore, notional costs, such as depreciation charges, notional interest costs and absorbed fixed costs, cannot be relevant to a decision.

1.4 Terms used in relevant costing

Several terms are used in relevant costing, to indicate how certain costs might be relevant or not relevant to a decision.

Incremental cost

An incremental cost is an additional cost that will occur if a particular decision is taken. Provided that this additional cost is a cash flow, an incremental cost is a relevant cost.



Example: Incremental cost

A company has identified that each cost unit it produces has the following costs:

	N000
Direct materials	50
Direct labour	20
	<hr/>
	70
Fixed production overhead	30
	<hr/>
Total absorption cost	100

Making one extra unit would not affect the fixed cost base.

The incremental cost of making one extra unit is N70,000.

There are different types of incremental cost (revenue) and these are explained in the following paragraphs.

Differential cost

A differential cost is an incremental cost.

A differential cost is the amount by which future costs will be different, depending on which course of action is taken. A differential cost is therefore an amount by which future costs will be higher or lower, if a particular course of action is chosen. Provided that this additional cost is a cash flow, a differential cost is a relevant cost.



Example: Differential cost

A company rents a photocopier for N2,000 each month

It is considering switching to a larger photocopier that will cost N3,600 each month.

If it hires the larger photocopier, it will be able to terminate the rental agreement for the current copier immediately.

The decision is whether to continue with using the current photocopier, or to switch to the larger copier.

The differential cost of the larger copier is N1,600 per month.

(The company would have to decide if it is worth paying this amount for the extra benefits the larger model would bring.)



Example: Differential revenue

A fruit seller rents a stall on a side street and makes sales of ₦15,000 per month.

He is considering moving to a new shop on a main thoroughfare.

He estimates that his sales would increase to ₦25,000 due to the better location.

The differential revenue from the move is ₦10,000 per month.

(The fruit seller would compare the differential revenue to the differential costs associated with the move. The differential costs would include the increase in rent for the better location and also the increase in cost of the fruit sold together with any other incremental expenses).

Avoidable and unavoidable costs

An avoidable cost is a cost that could be saved (avoided), depending whether or not a particular decision is taken (it is incremental to the decision). An unavoidable cost is a cost that will be incurred anyway (it is not incremental to the decision).

Avoidable costs are relevant costs.

Unavoidable costs are not relevant to a decision.



Example: Avoidable and unavoidable costs

A company has one year remaining on a short-term lease agreement on a warehouse. The rental cost is ₦100,000 per year.

The warehouse facilities are no longer required.

If the company stop using the warehouse, it would be committed to paying the rental cost up to the end of the term of the lease.

However, it would save local taxes of ₦16,000 for the year, and security costs of ₦40,000 each year.

The decision about whether to close down the unwanted warehouse should be based on relevant costs only.

The rental cost of the warehouse cannot be avoided, and so should be ignored in the economic assessment of the decision whether to close the warehouse or keep it open for another year.

Local taxes and the costs of the security services (₦56,000 in total for the next year) are relevant costs because they would be avoided if the company stops using the warehouse (i.e. they are incremental to the decision).

Committed cost

Committed costs are a category of unavoidable costs. A committed cost is a cost that a company has already committed to or an obligation already made, that it cannot avoid by any means. A committed cost is not incremental to a decision.

Committed costs are not relevant costs for decision making.



Example: Committed cost

A company bought a machine one year ago and entered into a maintenance contract for ₦20,000 for three years.

The machine is being used to make an item for sale. Sales of this item are disappointing and are only generating ₦15,000 per annum and will remain at this level for two years.

The company believes that it could sell the machine for ₦25,000.

The relevant costs in this decision are the selling price of the machine and the revenue from sales of the item.

If the company sold the machine it would receive ₦25,000 but lose ₦30,000 revenue over the next two years – an overall loss of ₦5,000

The maintenance contract is irrelevant as the company has to pay ₦20,000 per annum whether it keeps the machine or sells it.

Leases normally represent a committed cost for the full term of the lease, since it is extremely difficult to terminate a lease agreement.

Sunk costs

Sunk costs are costs that have already been incurred (historical costs) or costs that have already been committed by an earlier decision. Sunk costs must be ignored for the purpose of evaluating a decision, and cannot be relevant costs.



Example: Sunk cost

A company must decide whether to launch a new product on to the market.

It has spent ₦900,000 on developing the new product, and a further ₦80,000 on market research.

A financial evaluation for a decision whether or not to launch the new product should ignore the development costs and the market research costs, because the ₦980,000 has already been spent. The costs are sunk costs.

1.5 Opportunity costs

Relevant costs can also be measured as an opportunity cost. An opportunity cost is a benefit that will be lost by taking one course of action instead of the next-most profitable course of action.



Example: Opportunity costs

A company has been asked by a customer to carry out a special job. The work would require 20 hours of skilled labour time.

There is a limited availability of skilled labour, and if the special job is carried out for the customer, skilled employees would have to be moved from doing other work that earns a contribution of ₦600 per labour hour.

A relevant cost of doing the job for the customer is the contribution that would be lost by switching employees from other work.

This contribution forgone (20 hours × ₦600 = ₦12,000) would be an opportunity cost and should be taken into consideration as a cost that would be incurred as a direct consequence of a decision to do the special job for the

customer.

In other words, the opportunity cost is a relevant cost in deciding how to respond to the customer's request.

The above example is slightly misleading. It is correct in that the opportunity cost of ₦12,000 is a relevant cost. However, the cost of paying the skilled labour is also a relevant cost. This is difficult to understand as a person could be forgiven for reasoning that the cost of paying the skilled labour is not incremental as the company would pay it anyway! Consider the following example which attempts to explain this apparent illogicality.



Example: Opportunity costs

A company has been asked by a customer to carry out a special job. The work would require 20 hours of skilled labour time.

Skilled labour is paid at ₦400 per hour.

There is a limited availability of skilled labour, and if the special job is carried out for the customer, skilled employees would have to be moved from doing other work that earns a contribution of ₦600 per labour hour.

The fact that each hour of skilled labour is making a contribution of ₦600 means that in each hour they must be doing something that is being sold for ₦1,000 (this amount less the cost of employing skilled labour giving a contribution of ₦600).

Therefore, if they are transferred to do something else whatever they make that is being sold for ₦1,000 will not be made and this amount will be lost.

Therefore the relevant cost per hour is ₦1,000 (being the lost contribution per hour + the hourly rate of pay).

Another way of looking at this is as follows:

	Current use of labour	but if used on special job	Increment
	₦	₦	
Sales(per hour of labour)	1,000	nil	(1,000)
Cost per hour of labour	(400)	(400)	nil

This might seem a little complicated but all it means is that transferring the skilled resource to the special job would only be worthwhile if it generated more revenue than it does at the moment (i.e. ₦1,000 per hour).

2 IDENTIFYING RELEVANT COSTS

Section overview

Relevant cost of materials

Relevant cost of labour

Relevant cost of overhead

There are certain rules or guidelines that might help you to identify the relevant costs for evaluating any management decision.

2.1 Relevant cost of materials

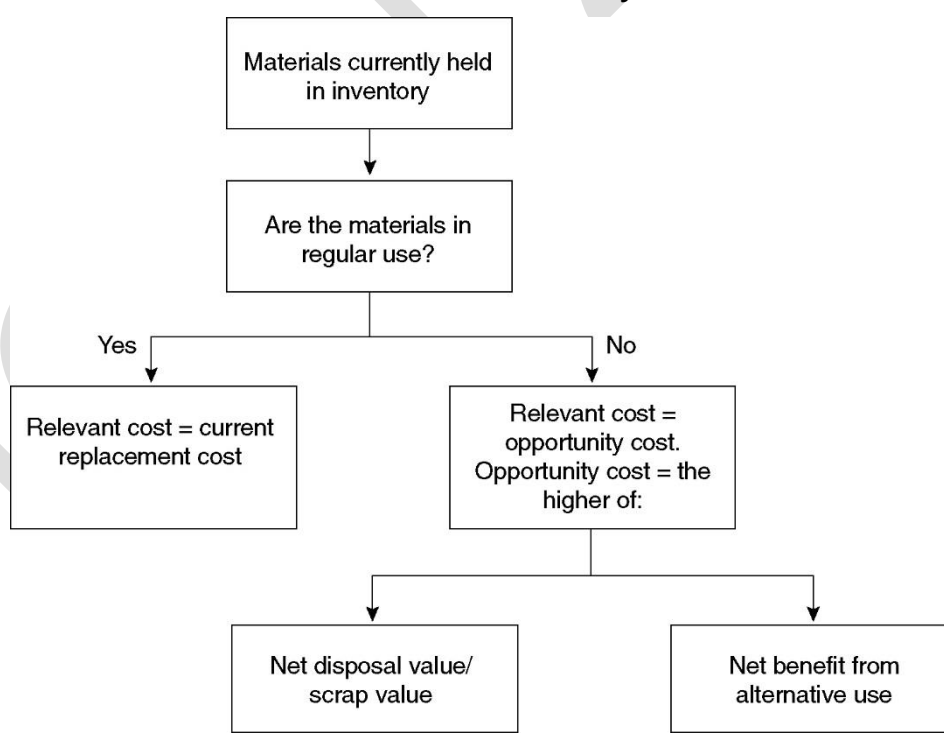
The relevant costs of a decision to do some work or make a product will usually include costs of materials. Relevant costs of materials are the additional cash flows that will be incurred (or benefits that will be lost) by using the materials for the purpose that is under consideration.

If materials required are not already held as inventory the relevant cost of the materials is simply their purchase cost.

Identifying the relevant cost of materials already held in inventory is a little more complicated. The relevant cost depends on what else the company would do with the inventory if it were not used in for the purpose under consideration.



Illustration: Relevant cost of material already held



Note that the historical cost of materials held in inventory cannot be the relevant cost of the materials, because their historical cost is a sunk cost.

The relevant costs of materials can be described as their 'deprival value'. The deprival value of materials is the benefit or value that would be lost if the company were deprived of the materials currently held in inventory.

If the materials are regularly used, their deprival value is the cost of having to buy more units of the materials to replace them (their replacement cost).

If the materials are not in regular use, their deprival value is either the net benefit that would be lost because they cannot be disposed of (their net disposal or scrap value) or the benefits obtainable from any alternative use. In an examination question, materials in inventory might not be in regular use, but could be used as a substitute material in some other work. Their deprival value might therefore be the purchase cost of another material that could be avoided by using the materials held in inventory as a substitute.



Example: Relevant cost of material already held

A company has been asked to quote a price for a one-off contract.

The contract would require 5,000 kilograms of material X.

Material X is used regularly by the company.

The company has 4,000 kilograms of material X currently in inventory, which cost ₦400 per kilogram.

The price for material X has since risen to ₦420 per kilogram.

Relevant cost of the Material X is as follows:

Material X is in regular use.

Therefore, any units used would have to be replaced for other work.

Therefore, the relevant cost is the replacement cost.

Relevant cost = replacement cost = 5,000 kilograms × ₦420 = ₦2,100,000.



Example: Relevant cost of material already held

A company has been asked to quote a price for a one-off contract.

The contract requires 2,000 kilograms of material Y.

There are 1,500 kilograms of material Y in inventory, but because of a decision taken several weeks ago, material Y is no longer in regular use by the company.

The 1,500 kilograms originally cost ₦1,440,000 and have a scrap value of ₦360,000.

New purchases of material Y would cost ₦1,000 per kilogram.

Relevant cost of the Material Y is as follows:

Material Y is not in regular use.

There are 1,500 kilograms in inventory, and an additional 500 kilograms would have to be purchased.

The relevant cost of material Y for the contract would be:

	₦
Material held in inventory	
The original cost is not relevant – it is a sunk cost	
The relevant cost of using this material on the one-off contract is scrap value (as the company would miss out on these proceeds)	360,000
New purchases	
(500 kg × ₦1,000)	500,000
Total relevant cost of Material Y	<u>800,600</u>

2.2 Relevant cost of labour

The relevant costs of a decision to do some work or make a product will usually include costs of labour.

The relevant cost of labour for any decision is the additional cash expenditure (or saving) that will arise as a direct consequence of the decision.

If the cost of labour is a variable cost, and labour is not in restricted supply, the relevant cost of the labour is its variable cost. For example, suppose that part-time employees are paid ₦18 per hour, they are paid only for the hours that they work and part-time labour is not in short supply. If management is considering a decision that would require an additional 100 hours of part-time labour, the relevant cost of the labour would be ₦18 per hour or ₦1,800 in total.

If labour is a fixed cost and there is spare labour time available, the relevant cost of using labour is nil. The spare time would otherwise be paid for as idle time, and there is no additional cash cost of using the labour to do extra work. For example, suppose that a new contract would require 30 direct labour hours, direct labour is paid ₦20 per hour, and the direct workforce is paid a fixed weekly wage for a 40-hour week. If there is currently spare capacity, so that the labour cost would be idle time if it is not used for the new contract, the relevant cost of using 30 hours on the new contract would be nil. The 30 labour hours must be paid for whether or not the contract work is undertaken.

If labour is in limited supply, the relevant cost of labour should include the opportunity cost of using the labour time for the purpose under consideration instead of using it in its next-most profitable way.



Example: Relevant cost of labour

A proposed new contract would require 200 hours of work in department 1. There are 50 employees in the department each earning ₦160 per hour for a fixed 40-hour week.

Currently the department has 1,700 hours work per week and there are no plans to reduce the workforce.

Analysis of relevant cost of labour from department 1

There is spare capacity in department 1 and no additional cash expenditure would be incurred on labour if the contract is undertaken.
Relevant cost = nil.



Example: Relevant cost of labour

A proposed new contract would require 100 hours of work in department 2.

The workforce is paid ₦240 per hour.

This department is currently working at full capacity.

The company could ask the workforce to do overtime work, paid for at the normal rate per hour plus 50% overtime premium.

Alternatively, the workforce could be diverted from other work that earns a contribution of ₦80 per hour.

Analysis of relevant cost of labour from department 2

There is restricted labour capacity. If the contract is undertaken, there would be a choice between:

	Hourly cost ₦
Overtime work: (₦240 plus overtime premium of 50%)	360
Diverting the labour from other work	
Lost contribution of per hour	80
Labour cost per hour	240
	320

Faced with this choice the company would divert labour from other work to give a relevant cost of:

$$100 \text{ hours} \times \text{₦}320 \text{ per hour} = \text{₦}32,000$$



Example: Relevant cost of labour

A proposed new contract would require 300 hours of work in department 3.

The workforce is paid ₦240 per hour.

Labour in this department is in short supply and all the available time is currently spent making product Z, which earns the following contribution:

	₦
Sales price	980
Labour (2 hours per unit)	480
Other variable costs	300
	<u>(780)</u>
Contribution per unit of product Z	<u>200</u>

Analysis of relevant cost of labour from department 3

There is restricted labour capacity.

If the contract is undertaken, labour would have to be diverted from making product Z which earns a contribution of ₦200 per unit or ₦100 per labour hour (₦200/2 hours).

The relevant cost of the labour in department 3 is:

	₦
Labour cost per hour	240
Contribution forgone per hour	100
Relevant cost per hour	<u>340</u>

Relevant cost of 300 hours = $300 \times \text{₦}340 = \text{₦}102,000$.

2.3 Relevant cost of overheads

Relevant costs of expenditures that might be classified as overhead costs should be identified by applying the normal rules of relevant costing. Relevant costs are future cash flows that will arise as a direct consequence of making a particular decision.

Fixed overhead absorption rates are therefore irrelevant, because fixed overhead absorption is not overhead expenditure and does not represent cash spending

However, it might be assumed that the overhead absorption rate for **variable** overheads is a measure of actual cash spending on variable overheads. It is therefore often appropriate to treat a variable overhead hourly rate as a relevant cost, because it is an estimate of cash spending per hour for each additional hour worked.

The only overhead fixed costs that are relevant costs for a decision are extra cash spending that will be incurred, or cash spending that will be saved, as a direct consequence of making the decision.



Practice questions

1

- 1 A company bought a machine six years ago for ₦125,000. Its written down value is now ₦25,000. The machine is no longer used for normal production work, and it could be sold now for ₦17,500. A project is being considered that would make use of this machine for six months. After this time the machine would be sold for ₦10,000.

Required

Calculate the relevant cost of the machine to the project.

- 2 A contract is under consideration which would require 1,400 hours of direct labour. There is spare capacity of 500 hours of direct labour, due to the cancellation of another order by a customer. The other time would have to be found by asking employees to work in the evenings and at weekends, which would be paid at 50% above the normal hourly rate of ₦15.

Alternatively, the additional hours could be found by switching labour from other work which earns a contribution of ₦5 per hour.

Required

Calculate the relevant cost of direct labour if the contract is accepted and undertaken.

3 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the characteristics of relevant costs;

Explain and differentiate between avoidable and unavoidable costs;

Explain the meaning of incremental cost (revenue), differential costs (revenue), sunk costs and opportunity costs (revenue); and

Measure relevant costs and revenue associated with a particular decision.

SOLUTIONS TO PRACTICE QUESTIONS

Solutions

1

- 1 Relevant cost = Difference between sale value now and sale value if it is used. This is the relevant cost of using the machine for the project.

$$\text{Relevant cost} = \text{N}17,500 - \text{N}10,000 = \text{N}7,500.$$

- 2 A total of 900 hours would have to be found by either working overtime at a cost of $\text{N}15 \times 150\% = \text{N}22.50$ per hour, or diverting labour from other work that earns a contribution of $\text{N}5$ per hour after labour costs of $\text{N}15$ per hour. The opportunity cost of diverting labour from other work is therefore $\text{N}20$ per hour. This is less than the cost of working overtime. If the contract is undertaken, labour will therefore be diverted from the other work.

It is assumed that the 500 hours of free labour time (idle time) available would be paid for anyway, even if the contract is not undertaken. The relevant cost of these hours is therefore $\text{N}0$.

Relevant cost of labour

500 hours	0
900 hours ($\times \text{N}20$)	18,000
Total relevant cost of labour	<u>18,000</u>

Decision-making techniques

Contents

- 1 Costs for decision-making
- 2 Limiting factor decisions
- 3 Make or buy decisions
- 4 Other short-term decisions
- 5 Chapter review

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Accountants play a vital role in management and management decision-making. Business information deals with the production of accurate and useful information to support management and decision-making including costing, management accounting and the application of quantitative methods in financial management.

Detailed syllabus

The detailed syllabus includes the following:

B	Forecasting, budgeting and decision making		
	5	Decision making	
		a	Explain the concept of limiting factor.
		c	Describe short-term decision making situations involving make or buy decisions using relevant cost approach.
		d	Explain and calculate optimal resource allocation to a product or service based on the concept of limiting factor (single constraint/bottleneck).

Exam context

This chapter explains the concept of limiting factors, how to identify them and how to formulate an optimum production plan when there is a single limiting factor.

Problems involving more than one limiting factors are solved using linear programming. This is examined in **Paper B4: Performance Management** and not in this paper.

By the end of this chapter, you should be able to:

- Explain the issue of limiting factors;
- Identify limiting factors;
- Carry out limiting factor analysis to formulate an optimal production plan (i.e., the production plan that maximises contribution and hence profit); and
- Analyse relevant costs to decide whether to make or buy a good.

1 COSTS FOR DECISION-MAKING

Section overview

Management information for making decisions

Using marginal costing for decision-making

1.1 Management information for making decisions

One of the functions of management is to make decisions about how to run the business. Decisions involve making a choice about what should be done, between different possible options. To help them make good-quality decisions, managers need reliable and relevant information.

Both financial and non-financial information is needed to make decisions. This chapter (and the chapters that follow) concentrate mainly on financial information for decision-making, but it is useful to remember that factors of a non-financial nature will often influence the choices that managers make.

Since it is often assumed that the aim of a business should be to maximise profits, financial information to assist managers with decision-making will consist mainly of information about revenues and costs.

Information for decision-making is different from information about historical costs. This is because decisions are concerned with the future, not what has happened in the past.

The following principles of relevant costs and revenues should be applied to all decision-making by management.

Information about costs and revenues should be about future costs and future revenues.

Decisions should be concerned with cash and cash flow. Only those costs and revenues that represent cash flow are relevant to decision-making. Non-cash items of cost or revenue, such as depreciation or absorbed fixed overheads, are not relevant for decision-making. The conventions of financial accounting and financial reporting, such as the accruals concept, are irrelevant for business decisions.

It is assumed for the purpose of providing cost information for decision-making that the aim or objective is to maximise profit.

Historical costs are irrelevant for decision-making, because they are not future costs. Costs that have been incurred in the past are 'sunk costs': they have already happened, and any decision taken now cannot affect what has already happened in the past.

A useful definition of relevant costs and revenues is as follows:



Definition

Relevant costs and revenues are future cash flows that would arise as a direct consequence of a decision being taken.

1.2 Using marginal costing for decision-making

It is often assumed that marginal costs are relevant costs for the purpose of decision-making.

The marginal cost of a product is the extra cost that would be incurred by making and selling one extra unit of the product.

Similarly, the marginal cost of an extra hour of direct labour work is the additional cost that would be incurred if a direct labour employee worked one extra hour. When direct labour is a variable cost, paid by the hour, the marginal cost is the variable cost of the direct labour wages plus any variable overhead cost related to direct labour hours.

This chapter focuses on decision-making when there are limiting factors that restrict operational capabilities. Decision-making techniques for limiting factor situations are based on the following assumptions:

The objective is to maximise profit and this is achieved by maximising contribution;
Marginal costs (variable costs) are the only relevant costs to consider in the model;
and

Fixed costs will be the same whatever decision is taken; therefore fixed costs are not relevant to the decision.

2 LIMITING FACTOR DECISIONS

Section overview

Limiting factor: the issue

Identifying limiting factors

Maximising profit when there is a single limiting factor

2.1 Limiting factor: the issue

It is often assumed in budgeting that a company can produce as many units of its products (or services) as is necessary to meet the available sales demand. Sales demand is therefore normally the factor that sets a limit on the volume of production and sales in each period.

Sometimes, however, there could be a shortage of a key production resource, such as an item of direct materials, or skilled labour, or machine capacity. In these circumstances, the factor setting a limit to the volume of sales and profit in a particular period is the availability of the scarce resource, because sales are restricted by the amount that the company can produce.

If the company makes just one product and a production resource is in limited supply, profit is maximised by making as many units of the product as possible with the limited resources available.

However, when a company makes and sells more than one different product with the same scarce resource, a budgeting problem is to decide how many of each different product to make and sell in order to maximise profits.

2.2 Identifying limiting factors

A question might tell you that there is a restricted supply of a resource without telling you which one it is.

In this case you must identify the limiting factor by calculating the budgeted availability of each resource and the amount of the resource that is needed to meet the available sales demand.



Example: Identifying a limiting factor

A company manufactures and sells two products, Product X and Product Y which are both manufactured using two different machines.

The time taken to make each product together with the maximum machine time availability and contribution per unit and demands are as follows:

Product	X	Y	Hours available
Machine type 1	10 minutes per unit (6 units per hour)	6 minutes per unit (10 units per hour)	3,000 hours
Machine type 2	5 minutes per unit (12 units per hour)	12 minutes per unit (5 units per hour)	4,200 hours
Sales demand in units	12,000	15,000	

The machine which is the limiting factor is identified by calculating the time needed to meet the total demands for both goods and comparing that to the machine time available:

	Machine type 1 (hours)	Machine type 2 (hours)
12,000 ÷ 6 per hour	2,000	
12,000 ÷ 12 per hour		1,000
Making 15,000 units of Y would use:		
15,000 ÷ 10 per hour	1,500	
15,000 ÷ 5 per hour		3,000
Total hours needed to meet maximum demand	<u>3,500</u>	<u>4,000</u>
Total hours available	<u>3,000</u>	<u>4,200</u>

Therefore, machine 1 time is the limiting factor

2.3 Maximising profit when there is a single limiting factor

When there is just one limiting factor (other than sales demand), total profit will be maximised in a period by maximising the total contribution earned with the available scarce resources.

The approach is to select products for manufacture and sale according to the contribution per unit of scarce resource in that product.

Step 1: Calculate the contribution per unit of each type of good produced.

Step 2: Identify the scarce resource.

Step 3: Calculate the amount of scarce resource used by each type of good produced.

Step 4: Divide the contribution earned by each good by the scarce resource used by that good to give the contribution per unit of scarce resource for that good.

Step 5: Rank the goods in order of the contribution per unit of scarce resource.

Step 6: Construct a production plan based on this ranking. The planned output and sales are decided by working down through the priority list until all the units of the limiting factor (scarce resource) have been used.



Example: Limiting factor analysis

A company manufactures and sells two products, Product X and Product Y which are both manufactured using two different machines.

The time taken to make each product together with the maximum machine time availability and contribution per unit and demands are as follows:

Product	X	Y	Hours available
Machine type 1	10 minutes per unit (6 units per hour)	6 minutes per unit (10 units per hour)	3,000 hours
Machine type 2	5 minutes per unit (12 units per hour)	12 minutes per unit (5 units per hour)	4,200 hours
Contribution per unit	₦7	₦5	
Sales demand in units	12,000	15,000	

Given that machine 1 is a limiting factor the optimal production plan (that which maximises annual contribution and hence profit) can be found as follows:

Step 1: Calculate the contribution per unit of goods produced (given)

Step 2: Identify scarce resource (given as machine 1 in this case)

Step 3: Calculate the amount of scarce resource used to make each type of product (given in this case)



Example (continued): Limiting factor analysis

Step 4: Contribution per unit of scarce resource (machine time)

Product	X	Y
Contribution per unit	₦7	₦5
Machine type 1 time per unit	10 minutes	6 minutes
Contribution per hour (Machine type 1)	₦42	₦50

Step 5: Ranking

2nd 1st

The products should be made and sold in the order Y and then X, up to the total sales demand for each product and until the available machine 1 time is used completely.

Step 6: Construct a production plan to maximise contribution

Product	Sales units	Machine 1 hours used	Contribution per unit	Total contribution
			₦	₦
Y (1 st)	15,000 (maximum)	1,500	5	75,000
X (2 nd)	9,000	1,500 (balance)	7	63,000
		<hr/> 3,000 <hr/>		<hr/> 138,000 <hr/>

Note: The plan is constructed as follows:

Y is ranked first so the company needs to make as many of these as possible. The most it can sell is 15,000 units which would take 1,500 hours (10 per hour) to make. The company has 3,000 hours available so all of these can be made.

The company now has 1,500 hours left. X is ranked second and the most of X that can be sold is 12,000 units. This would use 2,000 hours (6 units per hour). This means that only 9,000 units of X can be made (found as $1,500 \text{ hours} \times \frac{1 \text{ unit}}{2,000 \text{ hours}}$).



Practice question

1

- 1 A company makes four products, A, B, C and D, using the same direct labour work force on all the products.

The company has no inventory of finished goods.

Direct labour is paid ₦12 per hour.

To meet the sales demand in full would require 12,000 hours of direct labour time.

Only 6,000 direct labour hours are available during the year.

Budgeted data for the company is as follows:

Product	A	B	C	D
Annual sales demand (units)	4,000	5,000	8,000	4,000
	₦	₦	₦	₦
Direct materials cost	3.0	6.0	5.0	6.0
Direct labour cost	6.0	12.0	3.0	9.0
Variable overhead	2.0	4.0	1.0	3.0
Fixed overhead	3.0	6.0	2.0	4.0
Full cost	14.0	28.0	11.0	22.0
Sales price	15.5	29.0	11.5	27.0
Profit per unit	1.5	1.0	0.5	5.0

Calculate the optimal production plan



Practice question

2

- 1 A company makes four products, W, X, Y and Z, using the same single item of direct material in the manufacture of all the products. Budgeted data for the company is as follows:

Product	W	X	Y	Z
Annual sales demand (units)	4,000	4,000	6,000	3,000
	₦	₦	₦	₦
Direct materials cost	5.0	4.0	8.00	6.00
Direct labour cost	4.0	6.0	3.00	5.00
Variable overhead	1.0	1.5	0.75	1.25
Fixed overhead	8.0	12.0	6.00	10.00
Full cost	18.0	23.5	17.75	22.25
Sales price	50.0	31.5	59.75	54.25
Profit per unit	32.0	8.0	42.00	32.00

Due to restricted supply, only ₦78,000 of direct materials will be available during the year.

Required

Identify the quantities of production and sales of each product that would maximise annual profit.

Tutorial note

This question does not tell you the amount of material but it does give you its value. The analysis can proceed in the usual way using contribution per value of material rather than contribution per amount of material.

3 MAKE OR BUY DECISIONS:

Section overview

Introduction

Make-or-buy (outsource) decisions

Make-or-buy decisions with scarce resources

3.1 Introduction

Relevant costs can be applied to both short-term and long-term decisions. Short-term decisions are decisions where the financial consequences occur soon after the decision is taken. For example, a short-term decision may result in an immediate increase in profit (additional net cash inflows), or an increase in annual profits and cash flows.

A long-term decision is one where a capital investment may be required and the benefits of the investment will be obtained over a period of several years. The concept of relevant costs is the same for both short-term and long-term decisions, except that for long-term decisions the time value of money should also be taken into consideration.

Examples of management decisions where relevant costing is used are:
One-off contract decisions: management might want to decide whether or not to undertake a contract for a specified fixed price. If it is a one-off contract, rather than regular production work, it would be worthwhile undertaking the contract if the extra revenue from the contract is higher than the relevant costs of doing the work (including any opportunity costs);

Make-or-buy decisions;

Shutdown decisions; and

Joint product further processing decisions.

3.2 Make-or-buy (outsource) decisions

A make-or-buy decision is a decision about:
whether to make an item internally or to buy it from an external supplier; or

whether to do some work with internal resources, or to contract it out to another organisation such as a sub-contractor or an outsourcing organisation.

The economic basis for the decision whether to make internally or whether to buy externally (outsource production) should be based on relevant costs. The preferred option **from a financial viewpoint** should be the one that has the lower relevant costs.

A financial assessment of a make-or-buy decision typically involves a comparison of: the costs that would be saved if the work is outsourced or sub-contracted; and the incremental costs that would be incurred by doing the work internally.



Example: Make-or-buy decisions

A company manufactures a component to include in one of its final products. Management have identified an external supplier who would be willing to supply the component.

The variable cost of manufacturing the component internally is ₦100 and the external supplier would be prepared to supply the components for ₦130 each.

It has been estimated that cash savings on general overhead expenditure will be ₦48,000 each year if internal production is ended.

The company needs 1,000 units of the component each year.

Required

Should the company make or buy the component?



Answer

The annual relevant costs and benefits of a decision to buy the components externally can be presented as follows:

	₦
Extra costs of purchasing externally (1,000 units × (₦130 - ₦100))	(30,000)
Cash savings in overhead expenditures	<u>48,000</u>
Net benefit from external purchasing (outsourcing) per year	<u>18,000</u>

Conclusion: The company would increase its profit by purchasing externally instead of making the items in-house. The recommendation on financial considerations is therefore to buy (outsource production), not make internally.

3.3 Make-or-buy decisions with scarce resources

A different situation arises when an entity is operating at full capacity, and has the opportunity to outsource some production in order to overcome the restrictions on its output and sales. For example a company might have a restriction, at least in the short-term, on machine capacity or on the availability of skilled labour. It can seek to overcome this problem by outsourcing some work to an external supplier who makes similar products and which has some spare machine time or labour capacity.

In this type of situation, a relevant costing approach is to assume that the entity will: seek to maximise its profits, and therefore;

outsource some of the work, provided that profits will be increased as a consequence. The decision is about which items to outsource, and which to retain in-house. The profit-maximising decision is to outsource those items where the costs of outsourcing will be the least.

To identify the least-cost outsourcing arrangement, it is necessary to compare: the additional costs of outsourcing production of an item; with the amount of the scarce resource that would be needed to make the item in-house.

Costs are minimised (and so profits are maximised) by outsourcing those items where the extra cost of outsourcing is the lowest per unit of scarce resource 'saved'. The examples below illustrate the relevant costing technique required.



Example: Make-or-buy decisions with scarce resources

A contract cleaning company provides three services; daily office cleaning, intensive cleaning of office space and minor repairs. However it has insufficient resources to do all the work available, and wishes to use a sub-contractor to take on some of the work.

Information relating to the different type of work is as follows:

	Average labour hours per job	Budgete d number of jobs	Variable cost per job(₦)	Sub- contracto rquote per job (₦)
Daily office cleaning	4	1,500	600	800
Intensive cleaning	6	400	1,080	1,500
Minor repairs	3	640	560	1,000

There are 8,000 labour hours available.

The services that are to be sub-contracted and the total monthly variable cost are found as follows.



Example (continued): Make-or-buy decisions with scarce resources

The company can do all three types of job more cheaply with its own staff than by hiring the sub-contractor. However, provided that it earns more than ₦800 for a daily office cleaning job, ₦1,500 for an intensive cleaning job and ₦1,000 for a minor repairs job, it is profitable to use the sub-contractor to make up the shortfall in in-house resources.

The problem is to decide which work to outsource/sub-contract. The ranking should be established as follows:

	Daily office cleaning	Intensive cleaning	Minor repairs
	₦	₦	₦
Cost of doing the work in-house	600	1,080	560
Cost of sub-contractor	800	1,500	1,000
Extra cost per job (of outsourcing)	200	420	440
Hours saved by sub-contracting (÷)	4	6	3
Extra cost per hour saved	₦50	₦70	₦140
Priority for outsourcing	1 st	2 nd	3 rd
Priority for doing work with own resources	3 rd	2 nd	1 st

Optimum plan

	Total labour hours	Budgeted jobs	Total variable cost (₦)
			₦
Minor repairs	1,920	640	358,400
Intensive cleaning	2,400	400	432,000
Office cleaning (balance)	3,680	920	552,000
Maximum labour hours available	8,000		1,342,400
Sub-contract:			
Office cleaning		580	464,000
			1,806,400

Note: The number of office cleaning jobs outsourced is the total number (1,500) less those performed by own staff (920).



Practice question

3

A company makes four products, W, X, Y and Z. All four products are made on the same machines, and the machine capacity for the year at the company's factory is 3,500 hours.

The company is able to obtain any of these products in unlimited quantities from a sub-contractor.

Budgeted data is as follows.

Product	W	X	Y	Z
Annual sales demand (units)	4,000	6,000	3,000	5,000
	₦	₦	₦	₦
Sales price per unit	150	200	180	170
Variable cost per unit, in-house manufacture	50	70	60	70
Cost of external purchase (outsourcing)	80	118	105	110
Machine hours per unit, in-house production	0.25	0.5	0.3	0.4

Which items should be produced in-house and which should be outsourced?
Calculate the total cost associated with the optimal plan.

4 OTHER SHORT TERM DECISIONS

Section overview

Introduction

One-off contract decisions

Shutdown decisions

4.1 Introduction

The principles of relevant costing can be applied to any type of management decision, not just make-or-buy decisions. Examples of other types of management decision where relevant costing may be used include:

One-off contract decisions; and

Shutdown decisions

4.2 One-off contract decisions

Management might have an opportunity to carry out a contract or job for a customer, where the job is 'once only' and will not be repeated in the future. The decision is therefore to decide whether to agree to do the job at the price offered by the customer, or to decide a selling price at which an incremental profit would be made.

If it is a one-off contract, rather than regular production work, it would be worthwhile undertaking the contract if the extra revenue from the contract is higher than the relevant costs of doing the work (including any opportunity costs).

The incremental profit from the one-off contract is the revenue that would be obtained minus the relevant costs.

One-off contract decisions might occur when a company has spare capacity, and an opportunity arises to earn some extra profit. This type of analysis should not be applied to most contract decisions, however, because a company must earn sufficient profits in total to cover its fixed costs and make a profit. Relevant costs do not help management to decide what the size of the profit margin should be, in order to ensure that the company makes an overall profit from all its activities.



Example: One-off contract decision

Delta Plastics Limited (DPL) is deciding whether or not to proceed with a one-off special contract for which it would receive a once-off payment of ₦200,000

Details of relevant costs are:

- (a) The special contract requires 200 hours of labour at ₦600 per hour. Employees possessing the necessary skills are already employed by DPL but are currently idle due to a recent downturn in business.
- (b) Materials X and Y will be used. 100 kgs of material X will be needed and sufficient material is in inventory as the material is in common use by the company. Original cost of material in inventory was ₦150 per kg but it would cost ₦180 per kg to replace if used in this contract. Material Y is in inventory as a result of previous over-purchasing. The original cost of material Y was ₦50,000 but it has no other use. Unfortunately material Y is toxic and if not used in this contract DPL must pay ₦24,000 to dispose of it.
- (c) The contract will require the use of a storage unit for three months. Delta Plastics is committed to rent the unit for one year at a rental of ₦8,000 per month. The unit is not in use at present. However, a neighbouring business has recently approached DPL offering to rent the unit from them for ₦11,000 per month.
- (d) Overheads are absorbed at ₦750 per labour hour which consists of ₦500 for fixed overhead and ₦250 for variable overhead. Total fixed overheads are not expected to increase as a result of the contract.

A trainee accountant has calculated that it will cost ₦359,000 to deliver the contract (calculation below) and concluded that the contract should therefore not be accepted for ₦200,000.

Description	Relevant cost ₦
Labour: 200 hours x ₦600	120,000
Material X: 100 kgs x ₦150	15,000
Material Y: Original cost	50,000
Storage: 3 months x ₦8,000	24,000
Overheads: ₦750 x 200	150,000
Total	<u>359,000</u>

Required

Advise whether the contract should be accepted or not on financial grounds.



Answer: One-off contract decision

- (a) The relevant cost of labour is zero as no extra cost will be incurred as a result of this contract.
- (b) The relevant cost of a material that is used regularly is its replacement cost. Additional inventory of the material must be purchased for use in this contract. The relevant cost of material X is therefore ₦180 per kg i.e. $₦180 \times 100 = ₦18,000$
- There is a relevant saving from using material Y from not having to pay the disposal cost of ₦24,000.
- (c) As Delta Plastics is already committed to rent the storage unit for one year the monthly rental cost is not relevant to the contract. However, the opportunity cost is the foregone rental income that Delta Plastics would have made from the neighbouring business for the three months needed for this contract. i.e. $3 \times ₦11,000 = ₦33,000$
- (d) The fixed overhead is not relevant because there is no increment to fixed overheads expected as a result of this contract. Therefore the relevant overhead cost is just the variable part of ₦250 per hour $\times 200$ hours = ₦50,000

So in total the total relevant cost is ₦77,000 as follows:

Description	Relevant cost ₦
Labour	nil
Material X	18,000
Material Y	(24,000)
Storage	33,000
Overheads	50,000
Total	<u>77,000</u>

Conclusion: The contract should be accepted as it would make an incremental profit to Delta Plastics of ₦123,000 (revenue of ₦200,000 less relevant costs of ₦77,000).

4.3 Shutdown decisions

A shutdown decision is a decision about whether or not to shut down a part of the operations of a company. From a financial viewpoint, an operation should be shut down if the benefits of shutdown exceed the relevant costs.

A shutdown decision may be a long-term decision when there are large initial expenditures involved (for example, costs of making the work force redundant). For the purpose of the examination, however, any shutdown decision will be a short-term decision.



Example:

Company V makes four products, P, Q, R and S. The budget for next year is as follows:

	P	Q	R	S	Total
	₦000	₦000	₦000	₦000	₦000
Direct materials	300	500	400	700	1,900
Direct labour	400	800	600	400	2,200
Variable overheads	100	200	100	100	500
	<u>800</u>	<u>1,500</u>	<u>1,100</u>	<u>1,200</u>	<u>4,600</u>
Sales	1,800	1,650	2,200	1,550	7,200
Contribution	<u>1,000</u>	<u>150</u>	<u>1,100</u>	<u>350</u>	<u>2,600</u>
Directly attributable fixed costs	(400)	(250)	(300)	(300)	(1,250)
Share of general fixed costs	<u>(200)</u>	<u>(200)</u>	<u>(300)</u>	<u>(400)</u>	<u>(1,100)</u>
Profit/(loss)	<u>400</u>	<u>(300)</u>	<u>500</u>	<u>(350)</u>	<u>250</u>

'Directly attributable fixed costs' are cash expenditures that are directly attributable to each individual product. These costs would be saved if operations to make and sell the product were shut down.

Required

State with reasons whether any of the products should be withdrawn from the market.



Answer

From a financial viewpoint, a product should be withdrawn from the market if the savings from closure exceed the benefits of continuing to make and sell the product. If a product is withdrawn from the market, the company will lose the contribution, but will save the directly attributable fixed costs.

Product P and product R both make a profit even after charging a share of general fixed costs. On the other hand, product Q and product S both show a loss after charging general fixed costs, and we should therefore consider whether it might be appropriate to stop making and selling either or both of these products, in order to eliminate the losses.

Effect of shutdown	P	Q	R	S
	₦000	₦000	₦000	₦000
Contribution forgone	(1,000)	(150)	(1,100)	(350)
Directly attributable fixed costs saved	<u>400</u>	<u>250</u>	<u>300</u>	<u>300</u>
Increase/(reduction) in annual cash flows	<u>(600)</u>	<u>100</u>	<u>(800)</u>	<u>(50)</u>

Although product S makes a loss, shutdown would reduce annual cash flows because the contribution lost would be greater than the savings in directly attributable fixed costs.

However, withdrawal of product Q from the market would improve annual cash flows by ₦100,000, and withdrawal is therefore recommended on the basis of this financial analysis.

Decision recommended: Stop making and selling product Q but carry on making and selling product S.

5 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

Explain the issue of limiting factors;

Identify limiting factors;

Carry out limiting factor analysis to formulate an optimal production plan (i.e., the production plan that maximises contribution and hence profit); and

Analyse relevant costs to decide whether to make or buy a good.

SOLUTIONS TO PRACTICE QUESTIONS

Solution

1

Step 1: Calculate the contribution per unit of goods produced

Product	A	B	C	D
Sales price	15.5	29.0	11.5	27.0
Direct materials cost	3.0	6.0	5.0	6.0
Direct labour cost	6.0	12.0	3.0	9.0
Variable overhead	2.0	4.0	1.0	3.0
Variable cost per unit	(11.0)	(22.0)	(9.0)	(18.0)
Contribution per unit	4.5	7.0	2.5	9.0

Step 2: Identify scarce resource (given as labour in this case)

Step 3: Labour hours per unit

(total labour cost per unit / labour cost per hour)

$\frac{6}{12}$	$\frac{12}{12}$	$\frac{3}{12}$	$\frac{9}{12}$
0.5	1	0.25	0.75

Step 4: Contribution per hour

(contribution per unit / labour hours per unit)

$\frac{4.5}{0.5}$	$\frac{7}{1}$	$\frac{2.5}{0.25}$	$\frac{9}{0.75}$
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Contribution per hour (₦)

9 7 10 12

Step 5: Ranking

3rd 4th 2nd 1st

The products should be made and sold in the order D, C, A and then B, up to the total sales demand for each product and until all the available direct labour hours (limiting factor resources) are used up

Step 6: Construct a production plan to maximise contribution

Product	Sales units	Direct labour hours used	Contribution per unit ₦	Total contribution ₦
D (1 st)	4,000 (maximum)	3,000	9.0	36,000
C (2 nd)	8,000 (maximum)	2,000	2.5	20,000
A (3 rd)	2,000 (balance)	1,000	4.5	9,000
		<u>6,000</u>		<u>65,000</u>

Solution (continued)**1****Note: The plan is constructed as follows:**

D is ranked first so the company needs to make as many of these as possible. The most the company can sell is 4,000 units of product D which would take 3,000 hours (0.75 hours per unit) to make. The company has 6,000 hours available so all of these can be made.

The company now has 3,000 hours left. C is ranked second and the most of C that can be sold is 8,000 units. This would use 2,000 hours (0.25 hours per unit).

The company now has 1,000 hours left. A is ranked third and the most of this that can be sold is 4,000 units. However, this would use 2,000 hours (0.5 hours per unit) so only half of these can be made.

Solution**2**

	W	X	Y	Z
	₦	₦	₦	₦
Sales price/unit	50.0	31.5	59.75	54.25
Variable cost/unit	10.0	11.5	11.75	12.25
Contribution per unit	40.0	20.0	48.00	42.00
Direct materials per unit (₦)	5	4	8	6
Contribution per ₦1 direct material	8.0	5.0	6.0	7.0
Priority for making and selling	1st	4th	3rd	2nd

Profit-maximising budget

Product	Sales units	Direct materials	Contribution per unit	Total contribution
		₦	₦	₦
W (1st)	4,000	20,000	40	160,000
Z (2nd)	3,000	18,000	42	126,000
Y (3rd) - balance	5,000	40,000	48	240,000
		78,000		526,000

Solutions**3**

The selling price for each product is higher than the variable cost of purchasing each product externally; therefore profit will be maximised by making the products in-house or purchasing them externally, up to the full amount of the annual sales demand.

Product	W	X	Y	Z
	₦	₦	₦	₦
Variable cost per unit, in-house manufacture	50	70	60	70
Cost of external purchase (outsourcing)	80	118	105	110
Extra cost of outsourcing, per unit	30	48	45	40
Machine hours per unit, in-house production (÷)	0.25	0.5	0.3	0.4
Extra cost of outsourcing, per machine hour saved	₦120	₦96	₦150	₦100
Priority for outsourcing	3rd	1st	4th	2nd
Priority for in-house production	2nd	4th	1st	3rd

The cost-minimising and profit-maximising budget is as follows.

Product	Machine hours	Units	Total variable cost
			₦
In-house:			
Y	900	3,000	180,000
W	1,000	4,000	200,000
Z (balance)	1,600	4,000	280,000
	<u>3,500</u>		
Outsourced			
Z		1,000	110,000
X		6,000	708,000
Total variable cost			<u>1,478,000</u>

Information systems and electronic business technologies

Contents

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- 2 Definition and explanation of information system
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- 4 The usefulness of information system to key business functions
- 5 Relationship between organisations information systems and business processes
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- 12 Management issues associated with e-commerce/e-business
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- 14 Business operations outsourcing methodologies
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INTRODUCTION

Aim

Business information takes an integrated approach by developing an awareness of information technology and systems support.

Detailed syllabus

The detailed syllabus includes the following:

C		Information systems and electronic business technologies	
	1	Information systems	
		a	Define and explain information systems.
		b	State the approaches to information systems.
		c	Explain the usefulness of information systems to some key business functions:
		i	Sales and marketing;
		ii	Manufacturing and production;
		iii	Finance and accounting;
		iv	Human resources; and
		v	Office Management.
		d	Describe the relationship among organisations, information systems and business processes.
		e	State and explain the following classifications of information systems:
		i	Executive support systems (ESS);
		ii	Management information systems (MIS);
		iii	Decision support systems (DSS);
		iv	Knowledge management systems (KMS);
		v	Transaction processing systems (TPS); and
		vi	Office information systems (OIS).
		f	Discuss the following aspects of management information systems:
		i	Ethical, social and political issues;
		ii	Proprietary information privacy and violation issues;
		iii	Violation of intellectual property rights; and
		iv	Legal redress for information privacy violations.
	2	Electronic business and e-commerce	
		a	Discuss the following concepts in relation to e-commerce:
		i	IT infrastructure requirements for e-commerce/e-business;
		ii	The internet as the backbone for e-commerce;
		iii	Internet of Things or Internet of Every Thing (IoT/IoET);
		iv	Social media platforms;

			v	E-commerce models – B2B, C2B, B2G, B2C, M-C;
			vi	Payment systems including mobile payment platforms; and
			vii	Digitization of the middleman with examples such as Amazon, eBay, Konga, Jiji, etc.
			b	E-Commerce security
				Explain:
			i	Concepts of cyber threats and risks;
			ii	Cyber-attacks and its variants;
			iii	Protection mechanisms; and
			iv	Cyber deviants and implication in the workplace.
			c	Management issues associated with e-commerce/e-business
				Explain:
			i	Business case scenarios for firms' e-commerce proposition;
			ii	IT policies as steppingstone into e-commerce and e-business;
			iii	Making choices for e-commerce/e-business deployment;
			iv	Benefits and challenges of e-commerce and e-business
			v	Business operations outsourcing methodologies; and
			vi	Data centre disaster and contingency plans/recovery alternatives.

Exam context

The modern business environment requires a reasonable level of computer literacy amongst its professionals. The work of accountants and auditors will invariably involve interaction with some kind of information system typically supported by information technology.

Accountants will be involved in entering, maintaining and adjusting information within an information system. Auditors will need to assess whether the information system is capable of producing true and fair financial statements and whether they have been extracted accurately.

This is the first chapter on information systems and technology. The chapter introduces you to a number of fundamentals such as general systems concepts, hardware and software.

The chapter concludes with a section on information systems in business. By the end of this chapter you will be able to:

- Define and explain information system
- Describe the approaches to information systems
- Explain the usefulness of information system to key business functions
- Describe the relationship between organisations information systems and business processes
- Describe the types of information systems
- Describe behavioural issues in management information systems (MIS)
- Explain violation of intellectual property rights

- Explain electronic business and e-commerce
- Describe digitisation of the middleman
- Explain e-commerce security
- Describe Management issues associated with e-commerce/e-business
- Explain information technology (IT) policies
- Explain business operations outsourcing methodologies

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17.0 Information systems and electronic business technologies

17.1. Introduction

Organisations and businesses share information amongst themselves. Transactions of all kinds and dimensions are consummated through the architecture of information movement and management. Naturally, exchange of business information by organisations, including educational and research institutions occur through certain pre-defined media supported by certain components and devices.

17.2 Definition and explanation of information system

Information systems refer to a set of integrated components and devices for collecting, process, storing and sharing information across organisations and institutions.

Businesses rely extensively on information systems to cooperate and transact with one another in the business space, for example, managing organisations' human capital requires an information system of some sort. Similarly, dealing with vendors, accounts processing and associated financial reporting, online marketing, transactions and payments processing in banks and related institutions must rely on information systems to carry out these business-related activities. Some organisations in the business space run completely on information systems supported by interconnected networks of computers, for example, businesses such as Konga, Jiji, Jumia, in Nigeria run an end-to-end information system platform. Others across Europe and America are eBay, Amazon, Alibaba - marketplace for auction sales, Google and Yahoo for search engines, aiding research and knowledge sharing, and whole lot in the social media environments, such as Facebook, Twitter, YouTube, Instagram, etc.

17.3 Approaches to information systems

As explained in the earlier section, information system operations rely on some key components, namely: hardware; software; telecommunications devices; databases and human resources, as components of information systems (IS). The approach to IS design and implementation is usually tied to individual organisations and their types of business. This essentially refers to the business processes and procedures driven by the information system in design. In a nutshell, the IS design approach refers to the key steps an IS professional or consultant should take in resolving an organisation's business information management challenges through the application of information system. Accordingly, some of the key steps include:

- Problem analysis — This may also be called a discovery session or problem diagnostics, where the IS designer engages the organisation's personnel, while carrying out a work-through of their processes and procedures to determine how these processes can be mapped into the electronic process.
- Requirement documentation — This stage follows from the previous one. The diagnostic activities would lead to determining the requirements of the organisation in terms of the IS architecture, necessary components of information systems and the eventual solutions or outputs of the IS design and implementation.

- Design stage —This step comes after the IS designer has collected the necessary data and information from the organisation’s environment, including how the information system would run and process information, the designed outputs and related products, the IS designer now proceeds to design the system. The system could be any of the following:
 - Payroll;
 - Accounting processing;
 - Inventory;
 - Human resources; or
 - Other integrated system, such as enterprise resources planning system.

- System development—This stage derives from the conceptual framework of the IS designer which consolidates all the previous steps in the development stage leading to the eventual system building (or development) and testing. Note that no system is ever implemented without testing and a number of test methodologies exist. These include pilot and parallel testing before the emergent system is deployed into production.

- Implementation stage— This is the actual roll-out of the new system. An example of a real-life experience is the electronic parliament (eParliament) recently designed and currently undergoing implementation at the Nigerian National Assembly (NASS). This system was designed to eliminate completely all forms of paperwork that characterized the activities of Committees of the National Assembly, especially the Public Accounts Committee of the House of Representative. On deployment, the lawmakers and the interfacing Federal Government agencies including the Office of the Accountant General of the Federation and the Office of the Auditor-General for the Federation will interact at every committee hearing or trials in a seamless and paperless manner, as seen in the illustrations below:



Illustration A



Illustration B

Above—illustration “A” is a typical paper and completely manual environment at NASS now transformed into a paperless system as shown in illustration “B”.

As seen from the illustrations above, while illustration “A” represents a pre-system design stage, illustration “B” represents a rollout or system implementation stage. The last stage is the post-implementation reviews and audit. This process is carried out to eliminate any “noise” or other forms of inadequacies from the new system and ensure that the system is in top form and performs effectively and efficiently.

In summary, system development captures the stages of creating a business systems solution from systems analysis, design, development, implementation and post-implementation reviews.

17.4 The usefulness of information systems to key business functions

Information systems impact various business functions, thus:

17.4.1 Sales and marketing

Effective sales and marketing functions are key to business survival and sustainability. In this sense, the need to employ information system in these areas of business is instructive. Potentially a number of solutions exist to drive the sales and marketing functions of organisations, these include use of Websites, social media platforms such as Facebook, WhatsApp, Instagram, YouTube, Twitter, etc. Organisations use the tremendous power of social media applications to reach out to global and local markets for greater sales revenue. Readers are advised to access the Institute's online MPD resources on Social Media Strategies for Small Scale Businesses.

17.4.2 Manufacturing and production

The complex nature of manufacturing operations demand that a large part of the processes require some level of automation. Thus, information system (IS) is usually at the centre of manufacturing operations. Manufacturing concerns must procure raw materials, put them into production scheduling and setups, inventory management, machine maintenance scheduling, spare parts management, and the entire chain of logistics management require IS applications. Large manufacturing organisations usually deploy complex IS solution, such as enterprise resources planning (ERP) application for their day-to-day operations. This offers the advantage of end-to-end business automation and process enrichment for the entire organisation and its customers.

17.4.3 Finance and accounts

Every activity associated with cost and financial implication require some level of reporting; be it stewardship reporting or management information reports for daily monitoring of business process. Therefore, IS solution supporting finance and accounts abound and include both bespoke and off-the-shelf applications. These include Sage software, Solomon Systems, Pacciosi, Sun System, Peachtree, etc.

17.4.4 Human resources

Human resources management activities include recruitment, talent management, salary administration, training, performance appraisal, disciplinary measures, retirement planning and pension planning. These activities are equally supported by IS applications and usually integrated into ERP solutions.

17.4.5. Office management

Directly supporting office management activities are IS solutions required to process business communications, analyse simple data for business decisions and communicate with employees across the organisation and external stakeholders. These IS solutions include word processors, spreadsheets, presentation applications and email.

17.5 Relationship between organisations' information systems and business processes

Organisations differ in their business processes, for example, financial institutions, manufacturing entities and government institutions, all differ in their business processes. Likewise, information systems adopted by individual entities would differ from one entity to the other. However, business activities such as orders for goods and services and the associated payment processing would usually take place between one organisation and the other. Where there are differences in IS implementations between organisations, a methodology for business handshake should exist to ensure inter-entity seamless interactions. In this regard, a wider and global information systems interchange known as the World-Wide-Web (www) or the Internet enables inter-entity exchanges to take

place effectively and seamlessly. A more extensive discussion on the WWW and all the associated technology issues and disruption will be discussed later.

17.6 Types of information system

17.6.1 Management information systems (MIS)

Generically, MIS comprises of various computer hardware and software organised in desired format to collect data from multiple of sources, analyse them and produce meaningful information for management decision-making. MIS facilitates decision making process by making information available to management in a desired format. Various kinds of MIS are discussed below.

17.6.2 Executive support systems (ESS)

Top executives are always on the move and very often do not have the time to probe into the pool of company data and information to generate required information for effective decision making. This then requires system interfaces such as dashboards which enable them to instantly generate information for business decisions. In this sense, ESS are designed to allow busy executives generate instant reports from a wide-range of corporate databases for decision making. Examples of ESS are Excel dashboards, or reports of financial performance generated from accounting packages from the dashboards.

17.6.3 Decision support system (DSS)

As the names implies, DSS is a group of information system program routines that aid decision makers to use computer information and data to take effective business decisions. Typically, DSS programs may use graphics, data or other virtual aids to help busy executives take business decisions. These set of systems may include expert systems and artificial intelligence (AI) systems and are usually applied by skilled workers in managing both simple and complex business operations.

There are five categories of DSS, namely:

- Communication-driven DSS — These are driven by data and communication network devices to achieve collaborative tasks such as virtual meetings, instant messaging or group chats. Examples are the Microsoft Teams, Webex and Zoom for virtual meetings, etc.
- Data-driven DSS (DD-DSS) — Very often airline bookings, hotel reservations, and inventory management in a company are made through either manager-computer interface or customer-computer interface. This is achieved through a structured query interface via a web client or client-server link in a complex network environment.
- Document-driven DSS — This class of DSS aid users to locate documents or webpages electronically with little or no human intervention. Likewise, webpages and client-server architecture are deployed to achieve the objectives of document-driven DSS. For example, search engines such as Google, Yahoo etc, make extensive use of document-driven DSS, especially when users search for specific documents of various formats such as pdf, docx, ppt., etc. Such a search would require specifying the format of the document being sought at the command level of the search engine. For example, a student looking for materials on “poverty alleviation” research papers done only on pdf; will at the Google command level issue the following search command: pdf: “poverty alleviation”. This search request on Google will fetch all pdf documents on poverty alleviation. For Word documents, a similar search request is issued, beginning with the ..doc: “ the title of the document”.

- Knowledge-driven DSS— This class of DSS is equipped with a knowledge engine which often captures and stores the wisdom of the experts in a particular field. Such repository of knowledge is then used to provide solutions or information as may be requested by users. For example, in medical diagnostics, medical experts use knowledge-driven systems to determine certain medical conditions in humans.
- Model-driven DSS— Often we read or hear about business models, inventory models, optimisation models. In complex organisations, such as manufacturing plants, managers and executives are often confronted with decisions such as make or buy, acceptance or rejection of order, inventory scheduling options or optimisation techniques that produce a number of options for decision making purposes. Model-driven DSS help executives make choices out of different model options as may be generated by the model-driven DSS. For example, in its simplest form, the Microsoft excel sensitivity analysis sub-program helps users develop model options for profitable inventory. The technologies used in this class of DSS are similar to those used in other DSS classes and include complex networks and webpages.

17.6.4 Knowledge management system (KMS)

Entities exist as artificial persons, thus, possess attributes such as ethic, norms, employees' behavioural patterns, company goals, mission and vision of the company. Also, products and services, customer demography, service vendors, etc. all form a body of knowledgebase of the organisation and sharable among the employees and other stakeholders. Essentially, KMS is the information system mechanism adopted by an organisation for sharing the institutional knowledge of the organisation with employees and other third-parties.

17.6.5 Transaction processing system (TPS)

This is a computer application designed to capture and process transaction data such as sales orders, banking transactions, hotel reservations and payments, airline booking service centres, etc. TPS can be made a stand-alone system or an integral part of a financial and accounting application. For example, Oracle financials or SAGE accounting solutions both have sales and purchases order routines integrated in them. However, some TPS such as payroll system can come as stand-alone modules and run independently of other systems in place. In all cases, an integrated system is usually preferred, due to the convenience and seamless nature of data and information sharing across the various modules.

17.6.6 Office information system (OIS)

As businesses and the global community gravitate towards paperless environments orchestrated by the emergence of disruptive technologies and the impact of COVID 19 pandemic, businesses at the micro, small, medium and big levels are placed on higher pedestal of various forms of technology enablement to run their operations. In this sense, businesses deploy computer hardware and software suitable for their business activities and these are classified as office information systems. At the very basic level, word-processors and spreadsheet applications fall into this class of information system. Others are presentation applications, database software, virtual meeting apps, etc.

17.7 Behavioural issues in management information systems (MIS)

People ware is considered as one the key elements of information systems to the extent that organisations' personnel are at the centre of it all. This means that as long as humans are connected with information systems, potentially, emotions must set in, and where there are emotions, individuals are bound to behave in very many divergent ways. Some can become deviants while some would potentially become vanguards of the information systems as the mechanism for the organisation's well-being and growth catalyst. Some of those behavioural tendencies that have obvious impact for either

disrupting the information system or harmonising its effective use in the organisation are discussed below.

17.7.1 Ethical, social and political issues

Corporate powerplay, usually orchestrated by the level of ethical stance in every organisation can make or mar the information system. Procuring information systems, its deployment and use are often affected by corporate and individual ethos within the organisation. Notably, norms, that is, modes of behaviour of individuals in an organisation and the perceptions of those outside it, affect organisational performance and consequently, its information systems. A methodology for checking the excesses in ethical, social and political behaviour as they affect information systems will be highlighted in the section on IT governance.

17.7.2 Proprietary information privacy and violation issues

According to the English dictionary, proprietary means relating to ownership of something, for example, knowledge discovered by somebody, or invention of something or product. This term is very common in the context of software development and usage either by a programmer who developed a computer software either for himself or for a company he or she works for and paid for, such that the company can claim ownership to that computer software or other materials developed by the employee. Proprietary information privacy is usually protected by a proprietary agreement which usually specifies individual party's rights and obligations to the proprietary information. For further elucidation, a htm copy example of such agreements is reproduced from the following website: <https://www.sec.gov/Archives/edgar/containers>:

Exhibit 17.1

PROPRIETARY INFORMATION AND INVENTIONS AGREEMENT

This Proprietary Information and Inventions Agreement (this "Agreement") is entered into as of this ___ day of September, 2006 by and between Odyne Corporation (the "Company") and _____ ("Employee").

1. Definitions. For the purposes of this Agreement, the following terms shall have the meanings specified below:

- a. "Company Documents" shall mean documents or other media that contain Proprietary Information or any other information concerning the business, operations or plans of the Company, whether such documents have been prepared by me or by others. "Company Documents" shall include, but not be limited to, blueprints, drawings, photographs, charts, graphs, notebooks, customer lists, computer disks, tapes or printouts, sound recordings and other printed, typewritten or handwritten documents.

b. "Inventions" shall mean all improvements, inventions, works of authorship, mask works, computer programs, formulae, ideas, processes, techniques, know-how, and data, whether or not patentable.

c. "Proprietary Information" shall mean information (whether now existing or hereafter created or acquired) developed, created, or discovered by the Company, or which became known by, or was conveyed to the Company, which has commercial value in the Company's business. "Proprietary Information" shall include, but not be limited to, domain names, trade secrets, copyrights, ideas, techniques, know-how, inventions (whether patentable or not), and/or any other information of any type relating to designs, configurations, toolings, documentation, recorded data, schematics, circuits, mask works, layouts, source code, object code, master works, master databases, algorithms, flow charts, formulae, works of authorship, mechanisms, research, manufacture, improvements, assembly, installation, intellectual property including patents and patent applications, and the information concerning the Company's actual or anticipated business, research or development, or which is received in confidence by or for the Company from any other person.

2. Proprietary Information; Inventions. In consideration of Employee's employment by the Company and the compensation received by Employee from the Company from time to time, Employee and the Company hereby agree as follows:

- a. All Proprietary Information and all patents, patent rights, copyrights, mask work rights, trade secrets, moral rights and other rights in connection therewith shall be the sole property of the Company. Employee hereby assigns to the Company any and all rights Employee may have or acquire in such Proprietary Information. At all times, both during Employee's employment by the Company and after termination of such employment, Employee will keep in confidence and trust and will not use or disclose any Proprietary Information or anything relating to it without the prior written consent of an executive officer of the Company, except as may be necessary in the ordinary course of performing Employee's duties to the Company.
- b. Employee shall make and maintain adequate and current written records, in a form specified by the Company, of all inventions, trade secrets and works of authorship assigned or to be assigned to the Company pursuant to this Agreement. All Company Documents shall be the sole property of the Company. During the term of Employee's employment by the Company, Employee shall not remove or electronically transmit any Company Documents from the business premises of the Company or deliver any Company Documents to any person or entity outside the Company, except as required in connection with performing Employee's duties of employment. Immediately upon the termination of Employee's employment for any reason, or during Employee's employment if so requested by the Company, Employee shall return all Company Documents, apparatus, equipment, and other physical property, or any reproduction of such property, excepting only (i) personal copies of records relating to Employee's compensation; (ii) personal copies of any materials previously distributed generally to shareholders of the Company; and (iii) Employee's copy of this Agreement.
- c. Employee shall promptly disclose in writing to the President of the Company, or to any other person designated by the Company, all Inventions made or conceived or reduced to practice or developed by Employee, either alone or jointly with others, during the term of Employee's employment (i) that were created, developed or conceived during working hours or using Company property or (ii) that are related to, or have value in, the Company's business ("Employee Inventions"). Employee shall not disclose Inventions to any person outside the Company except pursuant to written directions from the President of the Company.

- d. All Employee Inventions shall be the sole property of the Company. The Company shall be the sole owner of all patents, copyrights and other intellectual property or other rights in connection therewith. Employee further acknowledges and agrees that such Inventions, including any computer programs, programming documentation, and other works of authorship, are “works made for hire” for purposes of the Company’s rights under copyright laws. Employee hereby assigns to the Company any and all rights Employee may have or acquire in such Employee Inventions.
- e. During Employee’s term of employment at the Company’s sole cost and expense, Employee shall perform all acts deemed reasonably necessary or desirable by the Company to permit and assist the Company in obtaining, maintaining, defending and enforcing patents, copyrights or other rights in Employee Inventions and improvements in any and all countries. Such acts may include, but are not limited to, execution of documents and assistance or cooperation in legal proceedings. Employee hereby irrevocably designates and appoints the Company and its duly authorized officers and agents as Employee’s agent and attorney-in-fact to act for and on Employee’s behalf and instead of Employee, to execute and file any applications or related findings and to do all other lawfully permitted acts to further the prosecution and issuance of patents, copyrights or other rights thereon with the same legal force and effect as if executed by Employee.
- f. Attached hereto as Exhibit A is a complete list of all Inventions or improvements to which Employee claims ownership and that Employee desires to remove from the operation of this Agreement (“Existing Inventions”), and Employee acknowledges and agrees that such list is complete. If no such list is attached to this Agreement, Employee represents that Employee has no Existing Inventions at the time of signing this Agreement. If, in the course of Employee’s employment with the Company, Employee incorporates into a Company product, process or machine an Existing Invention, the Company is hereby granted and shall have a nonexclusive, royalty-free, irrevocable, perpetual, worldwide license to make, have made, modify, use and sell such Existing Invention solely as part of or in connection with such product, process or machine.
- g. Prior to submitting or disclosing for possible publication or dissemination outside the Company any material prepared by Employee that incorporates information that concerns the Company’s business or anticipated research, Employee shall deliver a copy of such material to the President of the Company for his or her review. Within twenty (20) days of such submission, the Company shall notify Employee whether the Company believes such material contains any Proprietary Information, and Employee shall make such deletions and revisions reasonably requested by the Company to protect its Proprietary Information. Employee shall obtain the consent of the Company prior to any review of such material by persons outside the Company.

Employee represents that his or her performance of all terms of this Agreement does not and will not breach any agreement to keep in confidence proprietary information, knowledge or data acquired by Employee in confidence or in trust prior to Employee's employment by the Company. Employee shall not disclose to the Company, or induce the Company to use, any confidential or proprietary information or material belonging to any previous employers or others. Employee represents and warrants that he or she has returned all property and confidential information belonging to all prior employers. Employee has not entered into, and Employee shall not enter into, any agreement either written or oral in conflict herewith or in conflict with my employment with the Company.

1. Severability. If one or more provisions of this Agreement are held to be unenforceable under applicable law, such provisions shall be excluded from this Agreement and the balance of the Agreement shall be interpreted as if such provisions were so excluded and shall be enforceable in accordance with its terms.
2. Binding Effect. This Agreement shall be effective as of the date hereof and shall be binding upon Employee and Employee's heirs, executor, assigns, and administrators, and shall inure to the benefit of the Company, its subsidiaries, successors and assigns.
3. Injunctive Relief. Employee and the Company acknowledge and agree the covenants and obligations contained in this Agreement relate to special, unique and extraordinary matters and that a violation of any of such covenants or obligations may cause Employee or the Company irreparable injury for which adequate remedy at law will not be available; and, therefore, that upon any such breach of any such covenant or obligation, or any threat thereof, Employee or the Company shall be entitled to the immediate remedy of a temporary restraining order, preliminary injunction or such other form of injunctive or equitable relief in addition to whatever remedies they might have at law.
4. Modification. This Agreement can only be modified by a subsequent written agreement executed by the Company and Employee.
5. Governing Law. All questions pertaining to the validity, construction, execution and performance of this Agreement shall be governed by and construed in accordance with the laws of the XXXXXXXXXXXX, without regard to its conflict of law principles.
8. Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed to be an original, but all of which together shall constitute one and the same instrument.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement as of the day and year first above written.

ODYNE CORPORATION

By Title: EMPLOYEE _____

Name: _____

EXHIBIT A

Employee Inventions

It must be noted that in the Nigerian legal system, proprietary information is covered under the laws guiding trade secrets, or non-disclosure agreements usually entered into by companies and their employees where the situation demands.

17.8 Violation of intellectual property rights

Endeavours geared towards the development of original works of art, science, inventions, or other forms of discoveries are usually protected by patenting them under the laws dealing with patents or copyrights. There are four basic types of intellectual property, namely:

- a. Patents;
- b. Trademarks;
- c. Copyrights; and
- d. Trade secrets.

General examples of such rights cover the range of domain names for websites, patents, industrial designs, confidential information, inventions, moral rights, database rights, and works of authorship. In Nigeria for example, the Trademarks Act Cap. 436 Laws of the Federation of Nigeria and the Patents and Designs Act. The trademarks, patents and designs laws are currently implemented by the Trademarks, Patents and Designs Registry of the Federal Ministry of Commerce. Violations of intellectual property rights in Nigeria can be addressed under these laws.

Violations can occur in a number of ways, including:

- a. Infringement of patents;
- b. Trademarks or copyright rights;
- c. Counterfeiting of copyrights or trademarks; and
- d. Misappropriating trade secrets.

The following examples will elucidate on these violations:

- a. Applying a patented name, logo or product to make the public believe that the product, name or logo is the same as the original one in order to profit;
- b. Copying of musical recordings or other media without authorisation and distributing them for profit;
- c. Manufacturing of items according to what is spelled out in a patent, without having a license from the owner to do so;
- d. Engaging in corporate espionage to find out competitor's or others' secrets; and
- e. Producing goods or services in the belief that these have been patented, when in fact they have not been and they are actually copying someone else's patent.

17.8.1 Remedies

There are remedies to redress violations of intellectual property rights. They include:

- a. Confiscation of property that was used to create infringing products;
- b. Extinction and desist orders in cases of unauthorised use of trademarks; and
- c. Monetary damages to compensate for losses can be applied by the court of competent jurisdiction.

17.8.2 Information privacy violation—legal remedies

Privacy violation is a common phenomenon, especially within the information system environment. This could be external or internal, but more within the internal environment, due largely to access legitimacy employees enjoy within the organisation. Most common of the privacy violation across organisations include:

- a. Obtaining personal data without data subject's consent—this has been addressed by the Nigeria Information Technology Development Agency's (NITDA) regulation on data protection;
- b. Where customers, whose profiles are stored in a data controllers' databases without option of opting out. This could lead to compromise of customers' data and related information;



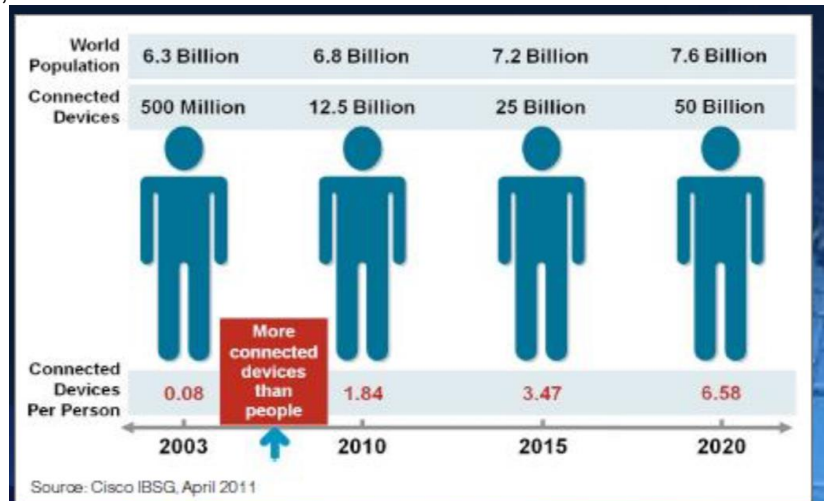
<https://www.symptai.com/post/5-common-privacy-violations>

- c. Lack of proper controls over the data centre of organisations could lead to privacy violations;
- d. Sharing of data—often, companies share information and data of their clients or customers without customers' knowledge or consent;
- e. When classified information is not properly protected, privacy may be lost;
- f. Hackers and interlopers could become agents of privacy violations; and
- g. Disgruntled employees may become deviants and violate privacy policies.

17.8.3 Remedies for privacy wrongs

The norms of appropriate behaviour have been as contentious as other forms of deviant behaviour or criminal wrongs. Courts have been under pressure to recognise and accord due attention to privacy wrongs, whether against individuals or organisations. In practice, remedies for privacy violations will depend on the degree of violation, for example, where an infringement has crystallised in revenues or profits for the offender, the courts may give order for damages and an injunction to prevent further breach. However, if the infringement is still in the course of action, the aggrieved party may seek for perpetual injunction on the actions leading to the breach. In Nigeria, NITDA's data protection regulations protect data subjects or individuals and corporate organisations whose data have been captured and stored in the systems of data controllers from all forms of privacy violation. Remedies can be granted and offenses also attract very stringent penalties, including fines and jail terms.

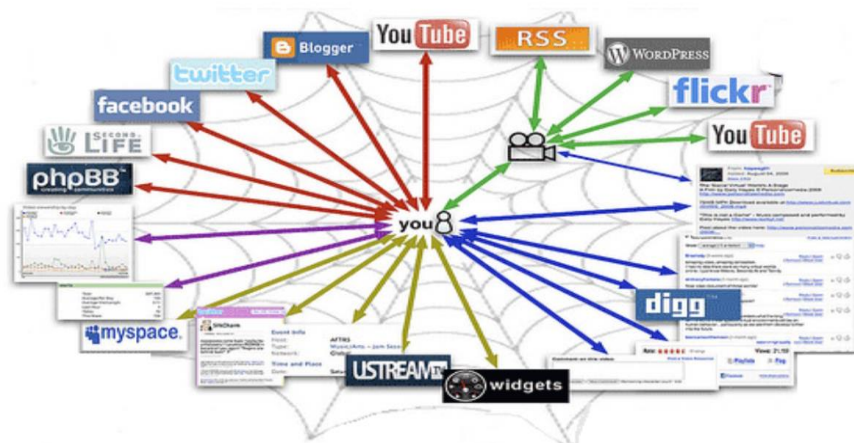
Statistics suggest that as of 2020, a greater number of the world's population were hooked on one device of IoT or the other and that there were more connected devices than people, as shown in the illustration below:



17.9.5

Social media

This is an electronic platform for sharing information content in the form of video, audio, text or multimedia, that is published using the information super-highway—the internet. These platforms exist in a large variety of formats and social/business models, namely Instagram, Facebook, WhatsApp, LinkedIn, YouTube, etc. (see illustration below):



Social Media Platforms

17.9.6

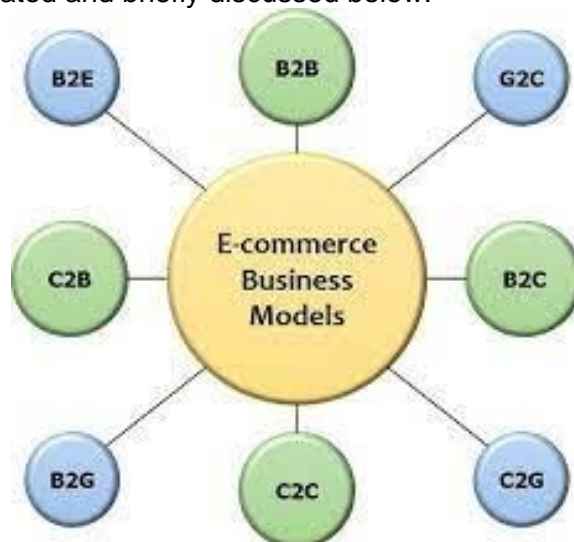
Benefits of social media applications

Social media serve as effective business and marketing tools for organisations and individuals. Some of the benefits include:

- Extending marketing reach affordably;
- Increasing brand awareness;
- Helping to drive traffic to your website;
- Improving personalised customer service;
- Creating excitement for events, for example using YouTube to create excitement for proposed business launches, etc.;
- Promoting product/service launches;
- Building a community of customers who, by virtue of membership, endorse your products/services;
- Testing new market ideas;
- Opening up new markets;
- Complementing other marketing efforts, such as paid marketing campaigns; and
- Integrating a social element in your business by personalising your company.

17.9.7 E-commerce models

The principle and framework for e-commerce exists in the form of a number of business models and are illustrated and briefly discussed below:



e-Commerce Model

Business – to – business model (B2B)—This depicts an electronic business interaction between two transacting business entities. Products and services are offered in an online format, purely for other businesses that benefit from such products and services. For example, security vendors offering their services to banks and other institutions that require security support.

Business – to- consumer (B2C)— This is a model requiring businesses offering their products or services directly to consumers, as consumers or potential consumers visit the site of these companies to make purchases directly. Examples are eBay, Alibaba, Jiji, Konga, Amazon, etc

Customer to customer (C2C) — Here, a consumer relates with another consumer directly, typically, engaging in an exchange of goods or services, mimicking the days of trade by barter, but with cash as the medium of exchange and the internet as the market place. Consider the example of one engaging a house help through an agent online, or someone renting a house apartment in the city of Lagos or Abuja and engages a housing agent through an online platform say, Facebook, Instagram, or Jiji, etc.

Customer to business (C2B) — This e-business model is a reverse of the B2C. the consumer now provides services or products needed by the organisation using an online platform. Individual web designers and those involved in personalised services provide such services or products to business entities, using the Internet as the main medium of interaction.

Government to citizen (G2C) — This model engages the government and its citizens. For example, the Federal Inland Revenue Service (FIRS) and a number of State revenue services around the country provide tax advisory services while the citizens pay their taxes online, with applications such as TaxPro MAX. Other examples include the Joint Admission and Matriculation Board (JAMB) that now provides online examinations through the computer-based tests (CBT) and results are released online. For some years now, the West African Examination Council (WAEC) provides students results online, where individuals procure WAEC result checker scratch cards and use the embedded codes together with examination numbers, logon to WAEC website and check their results. This makes it possible for students seeking university admission overseas to have their WAEC results checked independently, albeit remotely by their prospective universities overseas.

Citizen to government (C2G) —This model is the opposite of the former, G2C. The citizens exchange information or engage the government for some form of services or the another. Recently, the FIRS launched an online platform called TaxPro MAX specifically designed for tax payers' assessment and submission of tax returns online. It is obvious that government online is really working in Nigeria. Virtually all services rendered by the Institute are in an online format, including the Members' Professional Development and Training Seminars and workshops, all through the year.

These two models above are loosely referred to as government online.

Business to government (B2G)— This is the model whereby business entities provide services to government online. Examples where businesses make submissions for tenders or bids for government contracts, etc.

Business to employees (B2E)— This is a model by which businesses engage with their employees virtually as a result of the effects of COVID 19 pandemic. Employees perform various tasks and also receive their salaries online through various payment channels.

17.9.8 Payment systems

For online transactions to be fully consummated and recognised as valid, payments have to be made. Usually, online merchants have the liberty of designating the mode of payments preferable to them. The payment channels will be discussed in the following sections.

There are four main types of electronic payment channel, namely:

a. Wire transfer channel

This represents a seamless method of electronic payment method where a consumer transfers money through an Internet portal or through his or her bank portal, using available mobile banking applications or the internet banking applications. Either way, the recipient gets an alert message to validate the payment. This channel gives the payer the liberty of making both international and local payments for purchases procured either online or at a physical market-place such as malls, supermarkets, etc., provided the merchant accepts such a method of payment. Also, note that wire transfers can be effected through banks' automatic teller machines (ATM) located at various banking and public places across the country and overseas.

b. Debit card payment channel

This is a variant of electronic payment system using what could be referred as funded cards. This means that the debits are tied to the customer's bank account which could be savings or current accounts.



They can be used for online transactions such as internet purchases from merchants' sites, as well as point of sale (POS) devices and automatic teller machines (ATM). For debit cards to be used effectively, the holder needs to have an account with a bank, known as the issuer, a personal identification number (PIN)—a secret code which is known only to the card holder, the card number—usually a sixteen-digit number in blocks of four number digits. Other identifiable features include the card expiry date, and the card verification value (CVV). This is a combination of features in a card used to establish the identity of the card holder and helps in limiting identity theft fraud. These card credentials combine in a certain form to enable a valid card transaction to take place. Smart cards or debit cards are the most common and most popular channels for electronic payment system in Nigeria.

c. Mobile payment channels

As the human ecosystem becomes increasingly mobile, the need for consumers to engage in transactions anytime, anywhere and everywhere arises. Thus, applications usually referred as mobile apps were developed to be loaded and installed on mobile devices such as smart phones and tablets. Mobile apps are financial institutions specific and operate to enable payments or inter-bank transfers to be effected effortlessly from customers' mobile devices.

d. Wire transfers

This requires a customer to make online cash transfers from either his or her computer through an internet banking application. This requires the customer to have an Internet banking application configured on his or her computer such that transaction payments can easily be consummated.

17.10 Digitisation of the middleman

In business generally, the middleman plays a very important role of bridging the gap between the merchants and the consumers. In the electronic space, merchants and consumers are often separated by very great geographical distance, however, the emergence of communication technologies and the interplay of World-Wide-Web or the internet, bridged this gap. Also, creativity on the part of humanity helped to leverage this position as what may be described as commodity brokers came in between the merchants and the consumers. While merchants keep physical shops with assorted wares and products and categories ranging from electronics, kitchenware, to clothing, community brokers build electronic shops drawing the consumers' attention to these wares and products that are retailed by the merchants, albeit at physical locations. This enables customers to place orders on the websites of online vendors who then scout for these products coming from different merchants, then ship to the consumer who makes payments through the designated electronic channels, usually, the debit or credit card. These online shops or vendors became what is classified as the digitised middlemen. Examples include Amazon, eBay, Konga, Jiji, Jumia, etc.

17.11 E-Commerce security

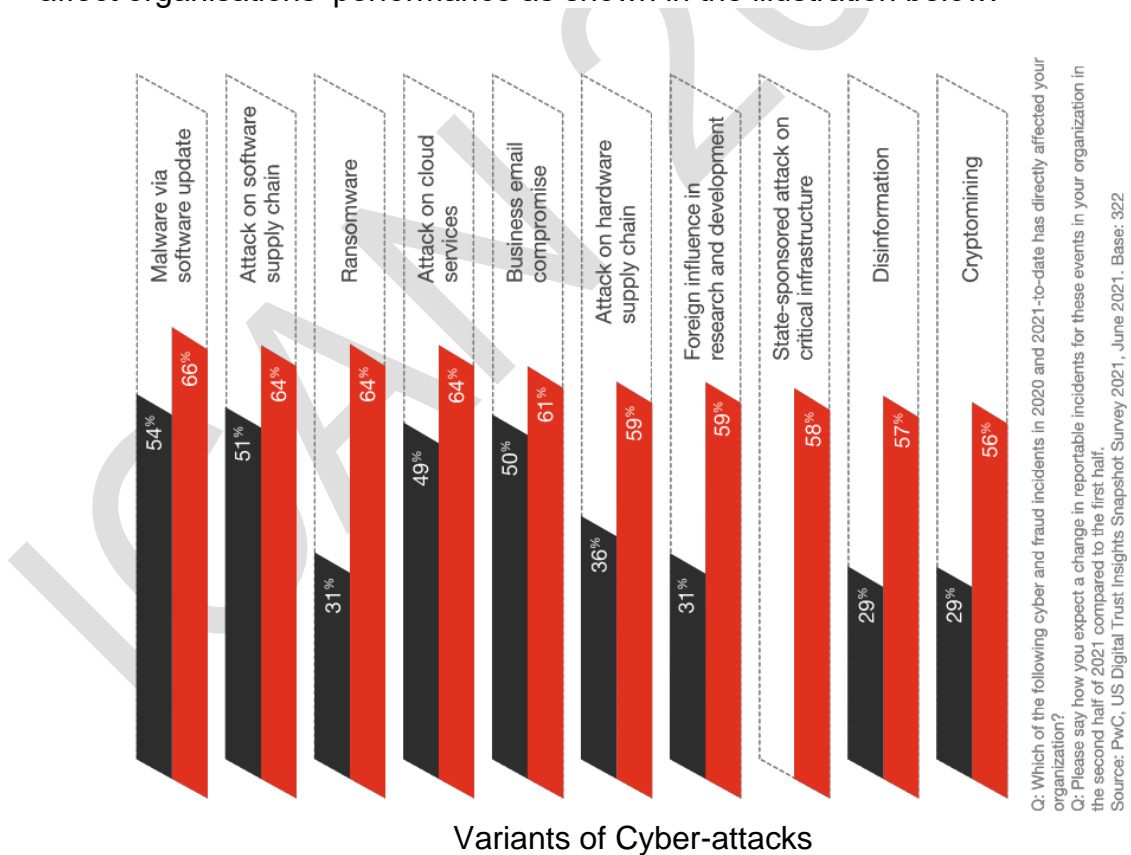
E-Commerce security is usually considered in the light of the entire cyberspace horizon and in the context of threats of attacks both from internal and external agents. Usually, organisations apply security policies to achieve e-commerce security. This is designed to fit into organisational rules, norms, and operational standards developed to protect information and information systems from unauthorised access, use, disclosure, disruption, modification, or destruction, such that the elements of confidentiality, integrity, and availability are assured (Greg Ezeilo, 2018). Further, all organisational rules and guidelines associated with normal operations of IT facilities are designed to help employees' compliance, with the sole objectives of reducing IS security incidents to the barest minimum. In spite of these policies, security threats still exist even with severe financial impact, including loss of corporate clients and reputational damage suffered by organisations and individuals. In the following sections, we will discuss some of these security threats and protection mechanisms.

17.11.1 Concepts of cyber threats and risks

Cyber threat refers to potential violations, either intentional or non-deliberate, perpetrated against organisations' information systems and related assets, usually with high risk of loss of financial assets or reputational damage to the victims. Many of these threats arise from either the nature and types of information systems, operational practices or other migration methodologies adopted by organisations. For example, remote work practices as imposed by the emergence of COVID 19 pandemic, adaption of cloud computing facilities arising from the demand of disruptive technologies, the concept of bring your own devices (BYOD) to the work-environment and the behavioural tendencies of employees contribute greatly to these threats and risks of attacks.

17.11.2 Cyber-attack and its variants

Attacks from the cyberspace come in different forms and intents. Attack vectors are usually dependent largely on degree of connections to the internet, number of devices, applications running on cloud technology, practices associated with organisational data storage and security architecture. Attack mechanisms include ransomware, malware attacks, espionage, brute-force applied to steal privileged passcodes, sql injections, and other hacking techniques designed to cause harm to organisation's information systems. In a recent survey by PWC, a number of these attack variants were studied and how they affect organisations' performance as shown in the illustration below.



Students who are desirous of exploring deeper into these attack exploits can make great in-roads through the domain of ethical hacking and countermeasure courses and training programmes.

17.11.3 Protection against cyber attacks

Safe computing within the myriads of malicious cyberspace can only be achieved through effective and sustained protection measures. Essentially, the baseline of effective security against cyber-attack is achieved through security education and training and awareness (SETA) programmes.

Technical measures would then include:

- a. Password protection;
- b. Perimeter protection using firewalls including content filtering devices, intrusion detection systems and tools such as Snort, Wireshark, etc.;
- c. Anti-virus software; and
- d. IT policies used to manage employees' security behaviour in the environment.
- e.

17.11.4 Cyber deviants and implications for the workplace

Deviant employees and non-deviant employees remain one of the greatest threats to cyber security in the workplace. IS security researchers found that negligence or apathy toward IS policy compliance is a continuing phenomenon especially among both IT and Non-IT employees (Ezeilo, G. U., 2018), notwithstanding the severity of sanctions and other technical controls implemented by organisations. When employees become disgruntled either by actions or omissions of their seniors, they often develop potential apathy and negligence over information systems security policies, which ultimately lead to breaches of various dimensions with grave implications for the organisations. For example, employees who do not comply with policies regarding visiting prohibited websites, opening and downloading email attachments from suspicious websites and other similar risky actions, expose the organisations to cyber-attacks of all kinds.

17.11.5 Remedy

While organisations do their best to institute technical controls, such as stringent password restrictions, firewalls, and other technical measures, they should also consider security education and training and awareness (SETA) programmes. Chief information security officers (CISOs) should consider developing blogs, organisational newsletters and group chats as media of disseminating security information and knowledge to employees. Similar information should also be included in employee's handbook, designed as part of the employee-orientation process at the entry point into the organisation.

17.12 Management issues associated with e-commerce/e-business

Responsible organisations would usually consider key benefits and drawbacks of every information systems-related project before embarking on such investments. More critical consideration would be the returns on such investment in the context of the expected value such an investment would add to the business of the entity. An exercise geared towards developing options for decision making that will affect the organisation's inclination towards making such procurement is described as a business case. A business case, therefore, would draw strongly on the following cardinal points:

a. **Current-state assessment**

This is an assessment of the present condition of the business process targeted, for the IT process deployment. For example, a business process, such as payroll or financial reporting process which had been either partially or totally manual in process, would have been evaluated by the technical team of the organisation to ascertain its current state and what would be required to make the payroll system mechanised.

b. **Benchmarking**

This derives from learning from other or similar organisations which use similar systems as being contemplated by the organisation intending to deploy information system. The objective is to determine how best to match or exceed existing facilities and operational practices of these other organisations. Critical in this process is the technical effectiveness of the emergent system.

c. **Gap analysis or option evaluation**

This process helps to determine potential deficiencies in the existing system with the view to ensuring that the emergent system is devoid of such or similar weaknesses.

d. **Cost benefit analysis**

This is usually the overriding factor in the whole process. An organisation may disregard a business case scenario for reasons of poor cost or benefit justifications. At all times, the economic value of the project is considered more strongly than the cost of such project. Where management feels that the cost does not justify the benefit, such projects would die naturally.

In summary, the business case scenario progresses from providing strong analytical support for the project, quantifying the impact of the project on the organisation's business value and ultimately creating an impetus for management action.

17.13 **Information technology (IT) policies**

As a rule of engagement with organisations' information systems and especially the cyberspace where potential malfeasance and other malicious characters exist, certain guidelines and procedures are developed to provide guidance on the manner of information systems usage and application. In this sense, IT policies and procedures are required to establish such guidelines for the use of information technology within an organisation. In this case, it outlines what everyone is expected to do while using company's information processing facilities and assets. Strong IT policies and procedures support the inclusion of actions that are consistent, effective and efficient. Furthermore, potential cybersecurity threats and risks can be prevented through deliberate security education and awareness (SETA) programmes, properly encapsulated into the IT security policies and procedures manual. As a premium, properly crafted security policies also help to delineate documented processes for every IT project acquisition of the company.

17.13.1 **Policies**

To make a clear distinction, policies are general guidelines an organisation can apply to its IT acquisition and usage including rules of behaviour for safe computing environment. They provide the parameters for decision-making without the details of implementation. Policies mainly focus on communicating an organisation's values, culture and philosophy, with regard to information systems facilities. A good policy outlines these rules of engagement with the information processing facilities (IPF).

17.13.2 Procedures

Procedures outline the step-by-step and end-to-end process of implementation of various aspects of the policy. Procedures outline what actions to take under specific circumstances. With procedures, one can achieve the desired outcome. For example, when a disgruntled employee is relieved of his or her job by a company, the policy might state that the particular employee must be escorted out of the company premises, however, the manner of such escort, who is involved, and what steps to take in order to enforce this policy will be found in the procedures for such actions.

17.13.3 Benefits of IT policies guidance

Below are some of the benefits of establishing good IT policies:

- a. Policy provides easy and understandable guidance for safe computing environment.
- b. Reasonable assurance of compliance— Policies give security professionals and the organisation a reasonable assurance of employees' compliance with the organisations' IPF and ensures best practice environment for the use of information systems.
- c. Improvement in internal processes—Very good policies provide compelling guide for internal processes' evolution towards efficiency and effectiveness of IT tasks and other related company operations. It is recommended that companies review and update their IT policies, more especially in the context of technology disruptions affecting businesses and demanding greater attention to security threats. Policies can help to ensure consistent service delivery, increase employee knowledge and awareness, and a speedy evolution of general IT education across the enterprise.

17.13.4 Crisis resolution

Strong policies and procedures help prevent or resolve workplace incidents with regard to security. For example, actions that are not intended to be malicious, but impede the IPF environment such as wrong use of password or inadvertent violation of clear desk and clear screen policy. These would be resolved with clear guidelines on the actions to be taken. Similarly, well-crafted policies on incident response, service level agreements, data backup, can help mitigate damages to reputation in cases of breaches.

17.13.5 Policy coverage

A well-articulated policy should cover the entire spectrum of the organisations' information processing facilities and environments—both internal and external. In more specific terms, the IT policy and procedures should cover the following high-level titles:

- a. IT administration;
- b. IT records management;
- c. IT document management;
- d. IT device naming conventions;
- e. TCP/IP implementation standards;
- f. Network infrastructure standards;
- g. Computer and internet usage policy;
- h. E-Mail usage policy;
- i. IT outsourcing; and
- j. IT department user satisfaction.

Other areas include:

- a. Asset management procurement;
- b. Vendor selection;
- c. Asset assessment;
- d. IT Asset installation satisfaction;
- e. Training & support;
- f. System administration;
- g. IT support centre;
- h. Server / network support;
- i. Troubleshooting;
- j. User-staff training plan;
- k. Security and disaster recovery plan;
- l. IT threat and risk assessment;
- m. IT security plan;
- n. Media storage, including clouds;
- o. Computer malware;
- p. IT access control;
- q. Security audits;
- r. Incident handling;
- s. Software development;
- t. IT Project definition;
- u. Project management;
- v. Systems analysis;
- w. Software design;
- x. Software programming;
- y. Software documentation;
- z. Software testing;
- aa. Design changes during development;
- bb. Software releases and updates;
- cc. Software Support;
- dd. Software consulting services; and
- ee. Software training.

17.13.6 Benefits and challenges of e-commerce

As a tool of business and global interaction, e-commerce has immense benefits as well as challenges.

- a. **Benefits of e-commerce**
Chiefly among the benefits are:
 - i. Speed of processing and interaction;
 - ii. Faster and global outreach to customers and associates;
 - iii. Cost reduction;
 - iv. Reduced cost of advertising, marketing and publicity;
 - v. Flexibility for customers;
 - vi. No geographical boundaries and 24/7 reach;
 - vii. Competitive product pricing and quality; and
 - viii. Speedy response time to enquiries and demand fulfillment.

b. **Challenges of e-commerce**

Among the challenges are:

- i. Cyber & data security threats;
- ii. Cyber-attacks by hackers;
- iii. Security breaches;
- iv. Online identity theft;
- v. Unassured customer loyalty;
- vi. Converting shoppers into paying customers may become an issue;
- vii. Competition and competitor analysis; and
- viii. Un-enforceable product return and refund policies.

17.14 Business operations outsourcing methodologies

Organisations would not normally have all the expertise and skills it requires for its operations. Certain business tasks, such as front-office customer services, network support service, security services and in some cases audit services are often farmed out to companies with the right expertise and capacity to deliver such functions to organisations. This enables the organisation to concentrate on its core business area. Such a business service delivery arrangement is described as outsourcing engagement. Some classical examples of business activities, which are frequently outsourced, include payrolls, accounting services, staff training, technical support, customer support, call centres, procurements, manufacturing, supply chains, recruitment, applications development, research and development services, data entry operations for large and complex data centres.

17.14.1 Variants of business process outsourcing

There are four classical variants of outsourcing engagement based on the location of the service provider to the procuring entity. These include:

a. **Onsite outsourcing**

This is an outsourcing model where the procuring office or company would have the outsourcing vendor virtually relocate his facilities to the client office premises. This provides the advantage of speed and close supervision of the client's service delivery and performance. This type of outsourcing also helps in knowledge sharing between the organisation's staff and the vendor or experts.

b. **Onshore outsourcing**

This entails contracting the business function in question to a third-party who resides either in another state or country. Cultural difference and language barriers are the usual hindrances to this type of outsourcing model. However, with the emergence of cloud services and remote computing, such barriers are no longer of serious challenge.

c. **Nearshore outsourcing**

This refers to a model engaging the services of companies that are located almost within neighbouring countries or states. This could be associated with the desire to procure services at affordable cost and with potential expertise and knowledge transfer initiatives.

d. **Offshore outsourcing**

This involves engaging the services of overseas professionals. This applies more especially to IT experts. For example, Microsoft support engineers are located almost everywhere across the globe especially in India, China and the Philippines. The basic motivation behind offshore outsourcing is low labour cost of acceptable quality of service. Additionally, there are other models of outsourcing engagements, namely staff augmentation, management team and project-based models.

17.14.2 Pricing of outsourcing engagement

In all cases, pricing is based on an agreed negotiated fee as follows:

a. Fixed Price model

In this type of pricing, a negotiated lumpsum professional fee will be applicable. It is a relatively old-fashioned model and usually charged depending on the client's inclination towards charges for workspaces and tools. The basic motivation for this pricing method is that payment would only be due and payable on completion of the assignment. However, the outsourcing partner would usually insist on certain flexibilities in payment terms and would usually prefer milestone payment against the agreed lumpsum price.

b. Time and materials model

This pricing is usually tied to the specific requirements of the client and the outsourcing partner would usually require the vendor to carry out the service in-house, which would usually come under the client's supervision.

c. Incentive-based model

In this model, there would generally be an agreed rate for the performance of the assigned job, however, the outsourcing partner agrees to pay an extra amount of money for superior service delivery over and above an expected level of performance. This serves as a form of motivation to the vendors.

d. Shared risk-reward model

This pricing method has a partnership orientation whereby both the risk and the returns of the project are shared between the vendor and the outsourcing partner. It also lessens the risk associated with new processes and technologies.

17.14.3 Data centre disaster and contingency plans/recovery alternatives



Disaster of this kind and magnitude would never sound a note of warning nor make choices where, when or why it would strike. Sometimes, it happens within business buildings and infrastructures hosting critical data centres and organisational information processing facilities (IPF). When such unplanned incidents occur, resulting in complete shutdown of data centres, the question of recovery efforts and alternative means of returning to operations tops the agenda of the chief information officers and business leaders. Organisations would generally adopt one of a number of variants of recovery plans as outlined below.

a. **Cold standby site**

This is a recovery alternative which provides for only building infrastructure such that in the case of emergencies, recovery efforts would require you to procure and install relevant hardware and applications including operating system and databases installation. This means that recovery efforts could take days or weeks.

b. **Hot standby site**

This provides an alternative data centre that becomes immediately available within seconds of failure of the production site. A hot site can take over processing while the primary site is down. A complete copy of the primary process may sometimes exist at the backup, with no need to install either the OS or the applications.

c. **Warm standby site**

This is a middle point between the cold and hot sites. In this model, the recovery infrastructure would have limited facilities such as network cabling, a number of hardware, such that in the event of failure of the primary site, the recovery team proceeds immediately to procure applications and connectivity setups ready for the recovery efforts which would usually last for shorter period of time compared to the recovery time period of the cold site alternative.

It must be noted that the choice of any of the alternatives would generally depend on the nature and criticality of the data centre and business operations of the entity. If the data centre runs very-mission-critical applications and the company cannot afford to lose any downtime, then the hot site alternative would be needed. Further, cost of deploying any of the alternatives would potentially induce the choice the organisations will make regarding the alternative models.

1 CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you can:

- Define and explain information system
- Describe the approaches to information systems
- Explain the usefulness of information system to key business functions
- Describe the relationship between organisations information systems and business processes
- Describe the types of information systems
- Describe behavioural issues in management information systems (MIS)
- Explain violation of intellectual property rights
- Explain electronic business and e-commerce
- Describe digitisation of the middleman
- Explain e-commerce security
- Describe Management issues associated with e-commerce/e-business
- Explain information technology (IT) policies
- Explain business operations outsourcing methodologies

Computer hardware, software and data life cycle

Contents

- Introduction
- Storage
- Network technologies
- Computer software concepts
- Data life cycle and information storage
- Data privacy and protection
- Database management system
- Data warehousing (DW)
- Big Data analytics
- Chapter review

INTRODUCTION

Aim

Business information takes an integrated approach by developing an awareness of information technology and systems support.

Detailed syllabus

The detailed syllabus includes the following:

D	Computer hardware, software and data life cycle		
	1	Computer hardware concepts	
		a	Explain:
		i	Storage devices;
		ii	Network technologies – explaining the concepts and typologies;
		iii	Communication protocols;
		iv	Wireless networks;
		v	WWW and the internet; and
		vi	Intranets and extranets
	2	Computer software concepts	
			Explain:
		i	Types of software – systems and application; and
		ii	Application bugs and treatment
	3	Data life cycle and information storage	
	4	Key data life cycle terminologies	
			Explain the following:
		i	Data acquisition;
		ii	Data cleaning and processing;
		iii	Data analysis;
		iv	Data privacy and protection;
		v	Database management system;
		vi	Data warehousing; and
		vii	Big data analytics

Exam context

In this second chapter on information systems and technology we will focus on networks and communications. This chapter is reasonably technical and will introduce you to the main acronyms and topics related to networks, architectures and protocols. The chapter also includes practical sections on email and video conferencing in the business environment.

By the end of this chapter students will be able to:

- Define storage
- Describe network technologies
- Explain computer software concepts
- Explain data life cycle and information storage
- Explain data privacy and protection
- Explain database management system
- Explain data warehousing (DW)
- Explain big data analytics

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18.1 Introduction

A typical information processing facility (IPF) would consist of a number of disparate and combining elements, components and devices, namely hardware and software, making up the entirety of the organisation's IPF. A typical arrangement or organisation of these hardware devices such, as storage and software, give the IPF the form and mode of operations, including whether the information system environment would be stand-alone, networks, or whether there would be a connectivity to the external environment such as the Internet or the World-Wide-Web (WWW). The following sections will discuss each of the above terms and terminologies used in a typical data centre, including methods of procuring data from inception to extinction—the data life cycle.

18.2 Storage

Data is not what one feels or touches, yet it requires a host container to preserve and use it when the need arises.

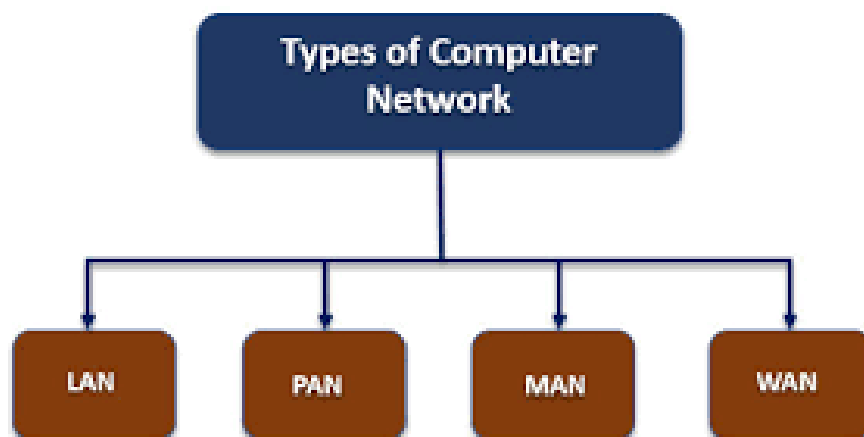


Storage devices vary according medium, capacity and mode of storage. These include floppy disks which are extinct, hard disk, CD, memory and USB sticks. Others include tapes, read only memory (ROM) and random access memory (RAM). These latter ones are classified as volatile storage media in the sense that they hold data as long as there is power and energy supply to the devices which is why once there is a power outage, the computer loses its memory content unless it is support by an uninterruptible power supply systems (UPS).

18.3 Network technologies

Prior to the emergence of remote handshake between computers or users per se, what was obtained were disparate stand-alone machines which are the only means of data and information exchange between individual users, removable storage devices such as compact discs, floppy disks, USB sticks and recently, memory cards. It became burdensome and somewhat impracticable to then exchange data and information at very remote locations. However, developments in communication devices such as telephony, hubs, switches, and routers made connectivity of disparate systems in various remote places feasible. The connectivity of computers is thus referred to as computer networks. Various kinds and topologies of network will now be discussed.

18.3.1 Types of computer network

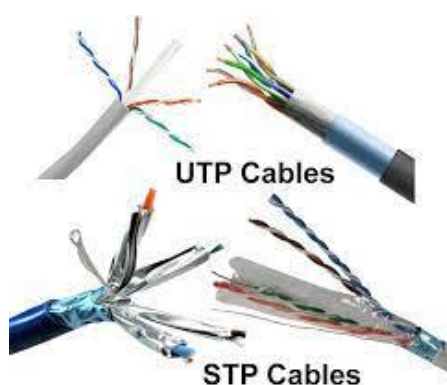


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There are three main types of business computer networks, namely LAN, MAN, and WAN. However, for purpose of completeness, and to accommodate individuality, a fourth type, personal area network (PAN) was added. This is a network with limited number of computers (either wired or wireless) within a perimeter area of ten (10) metres for personal use.

18.3.2 Network terminologies

- a. Node — A node is described as each item connected in a network, be it computer, hub, router, switch, printer, etc.
- b. Workstation — Each computer connected in a network is called a workstation.
- c. Server — This is the computer that hosts all shareable resources in a network, including data, pictures, applications, files, etc. Note that a printer that provides printing services to a host of users and computers in a network is also described as a printer server.
- d. Network cables — These are special types of signal cables used to connect computers in a network. They come in various categories know as Cat-5, Cat-6 and Cat-7 shielded twisted pair (STP) or untwisted twisted pair (UTP) as shown below.



Additionally, two other types of cable exist, the coaxial cable, which is the cheapest but prone to some deficiency in performance. The last type is the fibre optic cable, which has the greatest advantage of speed of transmission and unaffected by attenuation—signal degradation over long distances.



Twisted Pair Cable. Coaxial Cable. Fibre Optics Cable

<https://study.com/academy/>

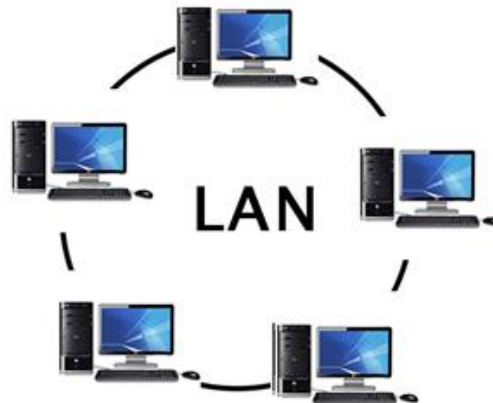
- e. Hubs— These are hardware devices used to create the LAN environment, usually within an office or building complex. It can also be used to connect different LANs such that they are brought into one cooperating network without losing their individual identities.



- f. Network switches—this device is similar to hub but more intelligent than hub.

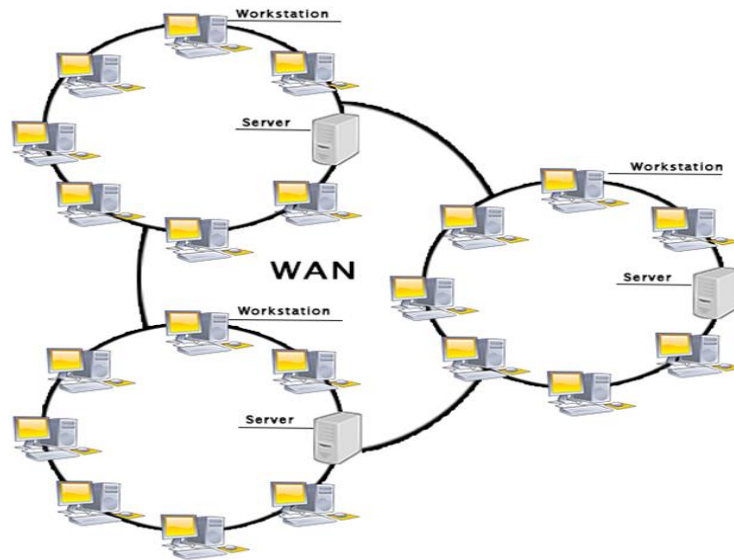


18.3.3 LAN—Local area network



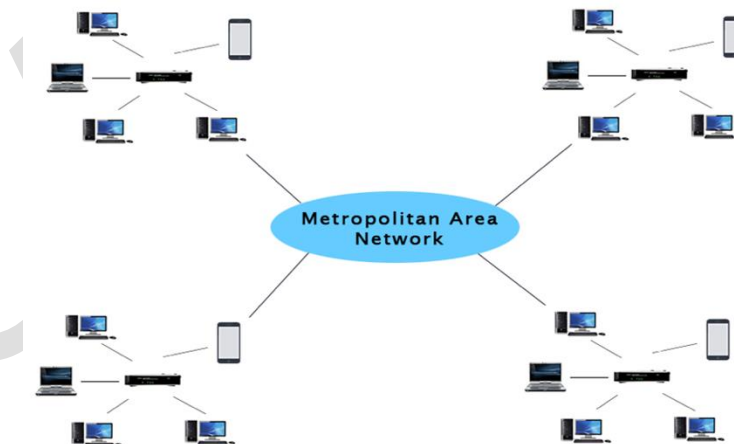
This is a type of network arrangement that is limited in scope, distance and resources it can host. The proximity is usually within an office environment, provided there are geographical boundaries between one network point and the other. It could be wired or wireless, depending on the intention and application. Network devices such as hub (outdated now) or switches and network cable (TJ45) are the usual devices used for the connectivity process.

18.3.4 WAN— Wide area network



A wide area network is a network that extends over a large geographical area, such as states or countries. It is a bigger network than the LAN. WANs are not limited to a single location, but span over a large geographical area through a telephone line, fibre optic cable or satellite links. The internet serves as the largest WAN in the world, as this is the network for connecting computers in the world. It is widely applicable in business, educational institutions, research institutes, government organisations, etc. For example, in Nigeria, there is a WAN described as GIFIMS—government integrated financial information management systems, with a connectivity of all financial information management of the federal agencies across the country. This solution aids in financial processes, such as payments of contractors, salaries of federal staff, federal inland revenue service (FIRS) collection processes, etc.

18.3.5 MAN—Metropolitan area network



Metropolitan area network— This is a network that covers a larger geographic area by interconnecting different LANs to form a larger network and operate usually within a metropolitan city. For example, Government agencies use MAN to connect to the citizens and private industries, such as the case with GIFIMS. It has a wider area coverage than LAN.

18.3.6

Wireless networks (WiFi)



Wireless networks are network connections that require no cables, no hubs, no switches, as media of connecting to other devices or systems. Instead, other devices, such as satellite dishes, routers, infra-red technology, Bluetooth and access points are used to effect the required connectivity. A classic example of wireless network is the global system of mobile (GSM) communications. Cell phone requires no cables or switches but satellites and base stations for its connectivity with every other device once such hand-held devices are equipped with Bluetooth or Wi-Fi technologies. For business applications, routers and or access points are required as exhibited below for enabling wireless network connectivity in offices and homes.



<https://www.conceptdraw.com/>

For purposes of clarification, wireless access point or WAP, is a device that enables wireless devices such as phones, printers, laptops, etc. to connect to a wired network using Wi-Fi, or related standards. The WAP usually connects to a router (via a wired network) as a standalone device, but it can also be an integral part of the router itself. With the creation of the wireless access point (WAP), network users would then be able to add devices that access the network with little or no cables at all.

18.3.7 Communication protocols

As an analogy, when one attends a national public function, at which the President of the Federal Republic of Nigeria, the Vice President, State Governors, Ministers, Senate President, Speaker of the House of Representatives and some Distinguished and Honourable members of the Red and Green chambers in attendance, the Master of Ceremony (MC), in recognising dignitaries at the function in a proper format, would start by announcing the President, Vice President, Senate President, Senators, Honourable members before the State Governors. This is in accordance with protocol established under the National Order of Precedence of Public Officers Act, 2000 in Nigeria.

Similarly, in the world of computing and in general, the emergence of internetworking of computers where myriad of computers across the WWW are interacting every second with one another across the globe, there must exist a certain manner of behaviour and order of communication with one another, less, there will be chaos! These vast number of users are communicating with different devices in different languages, meaning that, the issue of language interpretation comes in and various ways in which they transmit data along with different software they implement. So, communicating worldwide will not be possible if there were no fixed 'standards' that will govern the way users communicate for data as well as the way our devices treat those data. In this sense, such standard rules established are referred to as communication protocols. These standards are listed and explained below:

a. **Transmission control protocol (TCP)**

This is the main communication protocol used for communicating over a network. It breaks down any message into series of packets that are sent from source to destination and there it gets reassembled at the destination.

b. **Internet protocol (IP)**

IP is designed explicitly as an addressing protocol. It is usually used with TCP. The IP addresses in packets help in routing them through different nodes in a network until they reach the destination system. TCP/IP is the most popular protocol connecting networks.

c. **User datagram protocol (UDP)**

UDP is a substitute communication protocol to transmission control protocol (TCP) implemented mainly for creating loss-tolerating and low-latency linking between different applications.

d. **Post office protocol (POP)**

POP3 is designed for receiving incoming e-mails.

e. **Simple mail transport protocol (SMTP)**

SMTP is designed to send and distribute outgoing emails.

f. **File transfer protocol (FTP)**

FTP allows users to transfer files from one machine to another. Types of files may include program files, multimedia files, text files, and documents.

g. **Hyper text transfer protocol (HTTP)**

HTTP is designed for transferring a hypertext among two or more systems. HTML tags are used for creating links. These links may be in any form, like text or image. HTTP is used on Client-server principles which allows a client system to establish a connection with the server, for making a request. The server acknowledges the request originated by the client and responds accordingly.

h. **Hypertext transfer protocol secure (HTTPS)**

HTTPS is a standard protocol to secure the communication among two computers, one using the browser and the other fetching data from web server. HTTP is used for transferring data between the client browser (request) and the web server (response) in the hypertext format, same in case of HTTPS, except that the transfer of data is done in an encrypted format. This means that https deprives cyber criminals from interpretation or modification of data throughout the transfer of packets.

i. **Telnet**

This is a set of rules established for connecting one system with another. The connecting process here is termed as remote login. The system which requests for

connection is the local computer, and the system which accepts the connection is the remote computer. Offshore support engineers are enabled by this protocol to login into remote systems for purposes of providing support to clients.

j. **Gopher**

Gopher is a collection of rules implemented for searching, retrieving as well as displaying documents from isolated sites. Gopher also works on the client/server principle.

18.3.8 Intranets and extranets

a. **Intranet**

An intranet is a private network based on the internet protocol such as **transmission control protocol (TCP)** and **internet protocol**. An intranet, proprietary to an organisation which is only accessible by the **organisation's employees** and other stakeholders for their internal information system activities. The main aim of the intranet is to share the information and resources among the organisation's employees. An intranet provides the facility to work in groups and for teleconferences.

b. **Extranet**

An extranet is a communication network based on the internet protocol such as **transmission control protocol (TCP)** and **internet protocol**. It is used for information sharing. The access to the extranet is restricted to only those users who have login credentials. An extranet is the lowest level of internetworking. It can be classified as **MAN, WAN** or other computer networks. An extranet cannot have a single **LAN**, at least it must have one connection to the external network.

18.3.9 Benefits of Intranet

- a. **Communication:** It provides cheap and easy communication. Employees in an organisation can communicate with each other through email, chat, etc.
- b. **Time-saving:** Information on the intranet is shared in real time, that way, it saves a lot of time.
- c. **Collaboration:** Collaboration is one of the most important advantages of the intranet. The information is distributed amongst employees of the organisation and can only be accessed by authorised users only.
- d. **Platform independence:** It is a neutral architecture, as the computer can be connected to another device with different architecture.
- e. **Cost effective:** One can access the data and documents by using a browser and distribute duplicate copies over the intranet. This makes for cost reduction in materials and document usage.

18.4 Computer software concepts

18.4.1 Introduction

In the earlier discussions, we dealt with computer hardware and network connectivity principles and concepts, but there is the other part that makes the computing environment wholistic in nature, that is, computer software and the associated variants. A computer software is a logical set of instructions designed for the computer to perform a specific task, note, it is immaterial whether this task is positive or negative, this is why there are computer bugs and other related malicious computer programs, called viruses and worms. There are two classes of computer software namely, systems and application software which are explained below.

18.4.2 Systems software

System software is a class of computer programs primarily designed to control the computer's internal functioning, and controls peripherals, such as monitors, printers, and storage devices. System software are generally called operating systems (OS). Examples include macOS for Apple machines and related hardware, Linux, Android and Microsoft Windows. Others are computational science software, game engines, search engines, etc.

18.4.3 Application software

These are software designed for specific business or leisure purpose. They include application software such as Microsoft Word, spreadsheets, media players, Firefox or Google Chrome, accounting applications, auditing packages, AutoCAD for architecture, CorelDRAW for graphics, photo editors, mobile apps, such as video games, WhatsApp, Telegram, etc.

18.4.4 Application bugs and treatment

A software bug is an error, flaw or fault in a computer program or system that inhibits the computer from operating normally as intended. Bugs can trigger errors that may have ripple effects. Bugs may have subtle effects or cause the program to crash or freeze the computer. To treat bugs, programmers would take time to carry out a thorough scrutiny in order to debug the program, that is, reworking the software to isolate and remove the bug.

18.5 Data life cycle and information storage

Data objects acquired for various purposes go through various stages of acquisition, cleansing, storage, usage, and disposal. This constitutes data life cycle. A typical data lifecycle is explained below.

a. Data creation and capture

Data creation is the generation or production of data from activities, observations, etc which would further be processed into information. The process of entering these data into the information system is regarded as data capture.

Data cleansing is the process of removing invalid and null items from their data sets, then storage for further work.

b. Data processing

This entails all activities brought to bear on the data sets such as concatenating data sets from varied sources, validating data authenticity, applying transformation through coding where necessary, to produce information. For example, data generated from ethnological research associated with the study of crafts, plastics and graphic arts, music, dancing, oral literature, dream analysis, religion, world view, ethics, and ethnomedicine to produce valuable information. Data generated from this kind of study do not come as hardcore data items but sometimes symbols, stories, behaviours movements, all of which have to be converted through a coding system to make it amenable to analysis and interpretation. This entire process of getting data to the final and clean state ready for analysis is referred as data processing.

c. Data analysis

This is a process of sieving through the data, to determine what the data is telling about the study or findings of the study. At this stage of the data life-cycle, there is ample evidence to make conclusions and predictions about the population represented by the data subjects. To accomplish this task, tools are required, essential statistical tools and modeling, such as Statistical Package for Social Scientist (SPSS) and Microsoft Excel. At this stage, illustrations of analysis in the form of bar charts, pictograms, pie charts, etc. are used to give impressions of the population of study.

d. **Data sharing and publication**

Once analysis is completed and findings from the data are made, forecasts are done, then publication of results of analysis follows.

e. **Archiving**

This is the last stage in the data lifecycle. Once the object of data collection, processing, analysis, predictions and publication of findings are completed, the data is now archived into a somewhat perpetual storage, only for reference purposes in the future. This completes the data lifecycle until such a time when such data is bound to go into destruction for reasons of obsolescence. Some research data subjects associated with human beings are subject to destruction after seven (7) years of completing such a study.

18.6 Data privacy and protection

This refers to the manner of data storage and handling that enables data to retain its confidentiality, integrity and availability at all times. Data, especially relating to human records of medical or financial nature, once compromised, loses its authenticity and validity. This often happens through the actions of malicious agents such as data lifters and hackers. To prevent data privacy violations, organisations and individuals would employ both technical and regulatory controls, such as access rights and privileges, encryption technologies. The National Information Technology Agency (NITDA) released a regulation called Data Protection Regulation (DPR) 2019, geared towards ensuring and enriching data protection and privacy in Nigeria. Readers are advised to access this regulation from NITDA website for further knowledge development.

18.7 Database management system

Database management system (DBMS) is a suite of application programs designed for effective management of databases. Some DBMS examples include MySQL, PostgreSQL, Microsoft Access, SQL Server, FileMaker, Oracle, RDBMS, dBASE, Clipper, and FoxPro. Because there are so many database management systems, there is need for communication between one data format and the other.

Consequently, most database software come with an Open Database Connectivity (ODBC) driver that allows the database to integrate with other databases. For example, common SQL statements such as SELECT and INSERT are translated from a program's proprietary syntax into a syntax other database can understand.

18.8 Data warehousing (DW)

This concept relates to a structural design for integrating data from multiple heterogeneous sources that support analytical reporting, structured and/or ad hoc queries, and decision making. Data warehousing involves data cleaning, data integration, and data consolidation. Examples include enterprise data warehouse (EDW), operational data store (ODS), and data mart.



<https://corporatefinanceinstitute.com/resources>

18.8.1 Benefits of DW include:

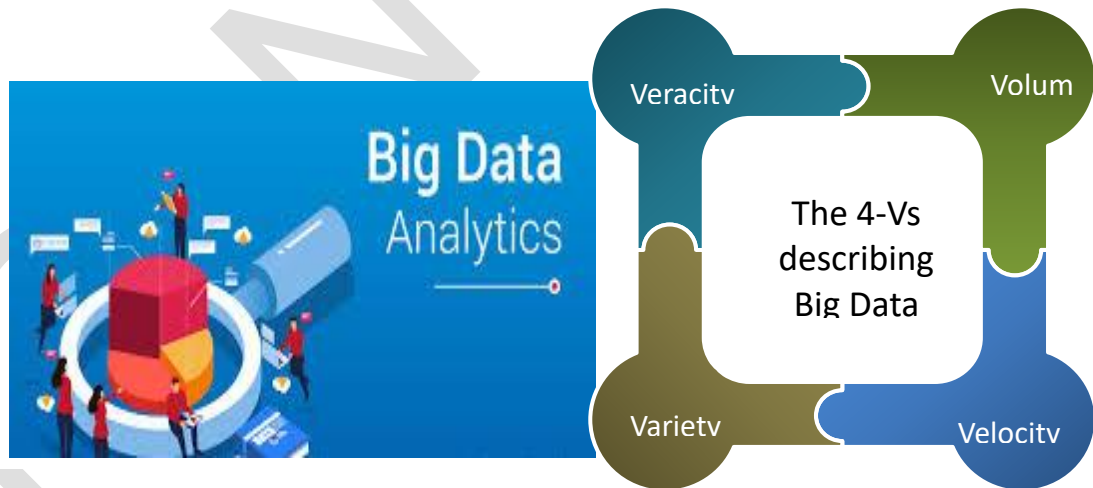
- a. The liberty to integrate data from multiple sources, with their separate identities intact;
- b. Non-volatility; and
- c. Changes can easily be analysed and business reporting made.

18.9 Big Data Analytics



<https://www.altexsoft.com/blog/big-data-analytics>

Big Data is one of the emergent disruptive technologies in contemporary global IT environment. Simply, Big Data apply to the huge volumes of continuously growing data that come in different formats, types, speed, and sources. These could be photo, music, text, etc. It also applies to the range of processes, tools, and approaches used to gain insights from that data. Big Data analytics helps companies deal with business problems that couldn't be solved with the help of traditional data analysis. Below are the key attributes of Big Data.



a. Volume

This signifies the “big thing” in Big Data, which is associated with the quantum of information from diverse sources and in varying sizes of terabytes to petabytes of information coming from a range of devices of internet of things, social media, text files, business transactions, etc. To highlight the scale of volume involved, 1 petabyte is equal to 1,000,000 gigabytes. For example, a single HD movie on Netflix takes up over 4 gigabytes, while watching and 1 petabyte contains over 300,000 movies. and Big Data is not about 1 petabyte, it's about thousands and millions of such data, so one can appreciate the volume involved.

b. *Velocity*

This depicts the speed and frequency at which the data is generated. It is represented in terms of batch reporting, near real-time/real-time processing, and data streaming. To exemplify this, consider that the speed with which the data is produced equates the speed with which it is processed. For example, in the logistic industry, a vehicle connected to the internet via a telematic device generates and transmits 25 gigabytes of data hourly at a near-constant velocity, and most of this data have to be handled in real-time or near real-time.

c. *Variety*

This is the vector showing the diversity of Big Data. This data is not just about structured data that reside within relational databases as rows and columns. It comes in all sorts of forms that differ from one application to another, and most of Big Data is unstructured. For example, as you receive messages from WhatsApp, the posts may contain some text information, videos or images and a timestamp, etc.

d. *Veracity*

This feature is perhaps one of most contagious and contentious, as majority of the data come as repeated and sometimes the origin and truth of the information cannot be readily ascertained. Data can be incomplete, inconsistent, or noisy, decreasing the accuracy of the analytics process. Accordingly, data veracity is commonly classified as good, bad or unstructured. This then becomes a challenge, when dealing with diverse data sets such as medical records, in which any inconsistency or ambiguity may have harmful effects.

18.9.1 Real life application of Big Data

Big Data analytics can be found in the predictive modeling in the following areas:

- a. Customer relationship management initiative;
- b. Market research;
- c. Product devilmment designs;
- d. Sales forecast;
- e. Human capital management; and
- f. Audit activities.

18.9.2 Effective tools for Big Data analytics

To be able to analyse Big Data and generate some opinions and make predictions, some tools are required, which include:

- a. Microsoft Excel;
- b. Structural query language (SQL);
- c. Quick view;
- d. Rapid miner;
- e. IDEA; and
- f. ACL.

1 CHAPTER REVIEW

Chapter review

Check that you now know how to:

- Define storage
- Describe network technologies
- Explain computer software concepts
- Explain data life cycle and information storage
- Explain data privacy and protection
- Explain database management system
- Explain data warehousing (DW)
- Explain big data analytics

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**Foundation
level**

CHAPTER

19

**Technologies
Supporting Business
Processes**

Contents

- 1 Introduction
- 2 Enterprise resource planning (ERP)
- 3 Artificial intelligence (AI) systems as business support agent
- 4 Blockchain technology (BT)
- 5 Computer robotics and business automation (CRBA)
- 6 Customer relationship management (CRM)
- 7 Warehouse management
- 8 Enterprise content management (ECM)
- 9 Supply chain management (SCM)
- 10 Online transaction processing (OLTP)
- 11 Centralised and decentralised processing
- 12 Distributed processing (DP)
- 13 Real time processing (RTP)
- 14 Chapter review

INTRODUCTION

Aim

Business information takes an integrated approach by developing an awareness of information technology and systems support.

Detailed syllabus

The detailed syllabus includes the following:

E	Technologies supporting business processes	
1	Explain the concepts of:	
	a	Enterprise resource planning (ERP);
	b	Artificial intelligence systems; and
	c	Blockchain technology.
2	Computer robotics and business automation (CRBA)	
	a	Business applications of CRBA:
		Explain:
	i	Customer relationship management (CRM);
	ii	Warehouse management;
	iii	Enterprise content management;
	iv	Supply chain management; and
	v	Virtual reality.
	a	Explain the following concept in relation to Mol supporting business processes:
	i	Online transaction processing;
	ii	Centralised and decentralised processing;
	iii	Distributed processing; and
	iv	Real-time processing.

Exam context

Information systems are the source of the financial statements on which an auditor expresses an opinion. Information systems also provide information for day-to-day running of an organisation as well as for medium and long-term strategic planning.

Given the importance and relevance of information systems to both the external auditor and management it is important for students to understand how data and information is processed, stored and organised.

By the end of this chapter students will be able to:

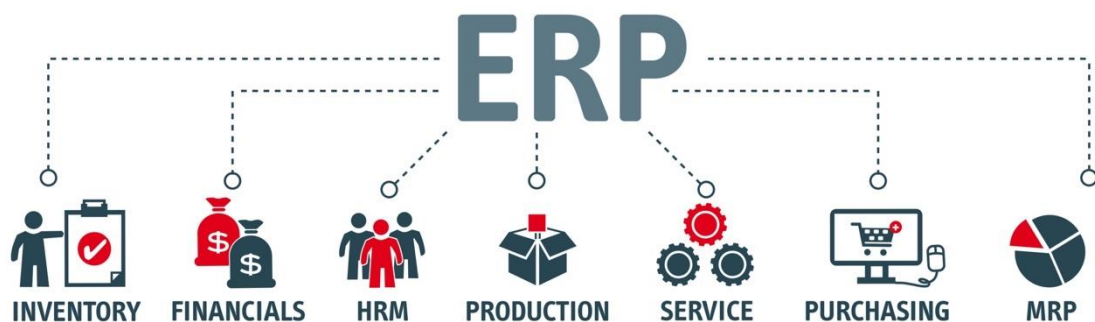
- Explain enterprise resource planning (ERP)
- Explain artificial intelligence (AI) systems as business support agent
- Explain blockchain technology (BT)
- Explain computer robotics and business automation (CRBA)
- Explain customer relationship management (CRM)
- Explain warehouse management
- Explain enterprise content management (ECM)
- Describe supply chain management (SCM)
- Explain online transaction processing (OLTP)
- Describe centralised and decentralised processing
- Explain distributed processing (DP)
- Describe real time processing (RTP)

19.0 Technologies supporting business processes

19.1 Introduction

In previous chapters, aspects of information system from the perspectives of need, types of information system, hardware and software, typologies, nomenclature, networks and their variants were discussed in addition to eBusiness and e-commerce, including their applications. This chapter will discuss how and in what configuration these IS processes can effectively support business processes.

19.2 Enterprise resource planning (ERP)



<https://www.redwoodlogistics.com/>

ERP is a business application that allows integration of business processes and business application tools into one whole. ERP is a tool that helps any business organise and manage its records, finances, resources, human capital, marketing,

inventory, purchasing, vendors resources and other aspects of a business in a seamless and workflow manner.

19.2.1 Benefits of ERP

ERP helps achieve the following benefits:

a. **Accurate forecasting**

Every serious business concern must make predictions regarding its operations. These forecasts might be in terms of sales, human capital, manufacturing output, etc. ERP hosts consolidated and centralised data about the business, thus, one can draw specific data information required to make business forecasts easily.

Using ERP software, one can easily and seamlessly analyse and make predictions with the following applications:

- i. Supply forecasting
- ii. Financial forecasting
- iii. Demand forecasting

b. **Improved process efficiency**

Given the nature and design of ERP, transaction processing in an electronic state and workflow manner eliminate the usual documents and file movement, and management that characterise the hitherto manual process. That way, efficiency and effectiveness are improved.

c. **Cost savings**

Cost is a major factor in every process. ERP applications reduce the cost of almost every aspect of business operations. Cost of paperwork, man-hours, machines, and related resources are effectively reduced.

d. **Customer satisfaction**

ERP positively impacts on customer satisfaction because transaction processing delays are eliminated and accuracy of processing and sometimes quality of output give some esthetics to the customer end of the processing. Note that the customer will appreciate effective and efficient processes with less or no transaction errors. Some customer loyalty-related features, such as volume or cash discount incentives or customer loyalty card-points attached to each customer transaction and purchase are provided by ERP.

19.3 Artificial intelligence (AI) systems as business support agent

AI is used to represent the phenomenon associated with fifth-generation computers, equipped with knowledge and artificial intelligence abilities. These systems, which are knowledge and experience based, are designed towards capturing the knowledge and wisdom of experts and hold them electronically. The knowledge is then used to make expert decisions, given certain facts obtained through questions and answers. They can accept, understand and convey information in the form of written or spoken human languages, and visual images.

Artificial Intelligence (AI) has the greatest impact on business processes

Knowledge Base

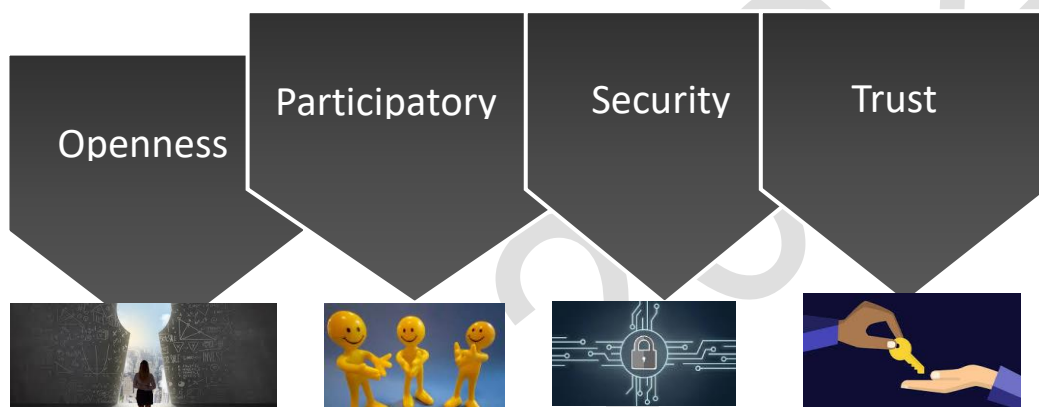
Expert Systems/Artificial Intelligence

This term is used to represent phenomenon associated with the fifth-generation computers, endowed with knowledge and **artificial intelligence**

This computer will be knowledge-based rather than data-based. It will be capable of making its judgments and solutions within a given field of knowledge. It will not follow a predetermined set of instructions, instead will utilise sets of rules derived from its knowledge. It will be told what to do and not how to do it. The system will work by breaking problems and requirements into smaller and smaller units until the points where direct solutions in its repository are applicable. The world is replete today with several of such artifacts that behave and act like humans, properly called Artificial Intelligence (Ezeilo, G.U. 2019).

19.4 Blockchain technology (BT)

A blockchain is a digital ledger created to capture transactions conducted among various parties in a network. BT is also a shared database relying on the strength of two key infrastructures peer -to-peer (P2P) network, giving it the feature of participatory and openness, and a public key infrastructure (PKI), giving it the feature of security and trust as seen in the illustration below. (Ezeilo, G. U. 2017).



Whenever any of the participant sends a value to another, all the other nodes in the network communicate with one another, using a pre-determined mechanism to check that the new transaction is valid. This mechanism is called a consensus algorithm. Once a transaction has been validated as true by the network, all copies of the ledger are updated with the new information. Multiple transactions of up to 500 or more (between 1 – 8MB) make up a “block” that is added to the ledger. Each block contains information that refers to previous blocks and thus, all blocks in the chain link together in the distributed identical copies. Participating nodes can add new, time-stamped transactions, but participants cannot delete or alter the entries once they have been validated and accepted by the network. If a node modifies a previous block, it would not synchronise with the rest of the network and would be excluded from the blockchain, thus, the secure and trusted modal aspect of the BT. A properly functioning blockchain is thus immutable despite lacking a central administrator. In addition, the lack of a determinate superior administrator or server in the network parlance, gives the benefit of openness, because all the computers in the network are seen to be in shoulder-rubbing mode.

For purposes of general application in world affairs, databases are “nodes” connected to the blockchain ledger and each entry into a blockchain is a transaction that gives rise to an exchange of value between participants. This value is called a digital asset that represents rights, obligations or ownership. In practice, many different types of blockchains are being developed and tested, resulting in various applications including the bitcoin, and other fintech-related applications.

19.5 Computer robotics and business automation (CRBA)



19.5.1 Applications of CRBA

Previous sections of this Study Text discussed AI or computer robotics and their applications in business. Areas of application of robotics to business and mankind in general will now be discussed.

a. **Military**

In the military, the illustration below speaks loudly.

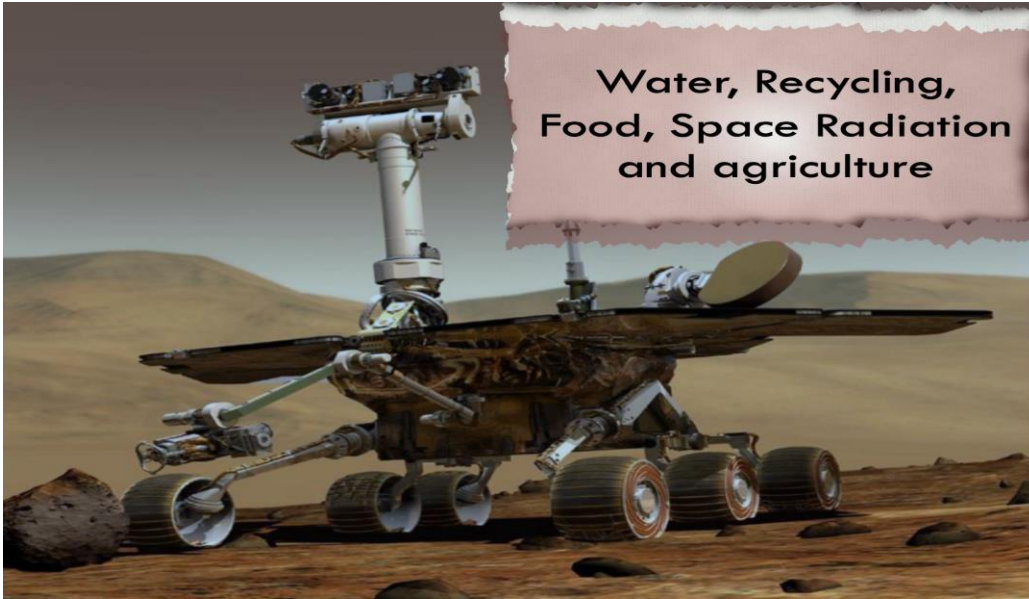
Military Technology

Aiming, Defending, and Moving are done simultaneously by us.

But with AI technology, the tank will be able to auto-detect enemy units and take action.

b. **Agriculture**

The illustration below explains the application of AI and robotics in agriculture and underwater research.



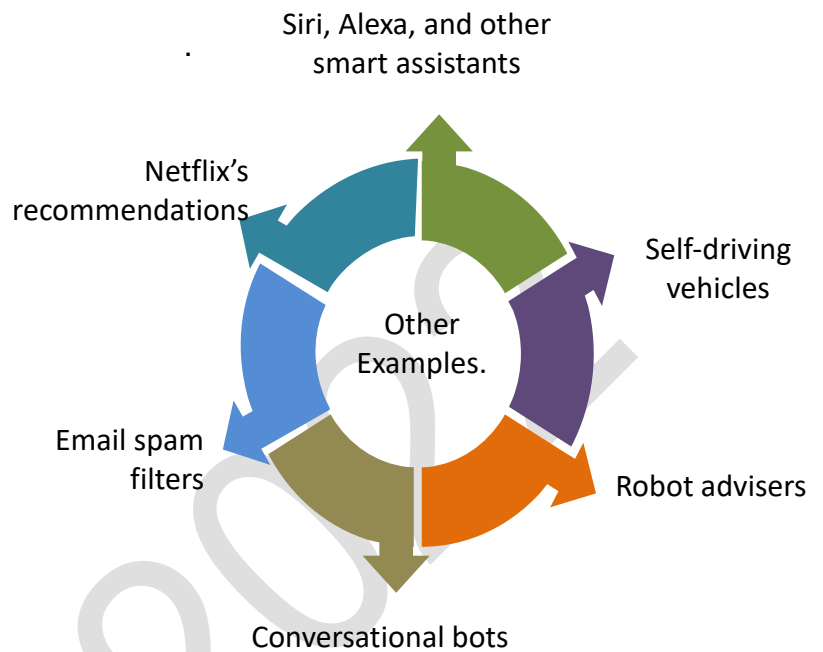
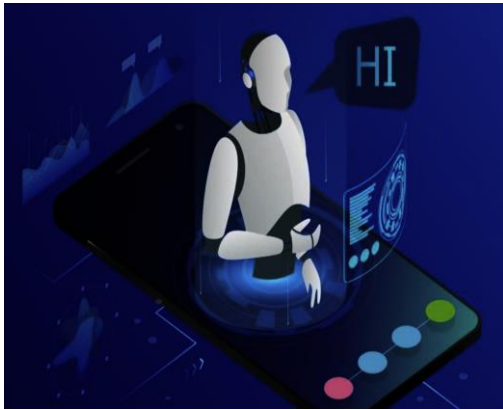
c. **Medicine**

In medicine, robots have almost taken over the most complex of clinical practice and administration as seen from the illustration below.



d. **Other areas of application**

Other areas of application are exemplified by the illustration below.



19.5.2 Strategies for deploying robots in business

For a seamless application of robots in business, the following key steps apply:

- a. There are no quick fixes;
- b. Feasibility study is crucial;
- c. Tasks and matching expert systems must be identified;
- d. The automation process must be paced and go for the LEAN robots;
- e. Conduct trials;
- f. Implement the automation;
- g. Conduct post-implementation review; and
- h. Calibrate.

19.5.3 Benefits of CRBA

These include:

- a. Efficiency of operations;
- b. Speed of operation;
- c. Consistency;
- d. Quality of service;
- e. Business-wide IT education;
- f. Cost reduction in the long-run in terms of:
 - employment cost,
 - salary cost,
 - human capital administration—training and leave allowances, human error, etc.

19.5.4. Disadvantage of CRBA

While there are several benefits associated with business automation using robots, labour crisis is ready to ensue, as captured in a recently published paper, “Robots and Jobs: Evidence from U.S. Labor Markets,” by Daron Acemoglu and Pascual Restrepo. It showed that industrial robots do have a negative impact on workers. It was revealed in the study that for every robot added per 1,000 workers in the U.S., wages dropped by 0.42% and the employment-to-population ratio went down by 0.2 percentage points. To date, this means the loss of about 400,000 jobs.

19.6 Customer relationship management (CRM)

As profit and wealth creation for business owners become the central objectives of businesses, one must realise that without customers, the business will go bankrupt over a short-term. This requires that business owners and managers should develop strategies, not only for creating customers but, strategies to manage and sustain their loyalty over the long-term. In this sense, Customer relationship management (CRM) is a technology for managing all the company's relationships and interactions with customers and potential customers. A CRM system helps companies to stay connected to customers, streamline processes, and improve profitability and the wealth of the business promoters.

19.6.1 Basic features of CRM

Below are the basic features of CRM. CRM:

- Generates customer's information, from potential sources and analyses data in a structured way;
- Sets up business methodology in sales, marketing and support to improve customer relationship and loyalty; and
- Improves system effectiveness and analyses key performance indicators, developed by the business.

19.7 Warehouse management

Warehouse management entails the techniques and processes associated with day-to-day operations of a warehouse. These include, but are not limited to, receiving goods and organising warehouse space, scheduling labour, managing inventory and fulfilling orders.

19.8 Enterprise content management (ECM)

This is a group of defined processes, techniques and tools used by businesses to effectively obtain, organise, store and deliver critical information to their employees, business stakeholders and customers. ECM has rapidly evolved as different forms of content have been introduced to the work environment. However, these tools continue to focus on digitally managing a company's information in a centralised repository and using the digital content to support business processes and help achieve organisational objectives. ECM operation is at the core of enterprise resources planning discussed earlier.

19.9 Supply chain management (SCM)

Supply chain management (SCM) is associated with the management of the flow of goods and services, which includes all processes that convert raw materials into finished products. This entails the active streamlining of a business's supply-side activities to maximise customer value and gain a competitive advantage in the marketplace.

19.9.1 Key elements of SCM

Supply chain management (SCM) is the centralised management of the flow of goods and services and it includes all processes that transform raw materials into final products. SCM is a network between a company and its suppliers to produce, and its distribution network to make its products available to the final consumers. This network includes different activities, people, entities, information, transportation, distribution and other resources. The supply chain also represents the steps it takes to get the product or service from its original state to the customer.

a. Key elements of SCM

Below are the key elements of SCM:

- i. It is a centralised process of flow of goods and services;
- ii. Effective and efficient management of SCM leads to cost reduction and faster delivery of products to the consumer; and
- iii. Remedial and associated legal obligations are reduced by an effective and efficient SCM.

b. Key components of SCM

The key components of SCM are stated below:

- i. Strategic plan for the SCM process;
- ii. Development of sources of raw materials or services;
- iii. Focusing of manufacturing activities on productivity and efficiency;
- iv. Delivery and logistics planning must be strong; and
- v. The return system for defective or unwanted products must be efficient.

19.10 Online transaction processing (OLTP)

OLTP is a class of software program capable of supporting transaction-oriented applications on the web. In computing, a transaction is a sequence of discrete information or data designated for a particular purpose and endpoint. OLTP is a daily routine in eBusiness, especially in banks, educational institutions, electronic voting process and shopping that deploys point of sale (POS) terminals.

19.11 Centralised and decentralised processing

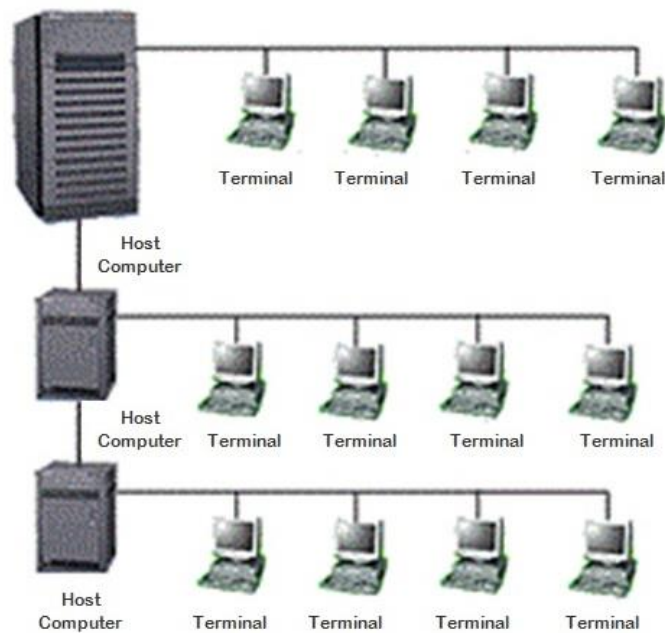
Processing performed in one computer or in a cluster of coupled computers in a single location as against processing carried out by different computers and at very different locations. Centralised processing is in contrast to the first computers in the 1950s, which were stand-alone with all input and output devices in the same room.

Essentially, the emergence of computer networks in its variants of LAN, MAN and WAN, facilitates the decentralised processing activities. By the 1990s, "client/server" architecture replaced terminal access. Client PCs communicated with network servers via the local network, rather than terminals hardwired to a central machine. Although there are still hardwired terminals in use, the common technology today is the local area network (LAN).

19.12 Distributed processing (DP)

Distributed processing is a term used to describe a setup in which multiple individual central processing units (CPUs) work on the same programs, functions or systems to provide more capability for a computer or other device. See the illustration below.

Distributed Processing



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The key element of a distributed processing is collaborative tasking, where a number of terminals engage collectively in a particular task in the host computer to boost the CPU power. It is akin to breaking down a certain assignment or project into work packages and assigning each work package to various collaborating individuals to perform and consolidate in the one single original package. This improves computing speed and efficiency as key benefits.

19.13 Real-time processing (RTP)

RTP connotes that transaction processing and the result of processing occur almost instantaneously. The processing is done as data is inputted, so it needs a continuous stream of input data to provide a continuous output. Business examples of real-time data processing systems are bank ATMs, traffic control systems and modern computer systems such as the PC and mobile devices. In contrast, a batch data processing system collects data and then processes all the data in bulk at a later time, which also means output is delayed. This method introduces delays and sometimes slows down business decision making process.

19.14. Statistical modelling

Statistical modelling is the use of mathematical models and statistical assumptions to generate sample data and make predictions about the real world. A statistical model is a collection of probability distributions about a set of all possible outcomes in an experiment.

It is also the data science process of applying statistical analysis to data sets. Hence, a statistical model is defined as a mathematical relationship between one or more random variables and other non-random variables. The application of statistical modelling to raw data helps data scientist approach data analysis in a strategic manner, providing intuitive visualisations that aid identification of relationships between variables and making predictions.

a. Statistical modelling techniques

Statistical modelling techniques involve the use of the following models:

- i. Regression model;
- ii. Classification model;
- iii. K-means clustering; and
- iv. Reinforcement learning.

b. Types of statistical models

There are three main types of statistical models thus:

- i. Parametric - This is a group of probability distributions that has a finite number of parameters;
- ii. Nonparametric – These are models in which the number and nature of parameters are flexible and not fixed in advance ;
- iii. Semiparametric – These models include parameters which may be a finite dimensional component (parametric) and an infinite dimensional component (non parametric).

CHAPTER REVIEW

Chapter review

Before moving on to the next chapter check that you can

- 1 Explain enterprise resource planning (ERP)
- 2 Explain artificial intelligence (AI) systems as business support agent
- 3 Explain blockchain technology (BT)
- 4 Explain computer robotics and business automation (CRBA)
- 5 Explain customer relationship management (CRM)
- 6 Explain warehouse management
- 7 Explain enterprise content management (ECM)
- 8 Describe supply chain management (SCM)
- 9 Explain online transaction processing (OLTP)
- 10 Describe centralised and decentralised processing
- 11 Explain distributed processing (DP)
- 12 Describe real time processing (RTP)

Information system development and security

Contents

- 1 Introduction
- 2 System development life cycle (SDLC)
- 3 Structured systems analysis and design methodology
- 4 Agile systems development methodologies (ASDM)
- 5 System security and control
- 6 Digital forensic methodologies
- 7 Chapter review

INTRODUCTION

Aim

Business information takes an integrated approach by developing an awareness of information technology and systems support.

Detailed syllabus

The detailed syllabus includes the following:

F	Information system development and security	
	1	Systems development methodologies
		Explain:
		i The system development life cycle (SDLC);
		ii Structures systems analysis and design methodologies; and
		iii Agile systems development methodologies.
	2	System security and controls
		Explain:
		i Internal and external aggressions against information processing facilities (IPF);
		ii Abuses and system vulnerabilities;
		iii Organizational insider threats – deviant employees;
		iv IT security policy and implementation;
		v Simple baseline protection mechanisms including use of phrases, anti-virus protection, etc.
		vi Data privacy and data protection principles;
		vii Perimeter protection systems such as use of firewalls and other penetration protection devices;
		viii Concepts of disaster and recovery strategies;
		ix Digital forensic methodologies; and
		x Public key infrastructure (PKI) protection tools.
	3	Explain ethical considerations in information technology

Exam context

Information system security is an important topic from both the auditor's and client's perspectives. The auditor themselves stores their work in an information system which must be kept confidential and secure in order to promote client trust and safeguard their work.

The auditor also needs to understand the client's information system relevant to the audit in order to conclude whether that information system is capable of producing a fairly presented set of financial statements.

This chapter explains the various information systems threats that exist and also describes the common safeguards available in countering those risks.

By the end of this chapter students will be able to:

- Explain system development life cycle (SDLC)
- Explain structured systems analysis and design methodology
- Describe agile systems development methodologies (ASDM)
- Explain system security and control
- Explain digital forensic methodologies

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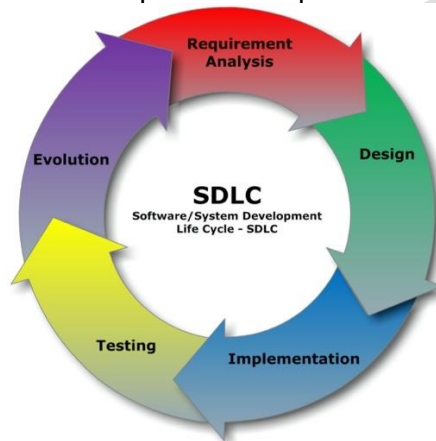
20.0 Information system development and security

20.1 Introduction

Every business desirous of introducing information system of any kind, must follow established rules and strategies for the development and deployment of its information systems, including the hardware, software, associated change management process and security. In this way, the entity can be assured of proper alignment of its information technology systems objectives with its core business objectives. In this section therefore, we will discuss some of the principles associated with system development and the associated security elements.

20.2 System development life cycle (SDLC)

SDLC is a process of converting the conceptual framework of a certain business process into the desired business support using information technology tools and principles. The SDLC has seven (7) traditional steps to accomplish its objectives, namely:



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v. **Planning**

For every system in contemplation, a business case needs to be made and accepted. This would involve vivid description of the problem, expected solutions and benefits, including what it will cost to develop and deploy such a system. Essentially, all resources, costs, time, benefits and other items should be considered at the planning stage.

vi. **Systems analysis and requirements**

This stage simply requires the designers to itemise in practical terms the problems of the entity and various elements needed to resolve them. In that way, all the needed elements for the system design would be captured. It will also be required to identify what kind of hardware, software and support systems required to be part of the emergent system.

There are a number automated tools applicable at this stage. These include:

- i. CASE (Computer Aided Systems/Software Engineering);
- ii. Requirements gathering; and
- iii. Structured analysis.

c. **Systems design**

This stage describes in detail, the necessary specifications, features and operations that will satisfy the functional requirements of the emergent system. This is the step for end users to discuss and determine their specific business information needs for the proposed system. At this stage, stakeholders will consider the essential components (hardware and/or software), structure (networking capabilities), processing and procedures for the system to accomplish its objectives.

d. **Development**

Building the system begins from this stage, particularly, all the potential actors in the system development process, including programmers, network engineers and/or database developers, who would do the major work on the system are brought together. This work includes using a flow chart to ensure that the process of the system is properly organised. The development phase marks the end of the initial section of the process and marks the beginning of the production process.

e. **Integration and testing**

This phase helps to determine if the proposed design meets the initial set of business goals. This is done by quality assurance professionals. Testing may be repeated, specifically to check for errors, bugs and interoperability. This testing will be performed until the end user finds the program acceptable. Another part of this phase is verification and validation, both of which will mark the system's successful completion for deployment to be initiated.

f. **Implementation**

Having completed the user-acceptance testing and fully certified, the implementation stage ensues. Potentially, this phase is associated with the actual installation of the newly developed system. This step puts the project into production by moving the data and components from the old system and placing them in the new system via a direct cutover. This can be a risky and complicated method. This changeover typically happens during off-peak period, thus minimising the risk. Both system analysts and end-users should be fully involved to ensure that necessary changes are implemented. To mitigate this risk, many organisations arrange parallel runs to validate the new system before cutover.

g. **Operations and maintenance**

The final phase involves maintenance and regular required updates to the new system. This step is when end users can fine-tune the system, if they wish, to boost performance, add new capabilities or meet additional user requirements.

20.3 **Structured systems analysis and design methodologies**

In every business environment that requires re-tooling or some kind of developmental process to improve it using technology, a study of the existing environment needs to be carried out in order to bring about the required changes. Such activities are referred to as system analysis and design. There are key elements required to enable such a design to take place. The discussion that follows will elucidate on the techniques and principles of system analysis and design. A variant of the technique is referred to as structured systems analysis and design methodologies (SSADM). This design method is based on a set of standards for systems analysis and application design. In this method, systems analysts use formal channels of eliciting information and needed requirements from system owners, which helps to reduce complications and misunderstandings about the systems before the design phase.

There are three different methods that are embedded in it, namely:

- a. Logical Data Modelling (LDM)
- b. Data Flow Modelling (DFM), and
- c. Entity Event Modelling (EEM).

20.3.1 Benefits of SSADM

The benefits of SSADM include Improvement of quality, detailed documentation of the development stages, and reusability for similar projects in the future. SSADM specifies exactly the flows and tasks of a development project and allows a detailed documentation of the project to be produced. These also include the following:

- a. Timelines—SSADM gives enough room for planning, managing and controlling a project more appropriately. This way, a product can be designed, developed and delivered on time;
- b. Usability— User needs are the key emphasis of SSADM, therefore particular attention is paid to the analysis of user needs. This way, the system model is developed with a comprehensive user requirement incorporated into it;
- c. Effective alignment to the requirement of the business—Since SSADM documentation takes into consideration critical issues, such as business objectives and business needs in the course of development, this potentially moves the project planning closer to the actual requirements of the business;
- d. Effective use of skills—SSADM's knowledge transfer is seamless, as it does not require complex design tools. Usually, common modelling and diagramming tools are used. Commercial CASE tools are also offered to be able to set up SSADM easily.
- e. Better quality— There are possibilities of less error when using SSADM by defining a certain quality level at the beginning and constantly validating the system for bugs and eliminating same;
- f. Productivity improvement—By encouraging on-time delivery, meeting business requirements, ensuring better quality, using human resources effectively as well as trying to avoid administrative bottlenecks, SSADM improves the overall productivity of the specific project and the entity as a whole; and
- g. Cuts costs: SSADM separates the logical and the physical systems design. In this way the system does not have to be implemented again with new hardware or software.

20.4 Agile systems development methodologies (ASDM)

This is one the software development techniques usually employed in an iterative form, beginning from requirement scanning or conception, through concept, inception, iteration, release, maintenance, and retirement. This method came into popularity in 2001 among other methods such as scrum and Kanban.

The key features of this method are the use of collaborative and multidisciplinary teams, such as accountants, engineers, architects, tax professionals, and other professionals from diverse fields working together to achieve a common purpose, depending on the field of solution type being sought. This is why this method is described as "agile". In this sense, the iterative nature and myriad of professionals involve are able to spontaneously deal with defects and achieve optimal project efficiency.

20.5 System security and control

management, one should not lose sight of the activities of malicious agents, both internally and externally, whose acts may put the organisation at risk of cyber-attacks. In this sense, information security controls (ISC), represent a whole range of measures, both technical and social, designed to reduce information security risks, such as system and data breaches, data theft, and unauthorised changes to digital information or systems.

20.5.1 Insider threats, deviant employee, Internal and external aggressions

Within an organisation, disgruntled employees become agents of breaches of information system security. These employees become risk agents towards organisation's information systems security. On the other hand, system vulnerabilities, such as poor technical controls may offer incentive for external agents, such as hackers to become aggressive against the organisation's IPF. These potential security challenges must not be overlooked by chief security officers in the organisation.

20.5.2 IT security policy and implementation

The fundamental bedrock for the effective and efficient operationalisation of organisational information processing facilities (IPF) remains at all times, the information technology policy in general, and not just IT security policy per se. Organisational IT policy covers guidelines and procedures regarding the procurement, deployment and use of information systems throughout the organisation.

20.5.3 Security and protection mechanism

Below are some security and protection mechanism:

a. Passwords and passphrases protection

A password or passphrase is the first line of defense in the computing environment. Some basic rules should be highlighted for the purposes of strength and completeness of passwords or passphrases. These include:

- A combination of characters and numeric figures;
- Birthdays, house numbers, car plate numbers, wedding anniversaries, etc. are forbidden;
- Alternate characters and numeric figures;
- Special characters such as \$%&#@ are encouraged;
- A length not shorter than 8 characters, but any length that you can easily remember; and
- Changes as often as possible, especially when you suspect a compromise.

Best known passphrases are made out of cognitive events—these are events in your life that no one other than you can remember easily.

b. Virus and worm attacks

This is also a primary defense against viral infections from both online sources and host carriers, such as USB and memory sticks. Caution is advised on using external storage devices including USBs and memory sticks. Use of strong Anti-virus software and continual updates are advised.

20.5.4. Data privacy and data protection principles

Data privacy is one of the topical issues around system security. The reason is that every attacker targets nothing else other than corporate information in the form of records, files or data. Consequently, a breach of privacy of data could jeopardise the integrity of IPF and by extension, mar the organisation's public image and integrity. Attackers often use both known and unknown tools to invade the IPF environment and may potentially breach one's data privacy. These tools include SQL injections, Cross-rite scripting, Adam and Eve, denial of service attack (DOS) or distributed denial of service (DDOS) attacks, etc.

20.5.5 Protection mechanisms

Preventing attacks on data privacy as well as other information systems facilities requires a number of technical controls and social remedies which are discussed below:

Firewall — This is a perimeter protection mechanism that ensures that all visitors to a IPF environment are screened, just like a visitor to a company is physically screened at the gate of company before gaining access to its internal facility. There are three basic types of firewall that are used by companies to protect their data and devices to keep away intruders and other cyber attackers. These are described below.

a. Packet Filters

Packet Filtering Firewall controls the network access by analysing the outgoing and incoming packets using routers. Packets are passed or blocked on their way by comparing them with pre-established criteria like allowed IP addresses, packet type, port number, etc. Packet filtering technique is suitable for small networks, but gets complex when implemented on large networks. Please note that these types of firewall may not prevent all forms of attacks. They can neither tackle attacks that exploit application layers vulnerabilities, nor can they prevent spoofing attacks.

b. Stateful Inspection

Stateful Packet Inspection (SPI), which is also called dynamic packet filtering, is a powerful firewall architecture which screens traffic streams from end to end. These intelligent and speed-oriented **firewalls** use an intelligent way to keep at bay unauthorised traffic by analysing the packet headers and inspecting the state of the packets along with providing proxy services. These firewalls work at the network layer in the OSI model and are more secured than the basic packet filtering firewalls.

c. Proxy Server Firewalls (PSF)

PSF is also referred to as application level gateways, PFSs are the most secured type of firewalls that effectively protect the network resources by filtering messages at the application layer. Proxy **firewalls** mask your IP address and limit traffic types. They provide a complete and protocol-aware security analysis for the protocols they support. Proxy Servers offers the best internet protection and experience in the network performance improvements.

20.5.6 Concepts of disaster and recovery strategies (DRS)

Contingency plan is a very important dimension for companies that must recover from disasters, or they remain closed forever. Recovery alternatives are as essential as daily backup plans in the case of emergencies or disasters.

20.5.7 Public key infrastructure (PKI) protection tools

At the core of protection of information systems assets are three basic concerns, namely;

- a. confidentiality— This is the assurance that information asset kept in any form or originating from a point to another destination remains known to only those entitled to the knowledge of the information or data.

- b. Integrity— This is the assurance that information asset also kept in any form or in transmission to a destination remains uncorrupted at all times, no matter what.
- c. Availability— This is the concern that information systems asset kept in any form or in transit to a destination remains available and accessible to legitimate persons at all times, no matter what.

These concerns can be vitiated at any time by the actions of interlopers, hackers, or mischievous and disgruntled employees and can equally be prevented by certain technical controls as discussed earlier. However, encryption is the best form of protection mechanism that potentially can give full assurance on all the basic concerns raised above.

20.5.8 Encryption

This is a process of converting plain text message into a secure-coded form of text, called cipher text that cannot be understood without converting back via decryption (the reverse process). This is achieved through a mathematical function and a special encryption/decryption password called the KEY. As a simple illustration using one of the oldest ciphers called Caesar's cipher. Consider the text below:

FKAOAD

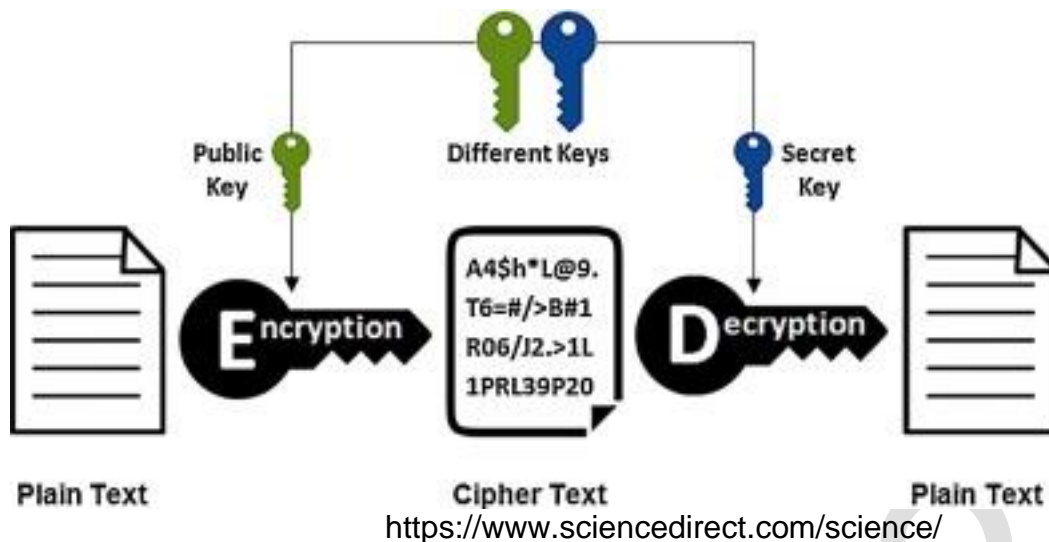
The above cipher is made out of Caesar's cipher, which is a private key system with the following algorithm:

- a. Based on the 26 alphabets—ABCDEFGHIJKLMNOPQRSTUVWXYZ as the key space.
- b. The key, being locating the next alphabet after every three alphabets preceding each letter of the plain text.

Using the above key therefore, we can decipher the above encrypted text into a plain text as:

20.5.9 Public key infrastructure

PKI is an encryption algorithm that ensures that information asset either residing within a host or in transit to a destination is transformed into a hash code, such that an intruder or hacker who intercepts or contrives access to such information asset finds it utterly meaningless and thus actions futile. It makes use of two keys, a private and public key. The PKI bridges the gap in the private key system for protection of information asset. In a private key system, one code or key as demonstrated above is required for coding or encrypting, as well as decrypting. This then renders the system potentially vulnerable to the actions of the man in the middle, usually referred to as the "man-in-middle" attack. The figure illustrates the workings of a public key system.



JOSEPH

Please note that the discussion above is much larger than we have and potentially beyond the scope of this text because PKI also entails the process of key management and audit.

20.6

Digital forensic methodologies

Cyber - attacks and data privacy breaches are becoming phenomenal, given the ubiquitous nature of the cyberspace. Attacks of various kinds and dimensions are reported daily, including ransomware, whereby the attackers seize the victims IPF and then demand for a ransom. Very often these ransoms are paid and the attackers, short of releasing the victims IPF still went ahead to auction the victim's data items in the dark web—a case of double ransom. In some cases where the offenders are insiders and the victim organisation desires to dig to the root of the matter with the intent to apprehend and bring the offender to justice, forensic methodologies and tools would be the necessary route.

20.6.1

Digital forensic methodologies

Below is a discussion of some digital forensic methodologies.

a. Test of Validity of Evidence

Valid evidence must possess the following characteristics

- i. Authenticity — The investigator must determine the source of evidence as an opposing counsel is likely to object to evidence of questionable source and this could jeopardise the investigator's testimony.
- ii. Reliability/competency — This is the quality of evidence being flawless. Competency is likely to come up if and when witnesses are put on the stand, since bias or jealousy generally disqualify someone as a competent witness.
- iii. Materiality/sufficiency — This is the quality of evidence being in adequate kind and form to support a case. Objections are likely to be encountered, if the investigation was sloppy, the chain of custody broken, or the way evidence is presented tends to confuse the judge or seems to waste the court's time.

b. **Basic procedures for conducting computer forensic investigation**

The following are procedures for conducting computer forensic investigation:

- i. Secure and manage the crime scene;
- ii. Evaluate the crime scene;
- iii. Conduct preliminary interviews;
- iv. Document the scene;
- v. Collect digital evidence;
- iv. Non-electronic evidence; and
- iv Stand-alone and laptops.

c. **Potential classification and sources of digital evidence**

Potential classification and sources of digital evidence include:

- i. Auction fraud;
- ii. Child abuse;
- iii. Computer network intrusions;
- iv. Murder/death investigations;
- v. Domestic violence;
- vi. Email threats/harassing/stalking;
- vii. Gambling;
- viii. Identity theft; and
- ix. Other peripherals and devices attacks.

Additional procedures that must be observed include:

- i. Packaging of digital evidence in proper evidence bags;
- ii. Transportation procedure;
- iii. Storage procedure; and
- iv. Maintenance of appropriate chain of custody

d. **Forensic tools**

Forensic practitioners need hardware and software tools, some which include:

- i. Digital detective;
- ii. Disk imaging tools;
- iii. File integrity checkers;
- iv. File Scavengers;
- v. Encase tools;
- vi. IDEA;
- vii. ACL;
- viii. Intellius; and
- ix. Email trackers.

e. **Goal or ultimate objective of digital forensic**

The ultimate goal of any forensic work, particularly where cyber incident is involved is outlined below: To

- i. ensure that all applicable logs and evidence are preserved;
- ii. evaluate how the intruder is entering the system;
- iii. obtain the information needed to justify a trap and trace of the phone line the intruder is using or to obtain information from an ISP;
- iv. discover why the intruder has chosen that particular computer;
- v. gather as much evidence of the intrusion as possible;
- vi. obtain information that may narrow the list of suspects;
- vii. document the damage caused by the intruder;
- viii. determine if asset lost could be recovered and to what extents;
- ix. interview the suspects for the above information; and
- x. gather enough information to decide if law enforcement should be involved.

f. Court appearance and procedures

Should the case proceed to the law court, the professional should be prepared and follow the following basic guidelines:

- i. There is a need to apprise oneself of normal court processes, rules, decorum and manner of addressing the bench;
- ii. One should articulate investigation procedures;
- iii. Wear appropriate business attire, no “business casual” or Polo shirt;
- iv. When testifying, if one does not understand a question, ask for it to be repeated;
- v. While under cross-examination, give the attorney a chance to object to every question;
- vi. Do not waste too much time answering questions and do not look to the counsel for guidance. Pause a while and pick your thought; and
- vii. Maintain a high degree of frankness and honesty. Be aware that the opposing attorney will attack your credibility, and ensure you do not give room for any doubts on your testimony, if you have no answer to any question, say so at the outset.

1 CHAPTERREVIEW

Chapter review

Before moving on to the next chapter check that you now know how to:

- Explain system development life cycle (SDLC)
- Explain structured systems analysis and design methodology
- Describe agile systems development methodologies (ASDM)
- Explain system security and control
- Explain digital forensic methodologies

**Foundation
level**

CHAPTER

21

Disruptive technologies and applications

Contents

- 1 Introduction
- 2 Disruptive technologies and virtual reality
- 3 Chapter review

INTRODUCTION

Aim

Business information takes an integrated approach by developing an awareness of information technology and systems support.

Detailed syllabus

The detailed syllabus includes the following:

G	Disruptive technologies and applications	
	Explain the following concepts of disruptive technologies:	
	a	Digitisation in a business environment – principles and technologies;
	b	Cloud computing (principles, technologies, benefits and risks);
	c	Internet of things (IoT);
	d	Artificial intelligence, machine learning and drones application in business;
	e	3D printing and virtualisation;
	f	Statistical modelling; and
	g	Blockchain and Fintech applications.

The above competencies are addressed through a combination of chapters 21 and 22.

Exam context

This chapter explains the early phases of a project: establishing whether a project is feasible by conducting a feasibility study, and then the project initiation. The chapter provides a brief overview of the steps typically involved in implementing a new information system before closing with an introduction to the systems development lifecycle model which is frequently used as a reference tool for project management.

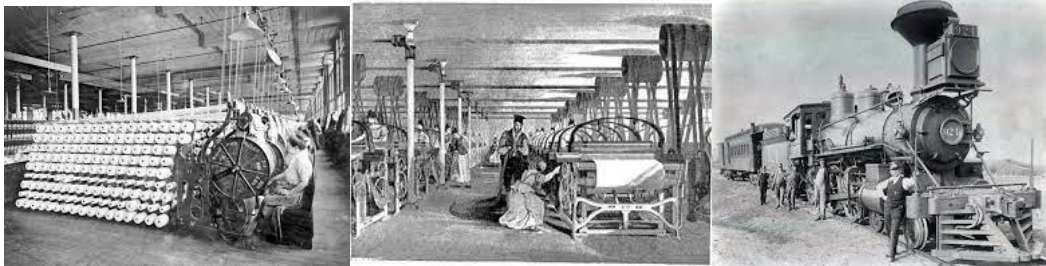
By the end of this chapter you will be able to:

- Explain disruptive technologies and virtual reality

21.0 Disruptive technologies and applications

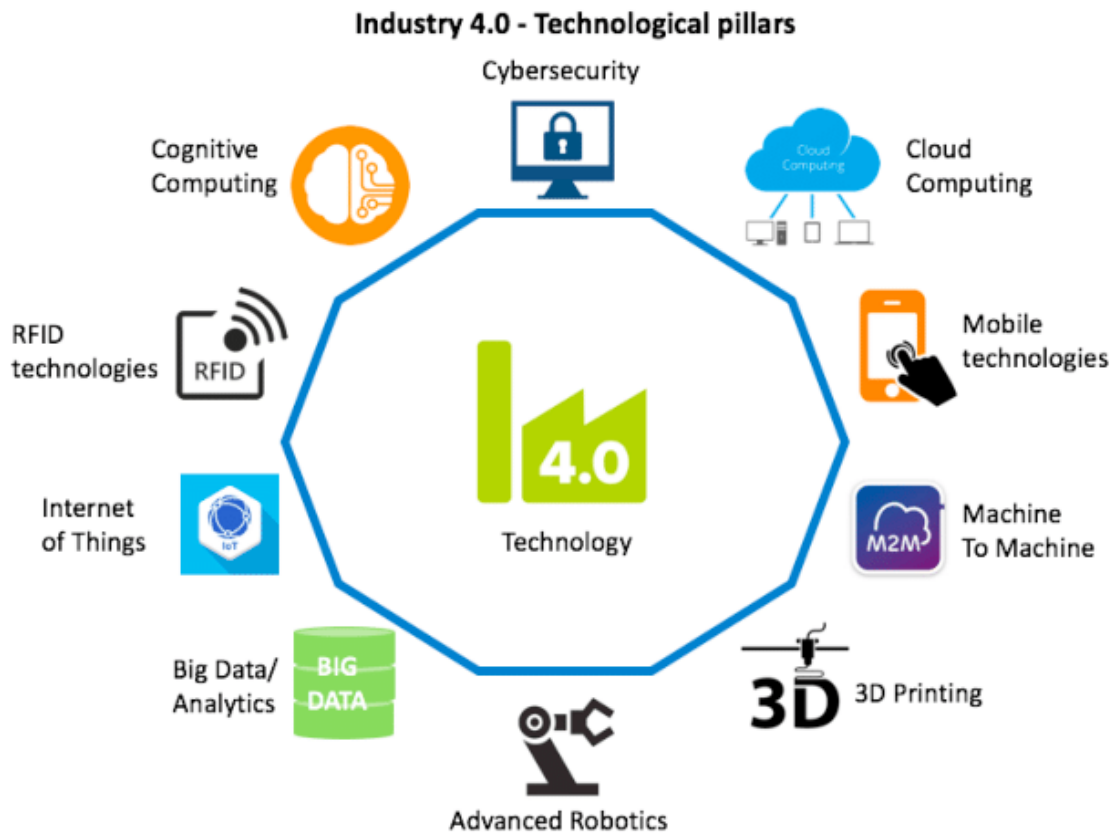
21.1 Introduction

As humanity navigates into twenty-first century, we are constantly bombarded with myriads of technological innovations and transformations that are constantly reshaping our entire existence. The industrial revolution which occurred between 1760 and 1830, witnessed vast industrialisation in the textile industry and high rates of growth in steam power and iron production which occurred in 1800.



<https://www.britannica.com>, <https://daydaynews.cc/>,
<https://trailhead.salesforce.com/>

This was followed by the second industrial revolution that heralded the advent of steel production, electricity and petroleum that caused series of innovations that changed the society. With the production of cost-effective steel, railroads were expanded and more industrial machines were built. Then the third industrial revolution, or properly called the Digital Revolution, which started in the late 1900s and is characterised by the spread of automation and digitisation through the use of electronics and computers, the invention of the internet, and the discovery of nuclear energy. The fourth industrial revolution, which is rooted in technological phenomena or technological disruptions, gave rise to the development of virtual reality worlds. This industry 4.0 or the fourth industrial revolution is characterised by technological pillars as exhibited in the illustration below.



This Study Text has virtually covered all the areas of industry 4.0, especially the key pillar-technologies, such as IoT or IoE, Big Data Analytics Computer Robotics, etc. Discussed below is virtual reality as a key element in this curriculum and an offshoot of technology disruptions. The term education 4.0, will also be discussed. Students are also advised to make good efforts in researching and reading to fully understand these technological issues as they transcend beyond the ordinary efforts to pass the qualifying examinations.

21.2 Disruptive technologies and virtual reality

Disruptive technology is an innovative trend in technological advancement that has largely changed and reshaped the industrial space, consumer behaviours and business operations around the world. The present and future are currently being altered by some of the key pillars of disruptive technologies, namely artificial intelligence (AI), virtual/augmented reality, internet of things (IoT), blockchain technology, and e-commerce. These have been fully discussed in this material except virtuality, which will be discussed below.

21.2.1 Virtual or augmented reality (VA/R)



<https://unsplash.com/s/photos/virtual-reality>

In the ordinary literal discussion, to augment means to make greater, more numerous, larger, or more intense. Thus, to become augmented means to make certain additions beyond the normal, hence, augmented reality defines any technology that 'augments' the user's visual and, or auditory perception of their environment as seen in the illustration above. Typically, digital information is superimposed over a natural existing environment, which appears to the user to be real, albeit artificial.

The interest in this technology has moved sharply from handset and movie appliances to huge industrial applications. In fact, experts predict that worldwide spending on augmented or virtual reality (VR) will hit \$160 billion in 2023, up from \$16.8 billion forecast in 2019. AR helps in accessing shares in the capital market due to its ability to facilitate tasks, provide resources and solving complex problems. AR has enjoyed greater applications in other areas and industries, such as manufacturing, utilities, telecommunications, retail, healthcare, and logistics. Its uses are profound at assembly plants, maintenance and repair services, education and training, retail showcasing, and diagnostics. In healthcare particularly, AR facilities are used to treat patients suffering from depression, amongst other uses.

21.2.2 Education 4.0



<https://ied.eu/project-updates/education-4-0>

In concluding this text, let us mention the innovation called Education 4.0 (E4.0), which supports industry 4.0 with potentially significant future benefits to the education sector. This is simply typifying the catch ups of education with technology disruptions.

In a nutshell, E4.0 is a purposeful approach to learning, that links-up with the fourth industrial revolution, using largely all the advanced technologies, including AR, IoT, blockchain and transforming the future of education with these advanced technologies and automation.

With the advent of COVID 19, virtual classes or offsite learning are now commonplace even in developing economies such as Nigeria. With these technologies, students can continue their education despite lockdowns and other restrictions to movements, which would otherwise have disrupted their education or learning process.

In reality and value addition, E4.0 will create a wider base of higher-skilled workers and reduce workforce shortages in critical sectors. It will deepen the linkage between employers and schools, meaning that school curricula will then be more in consonance with the actual needs of the workplace, and students will have better chances of being employed after graduation.

Chapter review

Check that you can explain disruptive technologies and virtual reality.

ICAN 2022