MANAGEMENT ACCOUNTING (MA)

STUDY TEXT

THE INSTITUTE OF
CHARTERED ACCOUNTANTS
OF NIGERIA

MANAGEMENT
ACCOUNTING (MA)

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Foreword

As the global economy continues to evolve, the importance of accounting professionals with strong technical skills, professional competence and ethical awareness cannot be overstated. The swift transformation in the business world, driven by globalisation, technological advancements and sustainability considerations, have significantly impacted the finance function and the skills required by professional accountants.

To remain relevant, the Institute's syllabus and training curriculum are designed to equip students with the knowledge and competencies required to succeed in the dynamic fields of accounting and finance. These are regularly reviewed and updated to reflect current trends and future needs of users of accounting and related services.

The Institute of Chartered Accountants of Nigeria (ICAN) is committed to ensuring that its syllabus and training curriculum remain current and relevant. To achieve this, ICAN undertakes a comprehensive review of these documents every three years, supplemented by annual updates to reflect emerging trends and developments in the national and global accountancy profession.

Following a rigorous process, the Syllabus Review, Professional Examinations, and Students' Affairs Committees have developed a new 3-level, 15-subject syllabus. As approved by the Council, the new syllabus will be implemented starting with the November 2025 examination diet.

The publication of the Study Texts has consistently accompanied syllabus reviews, yielding notable improvements in the performance of professional examination candidates. To further enhance student success rates, the Council has approved the development of new learning materials (Study Texts) for all the subjects. This sixth edition, incorporates significant updates, including IT and soft skills, thereby enhancing the contents, innovation, and quality. This edition has taken into consideration all requirements of the International Panel on Accountancy Education (IPAE).

The Institute engaged renowned writers and reviewers, comprising esteemed scholars and practitioners with extensive experience in their areas of specialisation, to develop high-quality learning materials. The 15 subjects include:

Foundation Level		
1.	Business Environment	A1
2.	Financial Accounting	A2
3.	Management Accounting	A3
4.	Corporate and Business Law	A4

Skills Level		
5.	Financial Reporting	B1
6.	Audit, Assurance and Forensics	B2
7.	Taxation	B3
8.	Performance Management	B4
9.	Financial Management	B5
10.	Public Sector Accounting and Finance	B6

Professional Level		
11.	Strategic Business Reporting	C1
12.	Advanced Audit, Assurance and Forensics	C2
13.	Strategic Financial Management	C3
14.	Advanced Taxation	C4
15.	Case Study	C5

A rigorous quality control process was implemented, featuring a detailed and comprehensive review of the materials developed by the writers and reviewers by the Study Texts Review Technical Subcommittee.
These Study Texts will be valuable resources, not only for our candidates but also for students of other professional bodies, tertiary institutions, and finance and management practitioners, providing valuable resources for their studies and practices.

Chibuzor Noel Anyanechi, (Chief) BSc, MBA, FCA
Chairman, Syllabus Review Committee

Acknowledgement

The Institute expresses its heartfelt appreciation to the following Syllabus Review Committee members, writers, reviewers, and editorial board members for their invaluable contributions, expertise, and scholarly dedication that enabled the successful production of these new Study Texts: They are:

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SYLLABUS

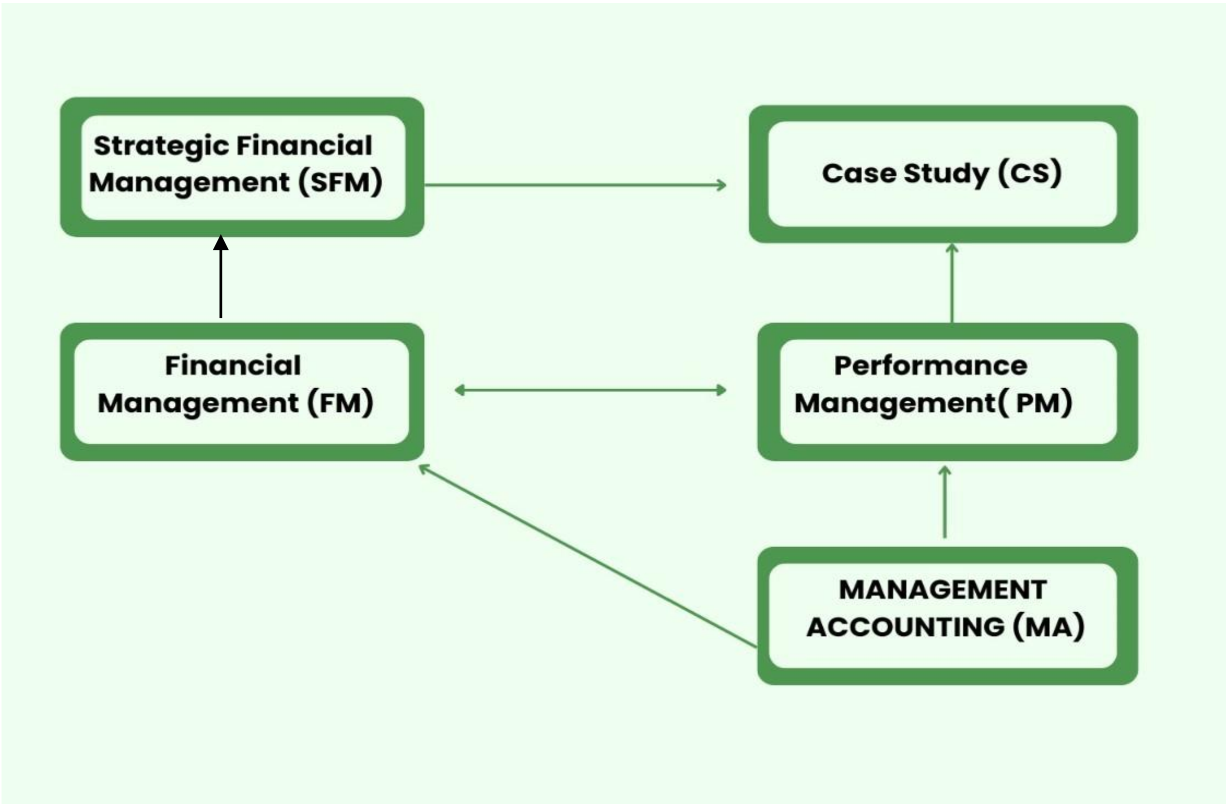
SYLLABUS

Aim

To develop candidates' knowledge and understanding of costing and management accounting techniques to support management in planning, controlling and monitoring performance under various organisational contexts.

Linkage with other subjects

The diagram below depicts the relationship between this subject and other related subjects.



Main competencies

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

(a) explain the nature, source and purpose of management information;

(b) explain and analyse data for cost elements;

(c) explain, ascertain and apply cost accounting methods and techniques;

(d) explain, analyse, forecast and prepare budgets for planning and control;

(e) compare actual costs with standard costs and analyse any variances arising therefrom; and

(f) explain and apply decision making techniques in facilitating business performance in situations of scarce resources.

Specification grid

The grid below shows the relative weightings of the main sections within this syllabus and should guide the study time spent on each. Over time, the marks available in the assessment will be within the ranges of weightings below, while slight variations may occur in individual assessments to enable suitably rigorous questions to be set.

Syllabus Review		
Grid		Weighting %
A	Management information	15
B	Accounting for cost elements	10
C	Costing methods and techniques	20
D	Forecasting, budgeting and budgetary control	20
E	Standard costing and variance analysis	15
F	Performance measurement	20
	Total	100

Detailed syllabus					Chapter
	Management information				**1**
		Nature and purposes of management accounting			**1**
			Identify the differences amongst financial, cost and management accounting considering the following:		1
				Differentiate between cost data and information.	1
				Explain the attributes of good information.	1
				Definition of management accounting;	1
				Purpose of management accounting;	1
				Definition and purpose of financial accounting;	1

Detailed syllabus	Chapter
The usefulness of accounting information in management decision;	1
Role of cost, management and financial accounting;	1
Management information and its uses;	1
Comparison of financial, cost and management accounting; and	1
Advantages and disadvantages of management accounting.	1
Roles of the management accountant.	1
Explain the importance of management information for planning, control and decision making.	1
Outline the managerial processes of planning, decision making and control.	1
Explain the concepts of strategic, tactical and operational planning.	1
Differentiate between cost data and information.	1
Explain the attributes of good information.	1
Management information systems (MIS)	**2**
Explain the role of information systems in organisations.	2
Differentiate between data and information.	2
Identify and explain the attributes of good information.	2
Explain the limitations of management information in providing guidance for managerial decision making.	2
Describe the sources of information from within and outside an organisation.	2
Explain the uses and limitations of published information/data, including information from internet.	2
Spreadsheets	
Identify the features and uses of spreadsheets.	3
Explain the use of spreadsheets in data analysis, cost and management accounting.	3
Big data and data analytics	4
Explain big data and describe the characteristics (volume, velocity, veracity and value).	4

Detailed syllabus	Chapter
Explain the purposes of big data pyramid (data, information, knowledge, wisdom).	4
List and explain the benefits and uses of data mining and data analytics.	4
State the risks an organisation faces when applying data mining and analytics.	4
Cost classifications, codification, segregation and estimation	
Cost classifications	
Explain the meaning of cost classification.	5
Explain the different classifications of cost.	5
Describe different types of cost behaviour using graphical illustrations.	5
Cost codification	5
Define cost codification.	5
Explain the principles of a coding system	5
Explain and illustrate the use of codes in categorising transactions	5
Cost segregation and estimation	5
Explain the meaning of cost segregation and cost estimation.	5
Explain the structure of linear functions and equations.	5
Demonstrate the use of the following cost segregation techniques:	5
High/low analysis; and	5
Least squares/regression analysis.	5
culate and explain simple correlation coefficient.	5
Accounting for Cost Elements	
Accounting for Inventory	**6**
Describe the different procedures and documents necessary for the following material management actions;	6
Ordering;	6
Purchasing;	6
Receiving;	6

Detailed syllabus	Chapter
Storing ;	6
Issuing.	6
Explain Inventory management procedures	6
Identify, explain and calculate relevant inventory costs.	
Compute optimal re-order quantities (involving quantity discounts).	6
Explain and calculate the value of closing inventory and materials issued to production, using Last-in-first-out (LIFO), First-in-first-out (FIFO) and average methods.	6
Explain Just-In-Time (JIT).	6
State the benefits and challenges of Just-In-Time (JIT).	6
Necessary Principles of Just-In-Time (JIT)	6
Exploring supplier relations and Just-In-Time (JIT) procurement	6
Explain the demand forecasting process for Just-In-Time (JIT)	6
Accounting for Labour	
Explain labour recording and monitoring procedures.	7
Identify and explain some of the different types of labour costs	7
Describe different remuneration methods: time-based systems, piecework systems, individual and group incentive schemes	7
Explain labour cost control and reduction strategies	7
Explain the advantages and disadvantages of each remuneration method	7
Determine the level, the causes and cost of labour turnover	7
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Explain the components of overheads.	8
Distinguish amongst allocation, apportionment and absorption of overheads.	8
Describe the bases of overheads apportionment and overhead rate calculation methods	8
Apportion and re-apportion overhead costs between production and service centres, using the reciprocal method (where service cost centres work for one another) and simultaneous equations method.	8

Detailed syllabus	Chapter
Describe the nature and treatment of administrative overheads	8
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Costing methods	**9**
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Job costing; and	9
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Costing techniques	**10**

Detailed syllabus	Chapter
Explain the various types of costing technique.	10
Prepare an income statement and determine the profit or loss under absorption and marginal costing.	10
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Reconcile the profits or losses computed under absorption and marginal costing.	10
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Explain the meaning of cost control.	11
Explain the meaning of cost reduction.	11
Distinguish between cost control and cost reduction.	11
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Reducing the labour costs;	11
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Applying value analysis and value engineering.	11
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Explain the importance of budgeting system	13

Detailed syllabus	Chapter
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Explain the importance of principal budget factor	13
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Price variance.	14
Usage variance, including mix variance and yield variance.	14
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Detailed syllabus	Chapter
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es quantity variance.	14
es mix variance.	14
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Identify limiting factors in a scarce resource situation and select an appropriate technique.	17

Detailed syllabus				Chapter
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			Determine the optimal production plan, where an organisation is restricted by a single limiting factor within the context of make-or-buy decisions.	17

Foundation Level
Management Accounting

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CHAPTER 1

NATURE AND PURPOSE OF MANAGEMENT ACCOUNTING

Contents

1 Nature and Purposes of Management Accounting

1.0 Learning objective

This chapter introduces readers to management accounting and the differences amongst financial, cost and management accounting.

1.1 Learning outcomes

At the end of this chapter, readers should be able to:
(a) differentiate between data and information;
(b) identify and explain the attributes of good information;
(c) explain the usefulness of accounting information in management decision;
(d) define and state the purposes of management accounting;
(e) define and state the purpose of financial accounting;
(f) state the roles of the management accountant;
(g) outline the managerial processes of planning, decision making and control; and
(h) explain the concepts of strategic, tactical and operational planning.

1.2 Data and information

The terms 'data' and 'information' are often used interchangeably. However, there is a difference between data and information. Data refers to facts. It must be turned into information in order for it to become useful. Information is derived from data or facts that have been processed, structured and analysed. Therefore:

a. **Data** consists of unprocessed facts and statistics;
b. Data is collected and processed to produce information; and
c. Data has no meaning until it has been processed into information.

Information has meaning and a purpose. It is produced from 'data'. It is a 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 shipyard 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 information to management, 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.
These attributes include:

Understandable

Information should be understandable to the individuals who use it.
Accounting information must be set out clearly and 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 its intended 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, it might be appropriate for up-to-date management accounting information to be available online 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 accounting information should be communicated to the proper erson.

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 The importance of information

The management is face with various problems, for example:

a. A company wishes to determine the selling price of a new product it has just introduced into the market;
b. A company wishes to determine whether to make an essential component needed in its production or to buy the component from outside; and
c. A firm is considering whether to reduce its selling price so as to increase sales volume.

For management to deal with the above problems and other varieties of problem organisations face, management need information. The management need both financial and non-financial information to solve these problems, and sometimes a combination of financial and non-financial information will be needed.

1.4.1 Financial and non-financial information

Financial information: Financial information is quantitative data, typically expressed in monetary terms, such as cost of material purchased, wages paid, expenses incurred, selling price, etc.

Non-financial information: These are qualitative or quantitative data that is not primarily expressed in monetary terms. It describes various aspects of an organization's operations, strategy, performance, and environment that are relevant to decision-making, but not directly reflected in financial statements. It provides context and insights beyond the numbers.

Both financial and non-financial information are crucial for effective decision-making. Financial information provides a historical and objective view of an organization's performance, while non-financial information provides context, insights into future prospects, and a broader understanding of the organization's impact on society and the environment. Integrated reporting, which combines both types of information, is becoming increasingly important for providing a holistic view of organisational value creation.

1.5 Importance of management information for planning, control and decision making

Management information is vital for planning, control and decision making because it enables organisation to convert data into actionable insights, leading to improved performance, resource allocation and strategic direction.

It allows organisations to analyse all factors necessary for strategic plans with overall objectives and emerging opportunities.

Management information helps in optimising resource allocation by providing data on current performance, identifying areas requiring improvement and projecting future needs.

1.6 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.

1.7 Management information and the accountant

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 cost, information and application of quantitative methods in financial management. Management information takes an integrated approach by developing an awareness of information technology and systems support.

Management information refers to the structured and relevant data used by managers to make informed decisions and monitor performance, enabling better planning, control, and operational efficiency. It is data that is collected, processed, and presented in a way that is useful for managers to make decisions and monitor performance. The primary purpose of management information is to provide managers with the information they need to make informed decisions.

1.8 Introduction to accounting information

Accounting is one of the key functions in 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 summarising, analysing and reporting these transactions.
>
> A systematic process of identifying, recording, measuring, classifying, verifying, summarising, 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:

(a) provide a record of the financial value of business transactions, and in doing so
(b) establish financial controls and reduce the risks of fraud;
(c) assist with the management of the financial affairs of an entity; and
(d) provide information - mainly information of a financial nature.

Accounting information is provided for:

(a) Management, so that managers have the information they need to run the company; and

(b) 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 which 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.

1.9 Management accounting

Management accounting provides financial and non-financial information internally to assist managers in planning, controlling operations and decision making.

The purpose of management accounting is to provide relevant and reliable information so that managers can make well-informed decisions. The value of management accounting depends on the quality of the information provided, and whether it helps managers to make better decisions.

In other words, the purpose of management accounting is to provide information for:
(a) planning;
(b) control; and
(c) decision making.

Management accounting includes these three concepts:

Planning

Planning involves the following:
(a) setting the objectives for the organisation; and
(b) 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:

(a) monitoring actual performance, and comparing same with the objective or plan;
(b) taking control action where appropriate; and
(c) 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 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 manager decide what to do in any situation, where a decision is needed.

1.10 Role of cost, management, 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 incurred.

Management accounting

Management accounting is concerned with providing information to management that can be used to help in running 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 the business who may not take part in the day-to-day running of the business.

1.11 Comparison of financial accounting, cost accounting 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).
Contents usually specified by a regulatory framework.	Contents 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).

1.12 Advantages and disadvantages of management accounting

Management accounting has a number of advantages and disadvantages.

Advantages of management accounting

Management accounting provides insights into operational and strategic decisions, helping managers make informed decisions. It allows for the effectiveness of strategies, identifying areas for improvement.

Management accounting techniques like budgetary control can help reduce expenses and increase profitability. It provides information that would enhance budgeting and forecasting, crucial for financial planning and long-term sustainability.

It helps to identify and eliminate unnecessary costs, leading to lower production costs and potential higher profit margins.

Disadvantages of management accounting

Management accounting information can be influenced by personal judgment, motivation and incentives of those who prepare and use it, leading to potential manipulation. Relying solely on management accounting information can lead to resistance to change, as managers may be reluctant to adopt new strategies.

Producing the reports and information that managers need can be expensive and time consuming. Managers may sometimes focus on short term financial performance, potentially neglecting long-term strategic goals.

A lack of knowledge and understanding of management accounting techniques can lead to poor decision making and ineffective management.

1.13 Roles of the management accountant

Management Accountants provide managers/business leaders with financial insights, cost control and management, analysing data, budget preparation and forecasting, giving reliable information/recommendations to improve operational efficiency and support strategic decision making.

More detailed roles of a cost accountant are:

(a) **Cost control and management:** Management Accountants assists in identifying and controlling costs by analysing expenses and suggesting cost saving measures.

(b) **Evaluating cost effectiveness:** They evaluate the cost effectiveness of different processes and provide relevant suggestion to management for decision making.

(c) **Budgeting and forecasting:** Management Accountants play a vital role in preparing budgets for the departments and the organisation as a whole. They predict future revenues and expenses, allowing the company to plan effectively.

(d) **Risk management:** The Management Accountant identify and assess financial risks associated with different decisions made by the management.

(e) **Internal control and compliance:** They play a crucial role in monitoring and improving internal controls to ensure the accuracy and integrity of financial data.

(f) **Financial analysis and reporting:** Management accountants meticulously analyse financial data to identify trends, variances and areas for improvement, providing detailed reports including performance analysis.

1.14 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.

1.15 Questions and suggested solutions

1.15.1 Questions

Question 1

Winner Limited is a polyethylene manufacturing company. The company wishes to launch a new product and wants to be careful in the pricing decision. Although, the pricing policy is to charge 10% of the cost price as profit.

A new machine is needed to produce the new product, and management is considering whether to buy or hire the machine.

The Management Accountant is given the task of gathering some useful information necessary for management decision.

Required:

In solving the issue faced by the company, **explain** the information needed by the management.
State the reasons why information is important to management.

Question 2

"Management accounting incorporates activities that aim to ensure that goals are consistently met in an effective and efficient manner. In order to achieve this, management requires reliable systems to support them in decision making".

Required:

Explain, with examples, the common types of information that are required by various levels of management for effective decision making, stating the qualities needed to classify such information as good.

1.15.2 Suggested solutions

Suggested solution 1

A successful management of any organisation depends on information for decision making in order to achieve the desired results.

Management of Winner Limited need the following information:
The cost of the new product;
The cost of purchasing or hiring the new machine; and
The price other competitors sell the product.

Management need information to solve varieties of problems it faces, and the information are necessary to:

understand the various options available;
make an informed decision;
streamline processes and reduce redundancies;
increase efficiency and productivity;
develop and implement business strategies, including forecasting, budgeting and resource allocation; and
gain competitive advantage, having market intelligence. Management would have information about competitors, market trends and emerging technologies.

Suggested solution 2

Levels of Management

Management may be classified into three levels:

Strategic management;
Tactical management; and
Operational management.

These three classifications are based on the types of decision that are taken by management at each level. For decisions at each level of management, a different type of information is required.

Strategic information is required at strategic management level. The characteristics of strategic information may be summarised as follows:

It is information about the organisation as a whole, or a large part of it.

It is in a summary form, without too much detail.
It is generally relevant to the longer term.
It is often forward-looking.

The data that are analysed, to provide the strategic information come from both internal and external sources.

It is often prepared on an „ad hoc" basis, rather than in the form of regular and routine reports.

It may contain information of qualitative and quantitative nature.

There is often a high degree of uncertainty in the information. This is particularly true when the information is forward-looking (for example, a forecast) over a number of years in the future.

Tactical information is used to decide how the resources of the organisation should be used, and to monitor how well they are being used. It is useful to relate tactical information to the sort of information that is contained in an annual budget. A budget is planning at a tactical management level, where the plan is expressed in financial terms.

The general features of tactical information are as follows:

It is information about individual departments and operations.

It is in summary form, but at a greater level of detail than strategic information. It is generally relevant to the short-term and medium term.

It may be forward-looking (for example, medium-term plans) but it is often concerned with performance measurement. Control information at a tactical level is often based on historical performance.

The data that are analysed to provide the information come from both internal and external sources, but most of the information come from internal sources.

It is often prepared on a routine and regular basis (for example, monthly or weekly performance reports). It consists mainly of quantified information.

There may be some degree of uncertainty in the information. However, as tactical plans are short-term or medium-term, the level of uncertainty is much less than for strategic information.

Operational information is the day to day (routine) information needed for control purposes. It may also be needed by employees, to process transactions in the course of their regular work.

The general features of operational information are as follows:

It is normally information about specific transactions, or specific jobs, tasks, daily workloads, individuals or work groups. (It is „task-specific".);
It may be summarised at a work group or section level, but is in a more detailed form than tactical information;
It is generally relevant to the very short-term.; and
It may be forward-looking (for example, daily plans) but it is often concerned with transactions, procedures and performance measurement at a daily level.

The data that are analysed to provide the information comes almost exclusively from internal sources.

It is often prepared frequently, as required for daily operational needs (routine in nature).

It consists mainly of quantified information. Most of this information is „factual" and is not concerned with uncertainty.

Qualities of Good Information

The qualities of good information include:

Relevance- It must have purpose and use.
Reliability - It must be accurate and complete for its intended purpose
Timely – It must be available as and when required.
It must attract user confidence and realistic.
It must be valuable and cost efficient – Cost and benefit.
It must be accurate.
It must be readily accessible.
It must be addressed to right recipient.

CHAPTER 2

MANAGEMENT INFORMATION SYSTEMS

Contents

2 Management Information Systems

2.0 Learning objective

This chapter explains management information systems as means of guidance for management decision making.

2.1 Learning outcomes

At the end of this chapter, readers should be able to:

(a) explain management information systems;
(b) explain the role of information systems in organisations;
(c) explain the limitations of management information in providing guidance for managerial decision making;
(d) describe the sources of information from within and outside an organisation; and
(e) explain the uses and limitations of published information/data, including information from the internet.

2.2 Introduction to management information systems

Generically, management information systems (MIS) comprise of various computer hardware and software organised in a desired format to collect data from multiple 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.

2.2.1 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.

2.2.2 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:

(a) **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.

(b) **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.

(c) **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".

(d) **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 solution 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.

(e) **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.

2.2.3 Knowledge management system (KMS)

Entities exist as artificial persons, thus, possess attributes such as ethics, 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 knowledge base 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.

2.2.4 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 independent 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.

2.2.5 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.

2.3 The role of information systems in organisations

Information systems (IS) impact various organisations. It plays a vital role in every organisation, acting as the pillar for managing operations, enabling decision making, and fostering competitive advantage. Information systems facilitate data collection, storage and supporting various functions.

The details of the role of IS in organisations are:

(a) **Enabling decision making:** IS provide managers and other stakeholders with timely and accurate information, in order to make informed decisions.

Systems like Decision Support Systems (DSS) provide specific decision making at various levels. 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.

(b) **Improving communication and collaboration:** IS enables communication and collaboration within organisations, allowing for seamless sharing of information.

Remote communication is enabled, and employees can receive and respond to information accordingly.

Systems like Enterprise Resource Planning (ERP) integrate various business processes, ensuring a consistent and coordinated flow of information across the organisation.

Large manufacturing organisations usually deploy complex IS solution, such as 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.

(c) **Enhancing efficiency and effectiveness:** IS automate processes, reduce errors and save time, leading to improved operational efficiency.

They enable organisations to manage resources effectively and optimise operations.

Real time data through IS helps organisations to make better decisions.

(d) **Gaining competitive advantage:** IS can assist organisations develop new products and services, giving them a competitive edge over their rivals.

By leveraging on data and technology, organisations can develop innovative strategies and create new business models.

2.4 The limitations of management information in providing guidance for management decision making

Management information, while very important, has limitations that could affect its guidance for management decisions. Management often relies on historical data which may not accurately reflect current or future conditions. Some of those constraints that have the tendencies of disrupting the information are discussed below.

(a) **Lack of comprehensive real time information:** Management information may not always provide a comprehensive real time view of a business. This can be problematic in dynamic environments. The need to collect and process data can lead to delays in information delivery, hindering timely decision making.

(b) **External factors:** Management information may not adequately consider the impact of factors not within the organisation on the business. Businesses need to monitor external factors, such as competitors' activities, government regulations, and general economic conditions, as they impact on management decisions.

(c) **Data accuracy and reliability:** The accuracy and reliability of the data used in providing information to the management are crucial to the decisions expected to be made by the management. Errors or inaccuracies in the data can lead to poor decisions.

(d) **Human and technological capabilities:** People, where 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.

A lack of skilled personnel or inadequate technology can hinder the effectiveness of the information system.

(e) **Cost of information:** The cost of producing and maintaining the information required by management can be significant and if not managed well could limit the quality of information used by management in making certain decision.

2.5 The sources of information from within and outside an organisation

It is very important to understand sources of information, both within and outside the organisation for making informed decisions.

Internal sources of information include:

a. accounting records;
b. production records;
c. customer data;
d. human resources records; and
e. data warehouses.

External sources of information include:
a. market research reports;
b. financial statements of competitors / other businesses;
c. government publications;
d. data from suppliers; and
e. social media and/or internets news.

2.6 The uses and limitations of published information/data, including information from internet

Published information/data, including information from the internet serves numerous purposes. It can be used for gathering information necessary for the growth of an organisation, communication, and even to facilitate collaboration and commerce. The internet in particular, offers the unique capability of providing access to enormous amounts of data and resources globally.

However, it has inherent limitations stemming from factors such as potential bias, unverified sources, and rapid pace of information dissemination, which can lead to outdated or inaccurate content. There are specific and general limitations of published information.

The specific limitations of published information/data are:

a. **Technical issues**
Internet access can be unreliable, and technical problems can hinder access to information.

b. **Unreliable sources**
The information from the internet could be published by anyone, making it difficult to determine the credibility of the source.

c. **Information overload**
The volume of information available online can be overwhelming and time consuming to sift through.

d. **Privacy concerns**
Sharing personal information online can raise privacy concerns and expose individuals to risks.

e. **Misinformation and disinformation**
The internet can be a breeding ground for false or misleading information.

The general limitations of published information/data are:

a. **Outdated information**
The world is constantly evolving, and information that was once accurate can quickly become outdated.

b. **Copyright and restrictions**
Certain information may be copyrighted or restricted, limiting its use and distribution.

c. **Lack of verification**
It is not all published information that is fact checked, meaning inaccuracies and misinformation can easily spread.

d. Bias and perspective
Information can be presented with a specific perspective, viewpoint or agenda, potentially skewing the narrative.

e. Accessibility issues
Some information may require specific institutional access, limiting who can access or make use of it.

2.7 Chapter review

Chapter review

Before moving on to the next chapter, check that you can:

a) explain management information systems;
b) explain the role of information systems in organisations;
c) explain the limitations of management information in providing guidance for
d) managerial decision making;
e) describe the sources of information from within and outside an organisation; and
f) explain the uses and limitations of published information/data, including information from internet.

2.8 Questions and suggested solutions

2.8.1 Questions

Question 1

Undoubtedly, management information systems help in collecting data from multiple sources and facilitates decision making by the management.

In view of this statement, you are **required** to:

a. Explain management information systems.
b. List **SIX** (6) uses of internet.
c. List and explain **SIX** (6) areas where IT can be applied to support management information systems.

2.8.2 Suggested solutions

Suggested solution 1

(a) Management information systems is a structured system that gathers, processes, stores, and distributes information to assist managers in making informed decisions and manage organisations effectively.

It involves collecting data from various sources, analysing them and aiming at providing managers with the information they need to make strategic and tactical decisions relating to their operations.

(b) Uses of internet include:
i. Information dissemination and browsing;
ii. Email;
iii. Transaction processing;
iv. File transfer;
v. Newsgroup;
vi. Marketing/Commerce;
vii. Entertainment/Music;
viii. Recruitment and job search;
ix. Education and research activities;
x. Games;
xi. Trainings;
xii. Advertisement;
xiii. Social media network; and
xiv. Capital market price movement.

(c) Areas where IT can be applied to support MIS include:
i. As a tool for support;
ii. For automating;
iii. For embedding;
iv. For processing business data;
v. For communicating;
vi. For networking; and
vii. For electronic data interchange.

Explanation of the above areas:

i. **Tool for support**: It can be considered as a tool for support in the areas of calculations, word processing, producing spreadsheet, diagrams and tables. It can enhance task performance.
ii. **For automating**: It can be employed to do things faster and more fundamentally and to automate many routines, clerical and information intensive organisational tasks and processes e.g. payroll, invoice production. etc.
iii. **For embedding**: This refers to the programming of organisational procedures, rules and controls into the IT. It thus aligns the existing technologies with the embedded business processor to achieve more effective control.
iv. **For processing business data**: This can be defined as the activity that translates description and measurements of activities, events and objects into usable information. The information capability of IT flows on the actual operations and processes through which work is produced.
v. **For communicating**: A huge and ever-increasing range of possibilities exists. This includes faxes, e-mails, voicemail, mobile telephones, videos, electronic displays, video conferencing, local and national worldwide network for transmitting and receiving all types of information.
vi. **For networking**: Networks are communication systems which link together computers, storage devices, word processors, printers, telephone system

and other electronic devices. Networks also allow users to share resources such as disks, printers and files.

vii. **For electronic data interchange**: This is computer- to- computer data interchange and so is a form of electronic mail. It replaces traditional paper-based communication via orders, invoices and so on. It is widely used in retailing businesses.

CHAPTER 3

SPREADSHEETS

Contents

3 Spreadsheets

3.0 Learning objective

This chapter explains the uses of spreadsheets in data analysis, cost and management accounting.

3.1 Learning outcomes

At the end of this chapter, readers should be able to:

(a) explain spreadsheets;
(b) identify the features of spreadsheets;
(c) state the uses of spreadsheets; and
(d) explain the use of spreadsheets in data analysis, cost and management accounting.

3.2 Features of spreadsheets

3.2.1 Definition of spreadsheet

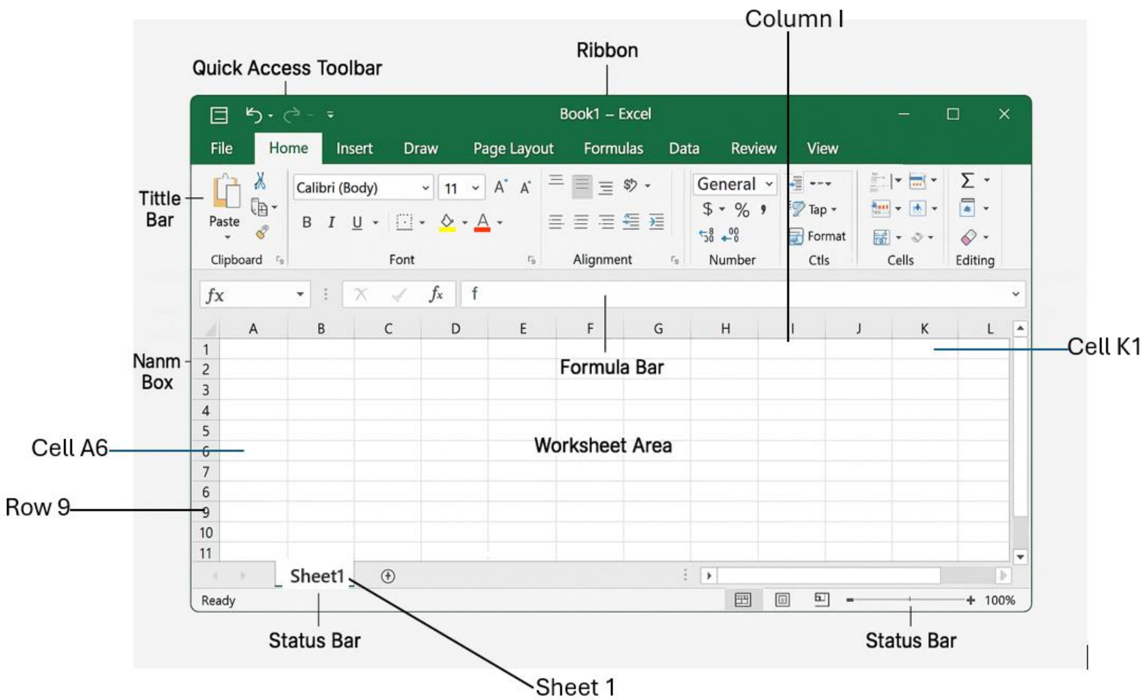
A spreadsheet is an electronic document that organises data in rows and columns, enabling users to perform calculations, analysis, and data storage.

The rows are numbered 1, 2, 3 . . . etc and the columns lettered A, B C . . . etc Spreadsheets are powerful tools used for organising, analysing, and storing data in tabular form. They are commonly used in business, education, finance, research, and personal tasks.

A spreadsheet id divided into rows (horizontal) and columns (vertical). The intersection of a row and column is called a cell. A cell address consists of its row and column reference. The cell that a cursor is currently in is known as the 'active cell' and the contents of any cell can be a text (words), values (number), and formulae (other cells), for example, =A1+B1. Formulae in Microsoft Excel follows a specific syntax. All Excel formulae start with the equals to sign (=), followed by the elements to be calculated and the calculation operators. For example, =D5/F8. This means the value in cell D5 is to be divided by the value in cell F8.

It is a digital equivalent of a paper ledger or worksheet. Spreadsheet packages permit the users to work with multiple sheets that refer to each other.

A simple Microsoft Excel spreadsheet is shown below:



3.2.2 Features of spreadsheets

Grid Layout

a. Grid layout
   i. Data is organised into rows and columns (cells)
   ii. Each cell can hold text, numbers, or formulas

b. Formulas and functions
   i. Perform calculations using formulas like =A1+B1
   ii. Built-in functions: SUM, AVERAGE, IF, VLOOKUP, etc

c. Data formatting
   i. Customise text, numbers, dates, and currency
   ii. Conditional formatting highlights cells based on criteria

d. Charts and graphs
   i. Visualise data using pie charts, bar graphs, line charts, etc

e. Data sorting and filtering
   i. Sort data alphabetically or numerically
   ii. Filter data to view specific information

f. Data validation
   i. Control the type of data entered (e.g., dropdown lists, number limits)

g. Pivot tables
   i. Summarise large datasets to show trends and comparisons

h. Collaboration and sharing
   i. Tools like Google sheets allow real-time multi-user editing and commenting

i. Cell referencing
   a. Use relative, absolute, or mixed references in formulas Automation (Macros)

j. Automate repetitive tasks with scripts or macros (especially in Excel).

3.3 Uses of spreadsheets

Spreadsheets are versatile tools used for a variety of purposes, including organising data, performing calculations, creating budgets and managing finance.

Common uses of spreadsheets are:

a. **Budgeting and financial planning:** Tracking income, expenses, savings, and investments;
b. **Data analysis:** Analysing sales, survey results, or research data;
c. **Inventory management:** Monitoring stock levels, orders, and product info;
d. **Project management:** Creating timelines, task lists, and progress trackers;
e. **Scheduling and timetables:** Planning calendars, appointments, or class schedules;
f. **Reporting:** Generating professional reports and dashboard;
g. **Record keeping:** Maintaining contact lists, attendance logs, or membership databases;
h. **Academic use:** Calculating grades, analyse student performance, and track assignments;
i. **Business forecasting:** Predicting future trends using historical data; and
j. **Data entry and storage:** Storing large amounts of structured data for easy access and reference.

3.4 The uses of spreadsheets in data analysis, cost and management accounting

Spreadsheets are widely used in data analysis and, cost and management accounting due to their accessibility, flexibility, and built-in tools that allow users to clean, organise, manipulate, and visualise data efficiently. Here is a detailed explanation of how spreadsheets help in data analysis, cost and management accounting.

a. **Data collection and entry:** Users can input or import raw data manually or from other sources (CSV, databases, APIs).
   Supports a variety of data types: text, numbers, dates, etc.
b. **Data cleaning:** Remove duplicates, correct errors, and fill missing values. Use find-and-replace, filters, and formulas (e.g., TRIM, CLEAN, ISERROR) to clean data.
c. **Data organisation:** Structure data into tables with clear headers and formatting;
   Group related data using sheets, columns, and named ranges.
d. **Data manipulation and transformation:** Perform calculations using formulas (=A1+B1, =AVERAGE(B2:B10)).
   Use logical functions (IF, AND, OR) to categorise or flag data;
   Rearrange, split, or combine data using tools like TEXT TO COLUMNS or CONCATENATE.
e. **Data visualisation:**
   - Create charts (bar, pie, line, scatter) to identify trends and patterns;
   - Use conditional formatting to highlight key values (e.g., top performers, low scores).
f. **Data summarisation:** Use **pivot tables** to quickly summarize large datasets by category, time, or other fields. Apply functions like SUMIFS, COUNTIFS, or VLOOKUP for detailed analysis.
g. **Integration and Collaboration**
   - Integrate with other tools (e.g., Google Forms, Microsoft Power BI); and
   - Collaborate in real-time (Google Sheets), enabling team analysis and shared insights.
h. **Reporting and decision-making:** Compile analysis into professional reports with charts, tables, and summaries. Help stakeholders make informed decisions based on trends and metrics.

i. **Cost analysis:** They help in analysing:
   - Fixed vs. variable costs;
   - Direct vs. indirect costs; and
   - Break-even analysis and contribution margin calculations.

j. **Variance analysis:** Accountants compare actual results to budgets to:
   - Identify discrepancies; and
   - Analyse reasons for variances (price, quantity, efficiency).

k. **Budgeting and forecasting:** Spreadsheets are widely used to:
   - Create budgets (operating, capital, cash);
   - Develop "what-if" scenarios for future planning; and
   - Forecast revenues and expenses based on assumptions.

3.5 Chapter review

Chapter review

Check that you now know how to:

a. identify the features and uses of spreadsheets; and
b. explain the use of spreadsheets in data analysis, cost and management accounting.

3.6 Question and suggested solution

3.6.1 Question

Question 1

Spreadsheet is a tool for the accountants.

Required:

a. Explain spreadsheets.
b. List three types of a cell content.
c. List five (5) uses of spreadsheets.

3.6.2 Suggested solution

Suggested solution 1

(a) A spreadsheet is an electronic document in which data is arranged in the rows and columns of a grid and can be manipulated and used in calculations. It is an application for computation, organisation, analysis and storage of data in tabular form. The data stored in a spreadsheet can be searched, sorted, calculated and used in a variety of charts and graphs.

(b) The three types of a cell content in a spreadsheet are:

i. Text;
ii. Values; and
iii. Formulae

(c) Uses of spreadsheets include:

i. Management accounting;
ii. Budgeting and forecasting;
iii. Accounts reconciliations;
iv. Data analysis;
v. Reporting;
vi. Payroll management;
vii. Project management; and
viii. Revenue analysis.

CHAPTER 4

BIG DATA AND DATA ANALYTICS

Contents

4 Big Data and Data Analytics

4.0 Learning objective

This chapter explains big data as one of the emergent disruptive technologies and its applications in the accounting profession.

4.1 Learning outcomes

At the end of this chapter, readers should be able to:

(a) define and explain Big Data;
(b) explain Big data and its attributes;
(c) list examples of Big Data sources;
(d) explain the Big Data Pyramid and its purposes;
(e) explain Data analytics;
(f) list and explain technologies for Big Data and Data Analytics;
(g) explain the key concepts in data analytics;
(h) list and explain the applications of big data and data analytics;
(i) list and explain the benefits and uses of data mining and analytics;
(j) explain the risks and challenges of Big Data and Data Analytics; and
(k) explain the future trends in Big Data and Data Analytics.

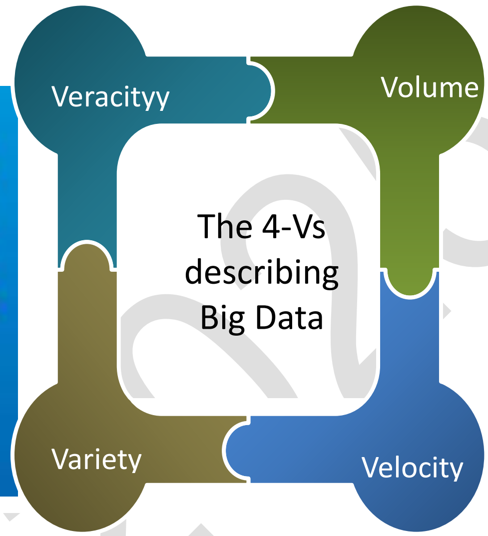
4.2 Definition and description of Big Data

Big data refers to massive, complex datasets that are difficult to manage and analyse using traditional methods. It encompasses a wide range of data types, including structured, and semi-structured data, and it often grows exponentially overtime.

4.3 Big Data analytics and attributes

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 is 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.

4.3.1 Real life application of Big Data

Big Data analytics can be found in the predictive modelling in the following areas:

a. customer relationship management initiative;
b. market research;
c. product devilment designs;
d. sales forecast;
e. human capital management; and
f. audit activities.

4.3.2 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.

4.4 Examples of Big Data sources

a. Social Media (Facebook, Twitter, Instagram)
b. Sensor Data (IoT devices, weather sensors)
c. E-commerce Transactions (Amazon, eBay)
d. Financial Data (Stock markets, banking)
e. Scientific Data (Genomics, astrophysics)
f. Log Files (Web server logs, application logs)

4.5 The Big Data Pyramid and Its Purpose

4.5.1 Introduction

The concept of the Big Data Pyramid offers a systematic approach to understanding and organising vast amounts of data in an actionable, insightful way. *It is based on the work of Jennifer Rowley in 2007, which explained the relationships between data, information, knowledge and wisdom or intelligence.* As data becomes increasingly central to decision-making across industries, frameworks like the Big Data Pyramid provide clarity on how raw data evolves into meaningful knowledge and supports decision-making. This pyramid is a metaphorical representation of how data is structured, analysed, and ultimately utilised to achieve informed outcomes.

4.5.2 The structure of the Big Data Pyramid

The Big Data Pyramid is often visualized as a hierarchy with distinct layers, each representing a step in the transformation of data from raw inputs to actionable insights. The key layers of the pyramid include:

Data

At the base of the Big Data Pyramid lies data in its raw, unprocessed form. This layer comprises the vast quantities of information generated every second, whether from social media, sensors, financial systems, or other sources. Raw data, while abundant, is often noisy, unstructured, and not immediately useful without refinement.

Purpose: The primary goal at this stage is data collection and storage. Organizations invest in technologies to gather, store, and process data efficiently, ensuring its availability for further analysis.

Information

The next level in the pyramid is information, which emerges when raw data is organised, categorised, and contextualised. This layer involves processes like data cleaning, integration, and presentation. Structured data sets, charts, and simple dashboards are common outputs at this stage.

Purpose: The purpose here is to transform raw data into a more comprehensible form, enabling stakeholders to observe patterns, trends, and correlations.

Knowledge

Knowledge is the result of deeper analysis and interpretation of the information layer. This involves applying analytical models, algorithms, and domain expertise to uncover insights that provide meaningful context to the data. For instance, identifying customer behaviour trends or the root causes of operational inefficiencies would fall under this category.

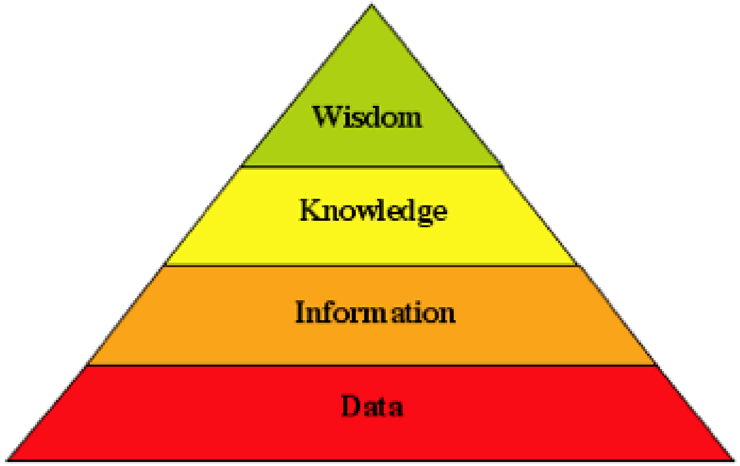
Purpose: The aim is to generate actionable insights that organisations can use to inform strategies and improve processes.

Wisdom or intelligence

At the top of the pyramid is intelligence, the pinnacle of the data hierarchy. Intelligence is derived when knowledge is applied with foresight and strategic intent. It aligns insights with business objectives and enables predictive modelling, scenario planning, and real-time decision-making.

Purpose: Intelligence serves as the foundation for making informed decisions, driving innovation, and achieving competitive advantages. It bridges the gap between data science and strategic execution.

Big Data Pyramid is illustrated as follows:



4.5.3 The purpose of the Big Data Pyramid

The Big Data Pyramid serves several purposes, making it an essential framework for organisations:

Guiding data utilisation

The pyramid provides a structured approach to understanding how data should be utilised. It encourages organisations to progress through the layers methodically, ensuring that raw data is refined into actionable intelligence rather than being left as an overwhelming mass of information.

Enhancing decision-making

By emphasising the transformation of data into intelligence, the pyramid promotes evidence-based decision-making. This ensures that decisions are backed by reliable and meaningful insights rather than intuition or incomplete information.

Aligning business strategy

The pyramid helps align data practices with business objectives. By defining each layer's purpose, it ensures that data collection, storage, and analysis contribute directly to organisational goals.

Supporting scalability

As organisations grow and their data needs expand, the Big Data Pyramid offers a scalable model for managing increasing volumes and complexity. Each layer's distinct focus ensures that processes remain effective as data ecosystems evolve.

Fostering innovation

The insights gained from the top layers of the pyramid fuel innovation. Whether it's identifying new market opportunities or optimizing supply chains, the pyramid's structure ensures that data-driven innovation is a continuous process.

4.5.4 Challenges in Implementing the Big Data Pyramid

Despite its many benefits, implementing the Big Data Pyramid is not without challenges. Organisations may face hurdles such as data quality issues, lack of skilled personnel, or insufficient technology infrastructure. Additionally, ensuring a seamless flow between the layers requires robust governance, collaboration, and clear objectives.

4.6 Data analytics: Extracting value from Big Data

Data Analytics is the process of examining raw data to draw conclusions about that information. It involves applying algorithmic or mechanical processes to derive insights.

4.6.1 Types of Data Analytics

a. **Descriptive analytics:** What happened? Summarizing historical data to understand past trends and patterns. (e.g., Sales reports, website traffic analysis)
b. **Diagnostic analytics:** Why did it happen? Analyzing data to understand the root causes of events. (e.g., Identifying the reasons for a decline in sales)
c. **Predictive analytics:** What will happen? Using statistical models and machine learning techniques to predict future outcomes. (e.g., Predicting customer churn, forecasting sales)
d. **Prescriptive analytics**: How can we make it happen? Recommending actions based on data analysis to achieve desired outcomes. (e.g., Optimizing marketing campaigns, suggesting inventory levels)
e. **Cognitive analytics:** Mimics human thought processes to automate *tasks, learn from data, and make decisions. (e.g., Chatbots, fraud detection systems).*

4.7 Technologies for Big Data and Data Analytics

4.7.1 Data storage and processing:

a. ***Hadoop****: An open-source distributed processing framework for storing and processing large datasets across clusters of computers. Key components:*
b. ***HDFS (Hadoop Distributed File System):*** *Distributed file system for storing large files.*
c. ***MapReduce****: Programming model for parallel processing of large datasets.*
d. ***YARN (Yet Another Resource Negotiator):*** *Resource management and job scheduling system.*
e. ***Spark:*** *A fast, in-memory data processing engine that is often used as an alternative to MapReduce. Offers faster processing speeds, especially for iterative algorithms.*
f. ***Cloud-Based Storage and Computing:*** *Services like Amazon S3, Azure Blob Storage, and Google Cloud Storage provide scalable and cost-effective storage for big data. Cloud platforms also offer powerful computing resources for data analytics.*
g. ***NoSQL Databases:*** *Non-relational databases designed for handling large volumes of unstructured and semi-structured data. Examples: MongoDB, Cassandra, Couchbase.*

4.7.2 Data Analytics tools

a. ***Programming languages:*** *Python (with libraries like Pandas, NumPy, Scikit-learn), R.*
b. ***Data visualisation tools:*** *Tableau, Power BI, QlikView.*
c. ***Machine learning platforms:*** *TensorFlow, PyTorch, Azure Machine Learning, AWS SageMaker.*
d. ***Data integration tools****: Apache Kafka, Apache NiFi.*
e. ***Data warehouses:*** *Snowflake, Amazon Redshift, Google BigQuery.*

4.8 Key concepts in Aata Analytics

a. **Data mining:** Discovering patterns and knowledge from large datasets using algorithms and techniques from statistics, machine learning, and database systems.
b. **Machine learning (ML):** A type of artificial intelligence that enables computers to learn from data without being explicitly programmed.
c. **Supervised learning:** Training a model on labelled data to predict outcomes.
d. **Unsupervised learning:** Discovering patterns and structures in unlabelled data.
e. **Reinforcement learning:** Training an agent to make decisions in an environment to maximise a reward.
f. **Artificial intelligence (AI**): The broader concept of creating intelligent machines that can perform tasks that typically require human intelligence.
g. **Deep learning:** A type of machine learning that uses artificial neural networks with multiple layers to analyse data.
h. **Data visualisation**: Representing data in a graphical format to make it easier to understand and identify patterns.
i. **Data wrangling/cleaning:** The process of cleaning, transforming, and preparing data for analysis. Involves handling missing values, correcting errors, and formatting data consistently.
j. **Statistical analysis:** Using statistical methods to analyse data and draw conclusions.
k. ETL (Extract, Transform, Load): The process of extracting data from various sources, transforming it into a consistent format, and loading it into a data warehouse or other data storage system.

4.9 Applications of Big Data and Data Analytics

a. **Business:**
   i. customer relationship management (CRM);
   ii. marketing automation;
   iii. supply chain optimisation;
   iv. fraud detection;
   v. risk management;
   vi. healthcare;
   vii. personalised medicine;
   viii. drug discovery;
   ix. predictive diagnostics; and
   x. healthcare fraud prevention.

b. **Government:**
   i. smart cities;
   ii. law enforcement;
   iii. national security; and
   iv. public health.

c. **Science:**
   i. climate modelling;
   ii. genomics research;

iii. astronomy; and
iv. materials science.

4.10 The *benefits and uses of data mining and analytics*

4.10.1 Benefits of data mining and analytics

Data mining and analytics offers numerous benefits, including:

a. uncovering valuable insights;
b. improving decision making;
c. enhancing security;
d. driving business growth; and
e. anomalies in large datasets, leading to more informed actions and competitive advantage.

4.10.2 Uses of data mining and analytics

Data mining and analytics has a wide range of uses across various industries, primarily focused on:

a. extracting valuable knowledge and insights from large datasets;
b. it can be used for prediction;
c. fraud detection;
d. customer segmentation and market analysis;
e. analysing customer behaviour preference and trends; and
f. improve customer experience and enhance product development.

4.11 Risks and challenges of big data and data analytics

Data mining and analytics helps companies deal with business problems that couldn't be solved with the help of traditional data analysis. However, it comes with inherent risks, primarily related to security, privacy, data quality, and potential misuse of information. These risks can lead to breaches of personal data, inaccurate analysis, and even illegal or unethical activities.

The following are the major challenges:

a. **Data quality**: Ensuring the accuracy and reliability of the data;
b. **Data security and privacy:** Protecting sensitive data from unauthorized access and misuse. Compliance with regulations like GDPR and CCPA is crucial;
c. **Data governance:** Establishing policies and procedures for managing data effectively;
d. **Scalability:** Building systems that can handle increasing volumes of data;
e. **Skills gap:** Finding and retaining qualified data scientists and analysts;
f. **Data silos:** Data being trapped in different departments or systems, making it difficult to get a complete view of the organisation; and
g. **Interpretability**: Making sense of complex models and explaining their predictions. "Black Box" models can be difficult to trust.

4.12 Future trends in big data and data analytics

a. **Edge computing:** Processing data closer to the source, reducing latency and bandwidth requirements.
b. **AI-powered analytics:** Using AI to automate data analysis tasks and provide deeper insights.
c. **Data fabric**: A unified data architecture that provides consistent access and management across distributed data environments.
d. **Cybersecurity analytics:** Using big data to detect and prevent cyber threats.
e. **Quantum computing:** Potentially revolutionizing data analytics by enabling faster and more complex calculations.

4.13 Chapter review

Chapter review

Check that you can:

a. define and explain Big Data;
b. explain Big data and its attributes;
c. list examples of Big Data sources;
d. explain the Big Data Pyramid and its purposes;
e. explain Data analytics;
f. list and explain technologies for Big Data and Data Analytics;
g. explain the key concepts in data analytics;
h. list and explain the applications of big data and data analytics;
i. list and explain the benefits and uses of data mining and analytics;
j. explain the risks and challenges of Big Data and Data Analytics; and
k. explain the future trends in Big Data and Data Analytics.

4.14 Questions and suggested solutions

4.14.1 Questions

Question 1

As data becomes increasingly central to decision-making across industries, technologies like the Big Data and Data Analytics help transform raw data into meaningful information and support decision-making.

Required:

(a) Explain Big data.
(b) Explain how big data solve challenges in industry.
(c) Explain the risks an organisation is exposed to when applying data mining and analytics.

4.14.2 Suggested solution

Suggested solution:

a. Big data can be explained as extremely large collections of data (datasets) that may be analysed to reveal patterns, trends, and associations. The datasets are so large that conventional methods of storing and processing the data will not work.

   Volume, Variety, Velocity and Veracity have been generally considered as the essential features of big data.

b. Big data addresses many critical challenges, such as managing and analysing unstructured data. It also helps businesses process massive datasets using distributed computing framework, which address scalability in storage and computing resources.

   Distributed computing splits a task that is computationally intensive into smaller sub-tasks that run at the same time on multiple machines. For example, Hadoop's MapReduce processes large datasets across many servers to handle petabytes of data efficiently. This approach is essential for big data as it enables faster processing, handles failures, and scales easily to manage data that a single machine cannot handle.

   Note: Hadoop Distributed File System (HDFS) is a key part of big data systems, built to store and manage large amounts of data across multiple nodes. It works by dividing large datasets into smaller blocks and distributing them across a cluster of nodes.

c. It is very important for every organisation to apply data mining and analytics in order to manage complex datasets. However, organisations face several risks in the process. Such risks include:

   i. How to ensure data mining algorithms are fair and unbiased;
   ii. How to validate models, ensure they are accurate and reliable;
   iii. How to communicate the results of data mining analysis to the stakeholders;
   iv. How to ensure data mining and practices comply with relevant laws and regulations;
   v. What are the potential penalties for non-compliance with data privacy regulations; and
   vi. The potential costs and benefits of implementing data mining technologies.

CHAPTER 5

COSTS CLASSIFICATION, CODIFICATION, SEGREGATION AND ESTIMATION

Contents

5 Cost Classifications, Codification, Segregation and Estimation

5.0 Learning objective

The objective of this chapter is to explain different approaches to cost classifications, how costs respond to the changes in the level of activities and the two methods of estimating fixed and variable costs from historical data.

5.1 Learning outcomes

At the end of this chapter, readers should be able to:

(a) explain the nature and behaviour of costs;
(b) explain (with examples) fixed, variable, and semi-variable costs;
(c) identify and give examples of fixed, variable, and semi-variable costs;
(d) describe direct and indirect cost;
(e) identify and give examples of direct and indirect cost;
(f) explain the terms product cost and period cost with appropriate examples;
(g) calculate fixed and variable costs by using high-low points method;
(h) calculate fixed and variable costs by using regression analysis; and
(i) explain correlation and interpret correlation coefficients.

5.2 Introduction to costs

5.2.1 Types of organisation

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

a. Manufacturing organisations; and
b. 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 Mobile phones Garments	Batch costing Standard costing
Identical products in large amounts by passing the product through a series of processes	Pharmaceuticals Paint Petroleum	Process costing (including joint product and by-product costing)
Identical products in large numbers customised in some way for different customers	Aircraft (which may vary in internal fit and external painting) Own-brand foods for supermarkets	Job costing

Service organisations

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

a. training and education;
b. healthcare;
c. travel and tourism;
d. financial services; and
e. 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:
a. how much it costs to make the products that it produces; or
b. 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:
a. make sure that the product or service is sold at a profit;
b. measure the actual profit that has been made; and
c. 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:
a. control the entity;
b. measure to what extent it is achieving its objectives; and
c. 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:
a. the cost of a product;
b. the cost of a service;
c. the cost of a department; and
d. 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
a.	Carrots	Production cost per tin of carrots
b.	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
Buses	Operating cost per bus per month
Bus routes	Operating cost per month for each bus route
Bus drivers	Cost of operating the depot per month, per bus driver employed

5.2.2 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: How cost varies at different levels of activity:

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

(b) Whether the cost can be directly attributed to units of production

(c) 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.

5.3 Cost Classification by Elements and Function

5.3.1 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 must be an organised system for recording them. Cost items need to be grouped into categories of similar costs.

5.3.2 Cost classification by function

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

a. production costs (manufacturing costs); and
b. 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:

a. the material cost of the raw materials and components, purchased from suppliers and used in the production of the goods that are manufactured;
b. the labour cost of all employees working for the manufacturing function, such as machine operators, supervisors, factory supervisors and the factory manager; and
c. 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:
a. selling costs and distribution costs;
b. administration costs; and
c. finance costs.

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:

a. the wages and salary costs of all employees working in the selling and distribution departments, including sales commissions for sales representatives;
b. advertising costs and other marketing costs;
c. operating costs for delivery vehicles (for delivering finished goods to customers), such as fuel costs and vehicle repair costs; and
d. other costs, including depreciation costs for the delivery vehicles.

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:

a. the salary costs of all the staff working in the administration departments;
b. the costs of the office space used by these departments, such as office rental costs; and
c. 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.

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.

5.3.3 Production or non-production?

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

a. the salary of the managing director, because the managing director spends time on all aspects of the company's operations; and
b. 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
A company uses three categories of functional cost in its cost accounting system. These are manufacturing costs, administration costs and sales and distribution costs.

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

a. Salary of the chief accountant
b. Telephone charges
c. Cost of office cleaning services
d. Cost of warehouse staff

5.3.4 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		200
Gross profit		400
Administration costs	120	
Selling and distribution costs	230	
		350
Net profit (or net loss)		50

5.3.5 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:

a. finished goods that have been produced during the financial period but not yet sold (finished goods inventory); and
b. 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:

a. goods produced and sold in the period;
b. goods produced but not yet sold (finished goods); and
c. work-in-progress.

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

5.3.6 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		175,000
Less: Closing inventory		(20,000)
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	
		162,000
Manufacturing costs		**417,000**
Add: Opening work in progress		85,000
Less: Closing work in progress		(95,000)
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**	
	457,000	
Closing inventory of finished goods	(40,000)	
Cost of sales		(417,000)
Gross profit		383,000
Administration costs	86,000	
Selling and distribution costs	94,000	
		(180,000)
Net profit for the period		203,000

5.4 Fixed and variable costs

5.4.1 Cost behaviour

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

a) the volume of sales;
b) the volume of production;
c) total labour hours worked, machine hours worked;
d) the number of production units inspected; and
e) 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:

a) forecast or plan what costs ought to be; and
b) 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.

5.4.2 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:

a. 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
b. 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.

5.4.3 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 include:

a. The cost of buying raw material is ₦500 per litre regardless of purchase quantity. The variable cost is ₦500 per litre:
   i. the total cost of buying 1,000 litres is ₦500,000; and
   ii. the total cost of buying 2,000 litres would be ₦1,000,000.

b. The rate of pay for hourly-paid workers is ₦150 per hour.
   i. 400 hours of labour would cost ₦60,000; and
   ii. 500 hours would cost ₦75,000.

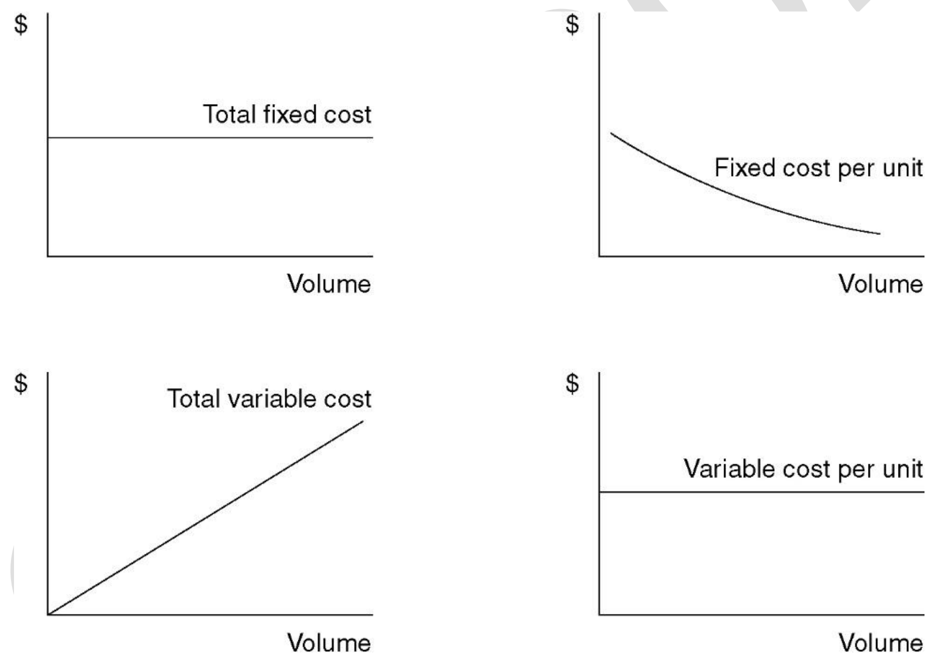
c. The time needed to produce an item of product is 4 minutes and labour is paid ₦150 per hour.
   Direct labour is a variable cost and the direct labour cost per unit produced is ₦10 (= ₦150 × 4/60).

d. 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.

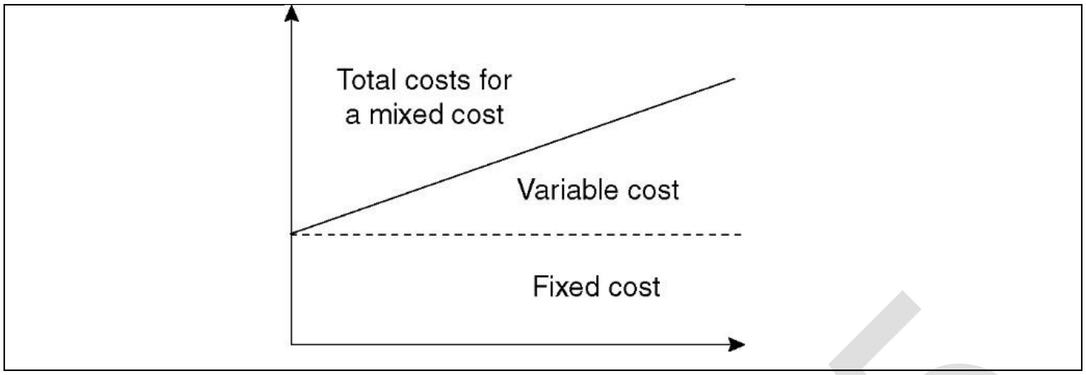
Illustration: Cost behaviour graphs for fixed costs and variable costs



5.4.4 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:

	₦
ed cost	4,000
iable 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	250,000
Total costs	3,850,000

Forecasting is covered in more detail in a later chapter.

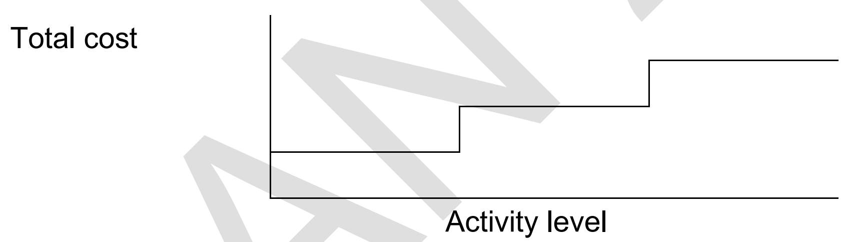
5.4.5 Stepped cost

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

a. has a fixed cost behaviour pattern within a limited range of activity; and
b. 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

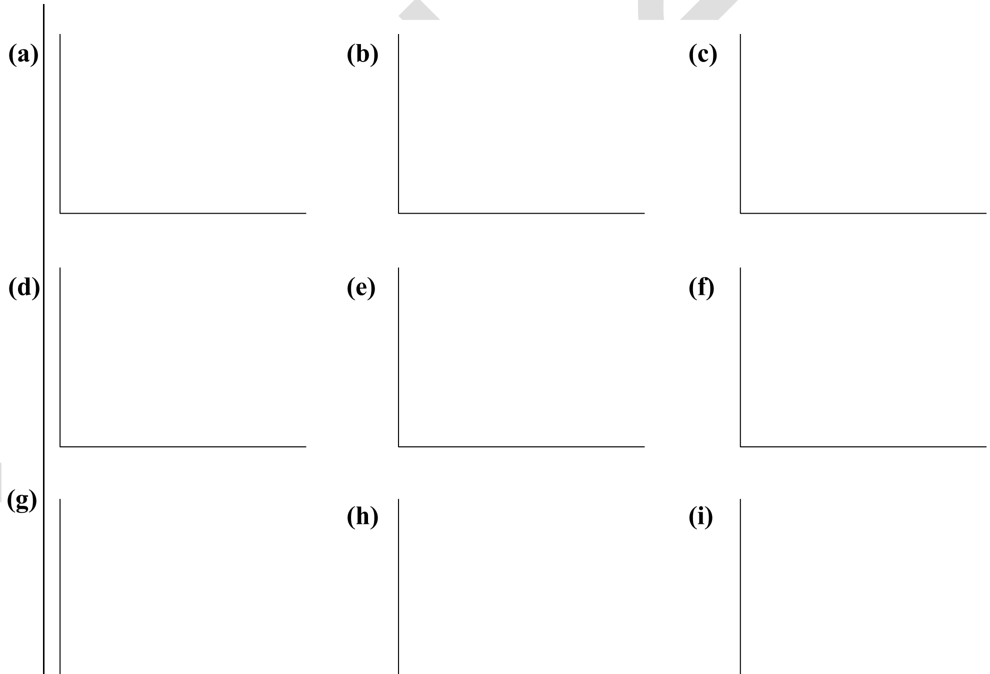
The supervision costs are fixed costs within a certain range of output but go up or down in steps as the output level rises above or falls below certain levels.

Practice questions

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:

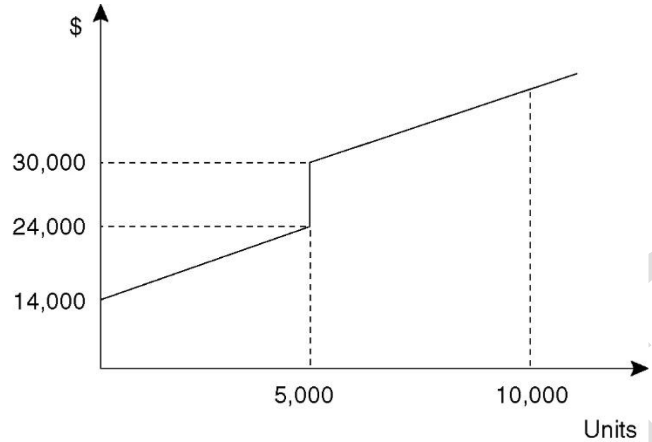
a. Fixed costs;
b. Variable costs;
c. Semi-variable costs;
d. Annual rates bill;
e. Direct labour cost;
f. Annual telephone bill;

Direct materials cost if a bulk discount is offered on all purchases once the total purchased exceeds a certain level;
Supervisory costs; and
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.



Practice question

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.



5.5 Direct and indirect costs

5.5.1 Introduction

Costs may also be classified as:

a) direct costs; or
b) indirect costs (also known as overheads).

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

5.5.2 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:

a. **raw materials**, such as glass, metals and chemicals; and
b. **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	X

5.5.3 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

Identify the types of company that would treat fuel costs as a direct material cost.

Manufacturing company

Road haulage (road transport) company

Construction company

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.

5.5.4 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:

a. Prime cost plus a share of production overheads is the full production cost or 'fully absorbed production cost' of the cost unit.

b. 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).

5.5.5 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:

a. 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;
b. facilitate electronic data processing. Computer analysis, summarisation and presentation of data can be performed more easily through the medium of codes;
c. 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;
d. simplify comparison of totals of similar expenses rather than all the individual items. This facilitates control; and
e. incorporate check codes within the main code to check the accuracy of posting.

A coding system should have the following characteristics:

a. the coding system should be comprehensive allowing every recorded item to be coded easily;
b. each item (expense type) should have a unique code, ideally of uniform length and with each code built according to consistent rules;
c. the system must be easy to use, communicate and interpret;
d. the system should allow for expansion; and
e. 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.

5.6 Product costs and period costs

5.6.1 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 expensed when they occur – i.e. in the period in which they occurred.

Period costs are the non-production overheads
In summary, **product costs** are expensed when the inventory is sold and **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.

5.7 Introduction to cost segregation

5.7.1 Analysing fixed and 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.

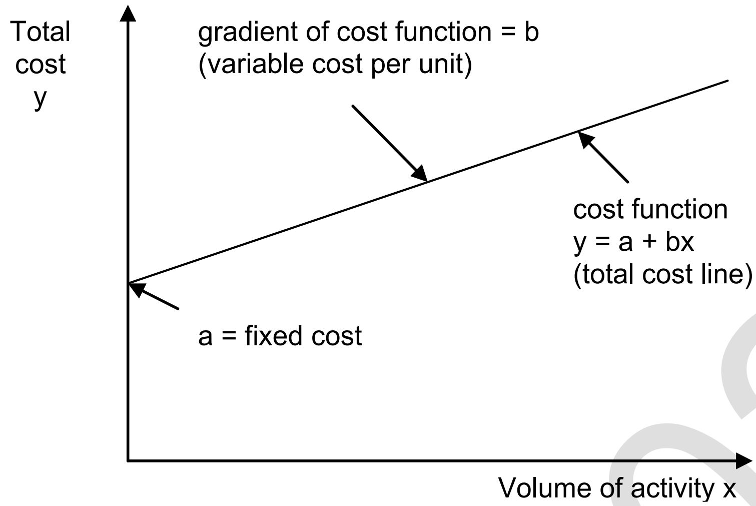
There are several methods of constructing the total cost function equation. These include:

a) high/low analysis; and

b) linear regression analysis.

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

Illustration: Linear total cost function



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.

5.8 High/low method

5.8.1 High/low analysis

High/low analysis can be used to estimate fixed costs and variable costs per unit whenever:

a. there are figures available for total costs at two different levels of output or activity.
b. It can be assumed that fixed costs are the same in total at each level of activity; and
c. the variable cost per unit is constant at both levels of activity.

High/low analysis uses two historical figures for cost:

a. the highest recorded output level, and its associated total cost; and
b. 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:

a) the highest activity level; and
b) 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
	2,400	8,400

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

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

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

Total cost of 8,200 units:

Fixed cost + Variable cost = ₦48,700

Fixed cost + (8,200 ×₦3.5) = ₦48,700

Fixed cost + ₦28,700 = ₦48,700

Fixed cost = ₦48,700 –₦28,700 = ₦20,000

Step 4: Construct total cost function

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:

Fixed cost + Variable cost = ₦40,300

Fixed cost + (5,800 ×₦3.5) = ₦40,300

Fixed cost + ₦20,300 = ₦40,300

Fixed cost = ₦40,300 –₦20,300 = ₦20,000

5.8.2 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.

Total cost = ₦20,000 + ₦3.5x

Total cost of 7,000 units =₦20,000 + (₦3.5 × 7,000) = ₦44,500

Practice questions

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.

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:

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

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

5.8.3 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:

(a) the highest activity level; and
(b) the lowest activity level.

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

a) add the step in fixed costs to the total costs of the lower level of activity; or
b) 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:

difference in total costs/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
	5,000	15,000

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

Therefore: The variable cost per unit = $^{₦15,000}/_{5,000 \text{ units}}$ = ₦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:

Fixed cost + Variable cost = ₦195,000

Fixed cost + (22,000 × ₦3) = ₦195,000

Fixed cost + ₦66,000 = ₦195,000

Fixed cost = ₦195,000 – ₦66,000 = ₦129,000

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

Total cost = a +bx = 129,000 + 3x

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

Total cost = a +bx = (129,000 – 15,000) + 3x

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.

Total cost = ₦129,000 + ₦3x

Total cost of 20,000 units = 129,000 + (₦3 × 20,000) = ₦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
	3,000	36,000

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

Therefore: The variable cost per unit = ₦36,000/3,000 units = ₦12 per unit

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

Total cost of 11,000 units:

Fixed cost + Variable cost = ₦276,000

Fixed cost + (11,000 × ₦12) = ₦276,000

Fixed cost + ₦132,000 = ₦276,000

Fixed cost = ₦276,000 – ₦132,000 = ₦144,000

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

Total cost = a +bx = 144,000 + 12x

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

Total cost = a +bx = (144,000 × 100/120) + 12x

Total cost = a +bx = 120,000 + 12x

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

5.8.4 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:

a) the 'in between' activity level; and

b) 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
	5,000	36,000

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

Therefore: The variable cost per unit above 24,000 units

= $^{₦36,000}/_{5,000\text{ units}}$ = ₦7.2 per unit

Therefore: The variable cost per unit below 24,000 units

= ₦7.2 per unit $\times ^{100}/_{90}$ = ₦8 per unit

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

Total cost of 30,000 units:

Fixed cost + Variable cost = ₦356,000

Fixed cost + (30,000 ×₦7.2) = ₦356,000

Fixed cost + ₦216,000 = ₦356,000

Fixed cost = ₦356,000 – ₦216,000 = ₦140,000

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

Total cost = a +bx = 140,000 + 7.2x

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

Total cost = a +bx = 140,000 + 8x

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

5.9 Linear regression analysis

5.9.1 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:

a. 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;

b. 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;
c. 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
d. 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:
a) it is more reliable; and
b) its reliability can be measured.

5.9.2 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.

rmula: Regression analysis formula

en a number of pairs of data, a line of best fit (y = a + bx) can be constructed by calculating values 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

$\sum$ = 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 ***x²***, calculate the square of each value of ***x*** and enter the value in the ***x²*** 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
	41.8	268.3	295.88	1,885.91
	$= \sum x$	$= \sum y$	$= \sum x^2$	$= \sum xy$

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

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

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

$$a = \frac{\sum y}{n} - \frac{b\sum x}{n} \qquad a = \frac{268.3}{6} - \frac{3.585(41.8)}{6}$$

$$a = 44.72 - 24.98 = 19.74$$

Line of best fit: $y = a + bx$

$$y = 19.74 + 3.585x$$

5.9.3 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.

ample: Linear regression analysis

e company is planning to make 9,000 units and wishes to estimate the total costs ociated 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

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

5.10 Correlation and the correlation coefficient

5.1.1 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.

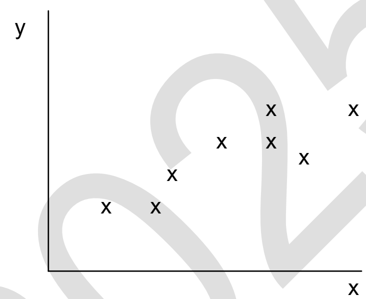
Correlation is a measure of how close the points on a scatter graph are to the line of best fit. If all of the points are very close to the line of best fit, then it is highly suggestive that there is a relationship between ***x*** and ***y***. However, this is not necessarily the case. Correlation is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

5.1.2 Degrees of correlation

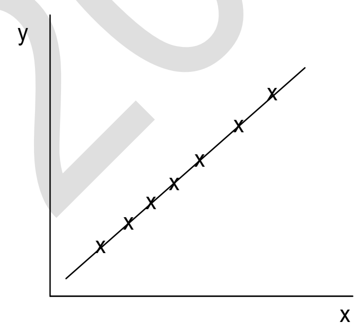
The following scatter graphs show the different degrees of correlation that may be seen to exist between two variables:

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.



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

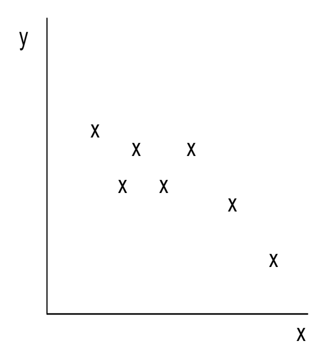
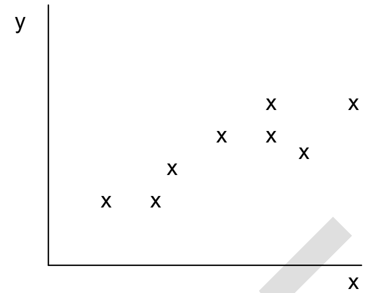
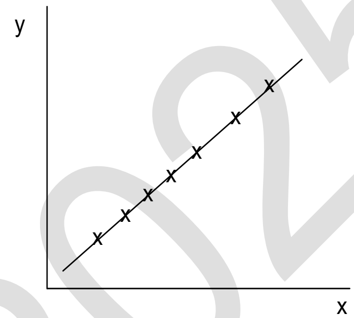


Illustration: Types of correlation

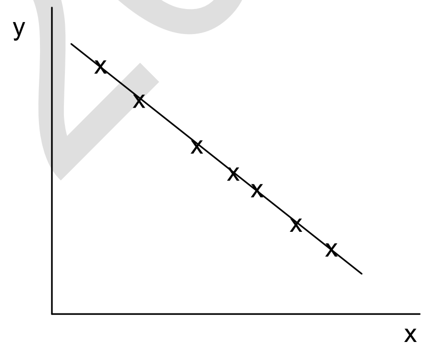
Positive correlation means that the value of y increases as the value of x increases (and vice versa).



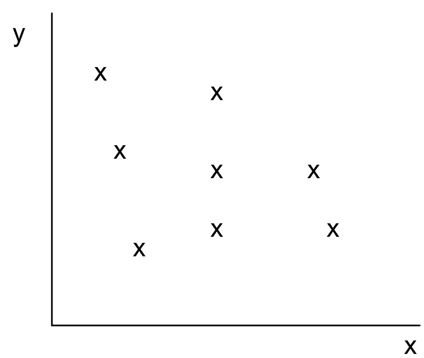
Perfect positive correlation is when all the data points lie in an exact straight line and a linear relationship exists between the two variables. This implies that the value of x and the value of y increase in a direct proportion.



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



correlated' means that no correlation is ·n to exist between the variables.



5.1.3 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	x^2	xy	y^2
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
	$= \sum x$	$= \sum y$	$= \sum x^2$	$= \sum xy$	$= \sum y^2$

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

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

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

The correlation coefficient r is + 0.97.

Practice question

Calculate the correlation coefficient of the following data:

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

5.11 CHAPTER REVIEW

Chapter review

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

a. explain the nature and behaviour of costs;
b. explain (with examples) fixed, variable, and semi variable costs;
c. identify and give examples of fixed, variable, and semi variable costs;
d. describe direct and indirect cost;
e. identify and give examples of direct and indirect cost;
f. explain the terms product cost and period cost with appropriate examples;
g. calculate fixed and variable costs by using high-low points method;
h. calculate fixed and variable costs by using regression analysis; and
i. explain correlation and interpret correlation coefficients.

5.12 Solutions to practice questions

Solutions

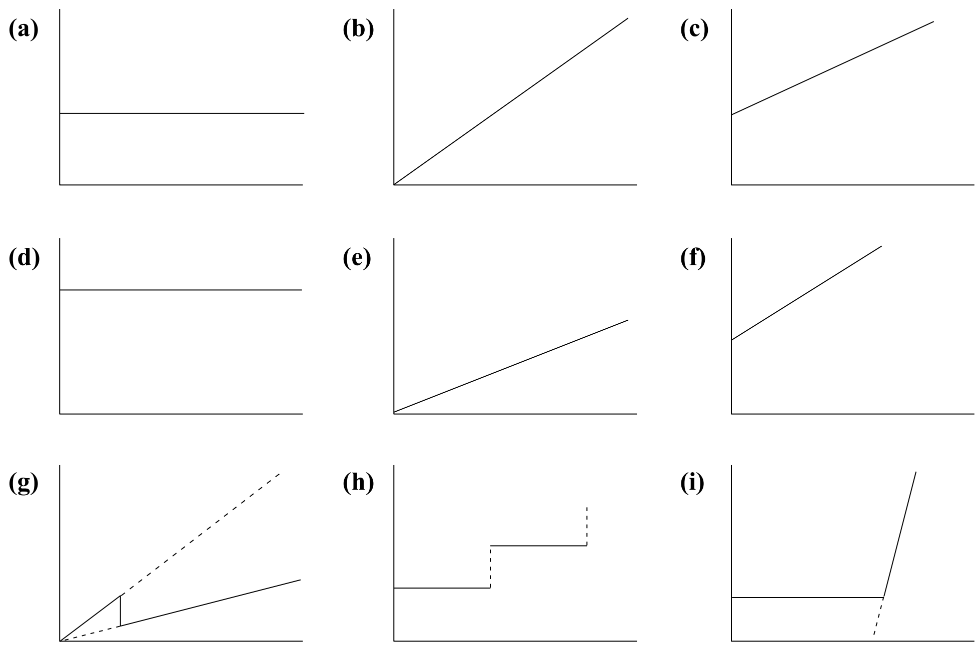
Chief accountant's salary. Accounting department costs are an administration cost, and the salary of the chief accountant is treated in full as an administration costs.

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.

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.

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



Solution

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 ₦(24,000 – 14,000)/5,000 units = ₦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	20,000
Total costs	40,000

Solutions

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.

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.

Construction company. Fuel costs are likely to be an indirect expense, for the same reasons that apply to a manufacturing company.

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).

Solutions

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 = ₦46,800/19,500 hours = ₦2.40.

Substitute in high equation	**Cost**
	₦
Total cost of 130,000 hours	662,000
Variable cost of 130,000 hours (×₦2.40)	312,000
Therefore fixed costs	350,000

	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 = ₦9,100/20 hours = ₦455.

Substitute in low equation	**Cost**
	₦
Total cost of 21 units	23,600
Variable cost of 21 units (≥₦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 (x ₦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 ₦27,700.

Solution

Working:

x	y	x^2	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
$= \sum x$	$= \sum y$	$= \sum x^2$	$= \sum xy$

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

$$b = \frac{5(5{,}464) - (84)(318)}{6(1{,}466) - (84^2)}$$

$$b = \frac{27{,}320 - 26{,}712}{7{,}330 - 7{,}056} = \frac{608}{274}$$

$$= 2.22$$

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

$$\mathrm{a} = \frac{318}{5} - \frac{2.22(84)}{5}$$

$$\mathrm{a} = 63.6 - 37.3 = 26.3$$

Line of best fit:

$$y = a + bx$$

$$y = 26.33 + 2.22x$$

15,000 units $\quad y = 26.33 + 2.22(15) = 59.63$

Solution

Working:

x	y	x^2	xy	y^2
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
$= \sum x$	$= \sum y$	$= \sum x^2$	$= \sum xy$	$= \sum y^2$

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

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

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

The correlation coefficient r is + 0.985.

5.13 End of chapter questions and suggested solutions

5.13.1 Questions

Question 1:

Maryland Manufacturing Company Limited makes a product called "Solo". As the Management Accountant of the company you are expected to solve the problem of identifying the manufacturing expenses that are fixed in nature and those that are directly variable with production, in order to prepare a flexible budget for the coming year.

The following details are provided for the first 10 months of the year:

Month	**No of units produced**	**Manufacturing expenses (₦)**
	x	**y**
1	1,000	1,300
2	1,500	3,000
3	2,500	1,850
4	2,000	1,750
5	2,500	1,800
6	2,000	1,700
7	3,000	1,900
8	2,500	1,650
9	2,000	1,550
10	1,500	1,000
	20,500	17,500

Required:

Determine the fixed and variable elements of the mixed manufacturing costs using:

a. The high and low method
b. The linear regression analysis
c. Explain correlation coefficient

5.13.2 Suggested solutions

Suggested solution 1

Maryland Manufacturing Company

Fixed and variable elements of the mixed manufacturing expenses using:

(a) The high and low method:

	No of units produced	Manufacturing expenses (₦)
High	3,000	1,900
Low	1,000	1,300
	2,000	600

Variable cost / unit (b) = 600/2,000 = ₦0.3 / unit

and fixed cost (a), using the low level of activity:

a = y - bx

a = 1,300 – 0.3 (1,000)

a = 1,300 – 300 = ₦1,000

(b) The linear regression analysis:

Month	x	y	xy	x^2
1	1,000	1,300	1,300,000	1,000,000
2	1,500	3,000	4,500,000	2,250,000
3	2,500	1,850	4,625,000	6,250,000
4	2,000	1,750	3,500,000	4,000,000
5	2,500	1,800	4,500,000	6,250,000
6	2,000	1,700	3,400,000	4,000,000
7	3,000	1,900	5,700,000	9,000,000
8	2,500	1,650	4,125,000	6,250,000
9	2,000	1,550	3,100,000	4,000,000
10	1,500	1,000	1,500,000	2,250,000
	20,500	17,500	36,250,000	45,250,000

$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x^2)}$ b = $\frac{(10 \times 36{,}250{,}000) - (20{,}500 \times 17{,}500)}{(10 \times 45{,}250{,}000) - (420{,}250{,}000)}$

b = $\frac{362{,}500{,}000 - 358{,}750{,}000}{452{,}500{,}000 - 420{,}250{,}000} = \frac{3{,}750{,}000}{32{,}250{,}000}$

b = ₦0.12 / unit

$a = \frac{\sum y}{n} - \frac{b\sum x}{n}$ a = $\frac{17{,}500}{10} - 0.12 \times \frac{20{,}500}{10}$

= 1,750 – (0.12 × 2,050)

= 1,750 – 246

= ₦1,504

(c) Correlation describes the extent to which the value of y is related to the value of x based on the pairs of data used to estimate the line of best fit.

The correlation coefficient ‘r’ measures the degree of correlation between y and x. The range of value it takes on, is between -1 and +1.

Perfect correlation means that all the pairs of data lie on a straight line.

CHAPTER 6

ACCOUNTING FOR INVENTORY

Contents

6 Accounting for Inventory

6.0 Learning objective

To enable readers, understand procedures and documents necessary for ordering, purchasing, receiving, storing, issuing, controlling and reporting inventory.

6.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain the need for procedures and documentation of materials;
b. explain procurement protocols and source documentation;
c. account for inventory transactions;
d. enter transactions and balances in a materials inventory account;
e. explain how to monitor physical inventory and comparison with the inventory records;
f. explain methods of valuing inventory;
g. explain and calculate economic order quantity (EOQ);
h. explain just - in - time system; and
i. explain other inventory control systems

6.2 Introduction

Inventory management is a very important aspect of any organisation's management decision making process and accountants play a vital role in ensuring that the management team gets accurate data as regards planning and control.

It is important to have clear procedures and proper documentation for managing materials. These procedures and records help ensure accuracy and accountability in inventory management. One key aspect involves monitoring the physical inventory by regularly comparing it with the recorded inventory data to identify any discrepancies. Additionally, maintaining accurate entries and balances in the materials inventory account is essential for effective tracking and financial reporting.

6.3 The need for procedures and documentation of materials

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

a. 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;
b. the receipt of materials from a supplier should also be documented, to make sure that the goods that were ordered have actually been delivered;
c. 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
d. 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:

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

6.4 Procurement protocols and source documentation

The detailed procedures for material acquisition and the corresponding documentation may exhibit variations contingent upon the operational scale and organisational structure of an entity. Nevertheless, the fundamental accounting control principles underlying material procurement are uniformly applicable across all business entities engaged in inventory purchases.

Procurement procedures and documentation

In a medium-to-large scale enterprise with distinct functional segregation namely, a procurement (buying) department and a stores (inventory management) department, the procurement cycle for materials typically adhere to the following sequence:

a. Initiation of procurement need

The stores department conducts routine inventory monitoring, often guided by minimum reorder levels and economic order quantity (EOQ) models. Upon identifying a requirement to replenish stock, a formal internal document, a purchase requisition, is generated. This document specifies the required material description, quantity, and inventory code. The purchasing requisition must be duly authorised by a manager with appropriate authority.

b. Selection of supplier and raising the purchase order

A procurement officer or buyer within the purchasing department evaluates approved suppliers, based on pre-established vendor selection criteria such as, cost-efficiency, quality, and reliability, and issues a purchase order (PO). The PO acts as a legally binding document indicating item specifications, quantities, agreed-upon pricing, delivery terms (Incoterms), and payment conditions. It also serves as a source document for subsequent three-way matching in the accounts payable process.

c. Inbound logistics and verification

Upon delivery, the supplier provides a delivery note, which itemises the materials supplied and serves as preliminary evidence of delivery. The delivery note accompanies the goods and is signed off upon receipt. One copy remains with the supplier as proof of delivery, while another is retained in the stores department.

d. Receiving documentation

The stores department then prepares a Goods Received Note (GRN), an internal document detailing the actual materials received, including inventory identification codes, quantities, and condition. This document is essential for reconciling received items against the PO and delivery note.

e. Document matching and invoice verification

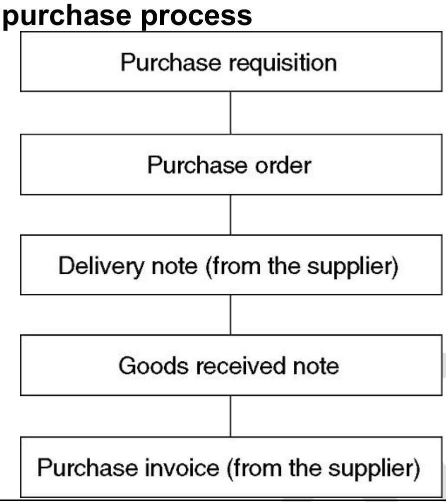
The accounts or finance department performs a matching among of the PO, GRN, and the supplier's invoice to verify:

i. accuracy of quantity received;
ii. conformity to purchase terms; and

iii. authorised pricing and payment terms.

Once verified, the invoice is approved for payment and becomes the basis for accounting entry in the purchase journal and subsequently, the general ledger.

Illustration: The purchase process



6.5 Accounting for inventory transactions

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. 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
b. 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:
a. the details of the quantity of materials issued;
b. the department (cost centre) that receives them; and
c. their cost (in a cost accounting system).
The inventory records are updated from the requisitions notes and returns notes to record all issues and returns of materials.

6.6 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;
a. Returns to suppliers: quantity and cost;
b. Issues of the item to user departments: quantity, cost and department identity;
c. Returns from user departments to the stores: quantity, cost and department identity; and
d. 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'.

These individual inventory accounts are integrated into a consolidated inventory control account within the cost ledger, which serves as the basis for managerial reporting, including the preparation of cost of goods manufactured statements, cost of sales calculations, and income determination for financial performance reporting. The inventory subsystem is usually embedded within the broader integrated or non-integrated cost accounting system, often maintained through a double-entry bookkeeping structure within the cost ledger, to ensure completeness, accuracy, and reconciliation with the financial ledger accounts.

6.7 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.

a. **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.

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

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

d. **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:

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

b. **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.

6.8 Valuation of inventory

6.8.1. Basic rule: Lower of cost or net realisable value (NRV)

Inventory valuation is a critical aspect of financial accounting due to its direct impact on the cost of sales, gross profit, and the valuation of current assets in the statement of financial position (balance sheet). According to generally accepted accounting principles (GAAP) and international standards (for example, IAS 2), inventories must be stated at the lower of historical cost or net realisable value (NRV).

Historical cost represents the acquisition cost incurred to bring the inventory to its present location and condition, which may include purchase price, import duties, transport, handling, and other directly attributable costs.

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		43,300

6.8.2 Inventory costing methods

To assign cost to inventory transactions, entities may adopt any of the following acceptable cost flow assumptions:

a. **First-In, First-Out (FIFO):** Assumes that the earliest purchased items are issued or sold first. Ending inventory comprises the most recent purchases.

b. **Weighted Average Cost (WAVCO):** Uses a moving or periodic average cost per unit, recalculated after each purchase or over a defined period.

c. **Last-In, First-Out (LIFO):** Assumes the most recent purchases are issued first. Ending inventory is valued using older costs. (Note: LIFO is prohibited under IFRS but still permitted under US GAAP.)

Illustration 1

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 purchase.

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)}.

6.8.3 First-In, First-Out (FIFO) Inventory Valuation Method

The First-In, First-Out (FIFO) and Weighted Average Cost (WAVCO) methods are commonly employed under perpetual inventory systems to continuously track and assign costs to inventory movements. These valuation techniques are also applicable within periodic inventory frameworks for determining the closing inventory balance at the end of an accounting period.

Under the FIFO method, it is presumed that inventory is consumed in the chronological order of acquisition. This approach assumes that the earliest acquired inventory layers are the first to be issued or sold, thereby assigning older cost layers to cost of goods sold (COGS) and valuing the ending inventory using the most recent acquisition costs.

To implement FIFO accurately, detailed inventory subsidiary records must be maintained, including:

a. the acquisition date of inventory receipts;
b. the quantity received and the unit cost (either purchase price or production cost);
c. the issue date of inventory and the quantity issued.

This detailed transactional data facilitates the application of FIFO in tracing the cost flow of inventory and accurately allocating historical costs to outgoing inventory, while valuing the remaining stock based on the cost of the most recently-acquired units of inventory.

Merits of the FIFO method

a. Reflects a logical inventory flow, often mirroring the physical movement of goods.
b. Conceptually straightforward and can be easily interpreted by operational and financial managers.
c. The resulting inventory valuation approximates current replacement cost, enhancing the relevance of reported figures in inflationary environments.

Limitations of the FIFO method

a. Operational complexity may arise in maintaining discrete cost layers, particularly in high-volume environments.
b. The variability in unit costs across issues can pose challenges for managerial analysis and comparative cost assessment.
c. During periods of rising prices (inflation), FIFO results in lower COGS and overstated profits, potentially leading to tax inefficiencies and reduced compatibility with current market valuations.

Using the same illustration in 2.2 above, inventory movement can be shown on a cost ledger card as follows.

	Receipts			Issues			Balance		
Date	**Qty**	**@**	**₦**	**Qty**	**@**	**₦**	**Qty**	**@**	**₦**
1Jan 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

6.8.4 Weighted Average Cost (WAVCO) Method

The Weighted Average Cost (WAVCO) method of inventory valuation operates on the premise that all inventory withdrawals (issues) are valued at the current weighted average unit cost. This cost is recalculated each time a new purchase is recorded, reflecting a perpetual inventory system. Under this moving average approach, the weighted average cost per unit is dynamically updated upon each inventory acquisition.

The recalculated average unit cost is derived as follows:

Weighted average unit cost =

$$\frac{\text{Total cost of existing inventory + Cost of newly acquired inventory}}{\text{Total Units in Inventory (Existing + New Receipts)}}$$

This method allocates the cost of goods available for sale over all units in stock, thereby normalising unit cost fluctuations caused by variations in purchasing prices.

Merits of the WAVCO Method:

a. Mitigates the effects of price volatility by distributing costs evenly over all units, resulting in smoother cost of goods sold (COGS) and ending inventory valuations.

b. Operationally more straightforward and less complex to apply than alternative flow assumptions such as First-In, First-Out (FIFO) or Last-In, First-Out (LIFO).

Demerits of the WAVCO Method:

a. The unit cost at which inventory is issued may not correspond to the actual historical purchase cost, potentially obscuring cost traceability.

b. During periods of gradual inflation, the computed average cost may lag behind prevailing market replacement costs, potentially understating the current economic value of inventory.

Example (Same as in 2.2 above)

Inventory ledger card (weighted average cost method)

	Receipts			Issues			Balance		
Date	**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		(200)	57.5	(11,500)
				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		(200)	66.43	(13,286)
				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		(200)	70.31	(14,062)
				14,062					
							500	70.31	35,152
12 Dec				200	70.31		(200)	70.31	(14,062)
				14,062					

Date	Receipts Qty	@	₦	Issues Qty	@	₦	Balance Qty	@	₦
	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

6.8.5 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.

Advantages of LIFO

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

Disadvantages of LIFO

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

Example (Using the same Illustration as in 6.8.2 above)

Inventory ledger card (LIFO method)

Date	Receipts Qty	@	₦	Issues Qty	@	₦	Balance 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)
	1,100		74,000	800		56,000	300	50/60/70	18,000

Inventory ledger card (LIFO method)

	Receipts		Issues		Balance
Note :	1,100	minus	800	equals	300
		74,000	minus	56,000	Equals 18,000

6.8.6 Comparative Analysis of Inventory Valuation Methodologies

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:

ation Method	t of Goods Issued	osing Inventory
	₦	₦
FIFO	51,100	23,000
WAVCO	52,900	21090
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.

6.9 Material purchase quantities: economic order quantity (EOQ)

6.9.1 Inventory-related Costs

In many enterprises, particularly within the manufacturing and retail sectors, substantial inventory holdings are maintained to ensure immediate fulfilment of customer demand. The absence of inventory at the point of demand referred to as a stockout event can result in lost sales opportunities and potential customer attrition, as customers may procure substitutes from competitors. Nevertheless, maintaining inventory levels imposes various carrying costs on the organisation.

The costs associated with inventory are:

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

Inventory holding costs include:

a. cost of capital tied up;
b. insurance costs;
c. cost of warehousing; and
d. obsolescence, deterioration and theft.

Shortage costs include:

a. lost profit on sale;
b. future loss of profit due to loss of customer goodwill; and
c. 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.

From a financial perspective, investment in inventory represents a capital allocation that entails explicit and implicit costs. Holding inventory necessitates financing, whether through internal funds or external borrowing, thereby incurring interest or opportunity costs that must be factored into inventory management decisions.

Illustration: 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 × 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
It is important to note that there is a trade-off between holding costs and ordering costs.

See illustration below

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.

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 later in the text.

6.9.2 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 $^{\text{order size}}/2$ 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 minimise total costs is the quantity at which ordering costs plus the costs of holding inventory are minimised.

The EOQ model formula

EOQ or economic order quantity is the order quantity or purchase quantity that minimises the total annual cost of ordering the item plus holding it in store. The formula for EOQ is as stated below:

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

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 $(^{Q}/_{2}) \times CH$.
The number of orders each year is $^{D}/_{Q}$. Total ordering costs each year are therefore $(^{D}/_{Q}) \times CO$.

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:

CO = Fixed cost per order = ₦ 6,500
CH = the cost of holding one item of inventory per annum = 10% □
300= ₦ 30
D = Annual demand = 120,000 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:

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

   Required:
   Ascertain 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.

Required:
Ascertain 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.

Required:
Ascertain the economic order quantity for material item XYZ (to the nearest unit).

6.9.3 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:

a. the economic order quantity; or
b. 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(		
$^{D}/Q \times CO = {}^{120,000}/7211.1 \times 6,500$	108,166	
$^{D}/Q \times CO = {}^{120,000}/10,000 \times 6,500$		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 minimizes total costs is10,000 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

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.

Required:
Ascertain the quantity that will minimise total costs.

6.10 Just-in-time (JIT) and alternative inventory management methods

6.10.1 JIT Production and JIT purchasing

The Just-in-Time (JIT) inventory management paradigm, pioneered in Japan during the 1970s, represents a paradigm shift from conventional inventory models such as the Economic Order Quantity (EOQ) and reorder point systems. The core tenet of JIT is the elimination of non-value-adding inventory holdings, as inventory is treated as a carrying cost that impairs working capital efficiency. The methodology predicates that any production of goods beyond immediate demand constitutes inventory obsolescence risk and capital tie-up without commensurate returns. Consequently, a JIT-oriented production system seeks to synchronise manufacturing output precisely with customer demand, effectively minimising finished goods inventory to negligible levels.

JIT procurement necessitates just-in-time acquisition of raw materials and components, thereby nullifying the need for inventory holding. This approach requires seamless coordination with suppliers to ensure inbound logistics align precisely with production schedules, mitigating stock holding costs and reducing the risk of material obsolescence or deterioration.

6.10.2 Fundamental assumptions underpinning JIT

a. **Demand stability**: JIT presupposes a stable and forecastable demand environment, enabling firms to calibrate production and procurement cycles with precision.
b. **Supplier reliability**: The system demands robust supplier performance, ensuring punctual delivery of materials in specified quantities to avoid production disruptions.
c. **Production flexibility and efficiency**: The production process must be highly adaptable and streamlined, capable of rapid response to fluctuations in demand without incurring downtime or process inefficiencies.
d. **Superior product quality**: Quality control is critical; the production process must maintain near-zero defect rates, as defective units jeopardise the smooth flow of operations inherent in JIT.

e. **Workforce competency and engagement**: Successful JIT implementation relies on a skilled, empowered workforce adept at continuous process improvement and problem resolution.
f. **Minimised lead times**: The strategy assumes truncated lead times across procurement and production to maintain uninterrupted product flow and minimize inventory buffers.
g. **Operational continuity**: JIT assumes minimal occurrences of production interruptions such as equipment failures or labour disputes, which could severely disrupt the just-in-time supply chain.
h. **Continuous improvement culture (Kaizen):** JIT thrives within organisations committed to perpetual refinement of operational processes to eradicate waste, boost efficiency, and enhance product quality.

6.10.3 Operational Implications of JIT Adoption

In a JIT environment, inventory availability is strictly demand-driven: finished goods must be available to fulfil customer orders instantaneously, and raw materials/components must be delivered precisely when required for production. The following operational imperatives arise:

a. **Expedited production cycles**: The absence of finished goods inventory necessitates rapid throughput times to meet dynamic customer demands without delay.
b. **Production process reliability**: Manufacturing must operate without bottlenecks, downtime, or quality defects. Any scrap or rework directly contradicts JIT's waste minimisation principles and erodes operational efficiency.
c. **Supplier performance:** Supplier deliveries must betimely, and materials must meet stringent quality standards to prevent disruptions and reject rates within production. Reliable supplier logistics are foundational to sustaining the JIT system's integrity.

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:

a. reduce or eliminate inventories and WIP;
b. reduce order sizes, since output is produced to meet specific demand and raw material deliveries should be timed to coincide with production requirements; and
c. 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.

6.10.4 Demand forecasting process for Just-In-Time (JIT)

Demand forecasting involves predicting future customer demand to align production and inventory management. In a JIT system, where the goal is to maintain minimal inventory levels while meeting demand promptly, accurate forecasting is critical. Unlike traditional forecasting, JIT requires a more responsive and precise approach to adapt to rapid market changes and prevent disruptions.

Key objectives of demand forecasting in JIT

a. **Reduced waste**: By predicting demand accurately, companies can avoid overstocking and reduce material wastage.
b. **Improved cash flow**: Holding minimal inventory frees up capital for other operations.
c. **Enhanced customer satisfaction**: Timely delivery of goods ensures customer loyalty and trust.
d. **Operational efficiency**: Forecasting ensures smooth production schedules and supply chain operations.

The demand forecasting process for JIT

a. **Data Collection**: The process begins with gathering relevant data, which serves as the foundation for accurate forecasting. Key data sources include:
   i. **historical sales data**: Past sales trends help identify recurring patterns and seasonal fluctuations.
   ii. **market trends**: Analyzing industry trends and consumer behavior provides insights into potential demand shifts.
   iii. **customer orders**: Real-time customer orders can signal immediate demand changes.
   iv. **suppliers lead times**: Understanding supplier timelines ensures that inventory aligns with production needs.

b. **Demand Analysis**: After data collection, the next step is analysing the data to extract meaningful patterns and insights. This involves:
   i. **trend analysis:** Identifying long-term growth or decline in demand.
   ii. **seasonality**: Recognising periods of high or low demand based on seasonal factors.
   iii. **demand variability**: Assessing how demand fluctuates over time to account for unpredictability.

c. Forecasting Techniques: Various forecasting methods are used to predict demand under JIT:
   i. **qualitative methods**: Expert opinions, market research, and customer feedback are valuable in scenarios with limited historical data.
   ii. **quantitative methods**: Statistical models such as time series analysis, moving averages, and regression models provide data-driven forecasts.
   iii. **machine learning models**: Advanced algorithms analyze large datasets to detect complex patterns and improve forecast accuracy.

d. **Collaborative Forecasting**: Collaboration with stakeholders is crucial for refining forecasts. Involvement of sales teams, production managers, and suppliers ensures that all perspectives are considered:
   i. **sales teams**: Provide insights into customer preferences and upcoming orders.
   ii. **production managers**: Align forecasts with production capacities and schedules.
   iii. **suppliers**: Collaborate on lead times to ensure raw materials are available when needed.

e. Continuous monitoring and adjustment: Demand forecasting in JIT is not a one-time activity but an ongoing process. Companies must continuously monitor forecasts and adjust account for:
   i. **demand variability**: Sudden changes in customer behaviour or market conditions.

ii. **supply chain disruptions**: Delays from suppliers or logistical challenges.
iii. **economic factors**: Broader economic conditions that impact purchasing power.
iv. real-time data and advanced analytics tools play a key role in enabling swift adjustments.

Challenges in demand forecasting for JIT

a. **Data accuracy and availability**: Reliable forecasting relies on accurate data. Incomplete or outdated data can lead to errors that disrupt the JIT system.
b. **Market volatility**: Economic fluctuations, consumer preferences, and competitive pressures add complexity to demand forecasting.
c. **Supplier dependencies**: JIT systems are highly dependent on suppliers. Delays or inconsistencies in supply can disrupt production and lead to unmet demand.
d. **Technological barriers**: Implementing advanced forecasting tools, such as machine learning algorithms, requires investment in technology and skilled personnel.

Best practices for effective demand forecasting in JIT

a. **Invest in technology**: Adopting advanced analytics and machine learning tools enhances forecasting accuracy and responsiveness.
b. **Enhance collaboration**: Building strong relationships with suppliers, sales teams, and production managers fosters a more integrated approach to forecasting.
c. **Adopt a hybrid forecasting approach**: Combining quantitative models with qualitative insights balances precision with contextual understanding.
d. **Focus on flexibility**: Being prepared to adapt to sudden demand changes ensures a resilient JIT system.

6.11 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 weeks + 2 weeks) = 5 weeks × 400 units = 2,000 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.

6.12 Chapter Review

Before moving on to the next chapter, check that you can:

a. explain the need for procedures and documentation of materials;
b. explain procurement protocols and source documentation;
c. account for inventory transactions;
d. enter transactions and balances in a materials inventory account;
e. explain how to monitor physical inventory and comparison with the inventory records;
f. explain methods of valuing inventory;
g. explain and calculate economic order quantity (EOQ);
h. explain just – in – time system; and
i. explain other inventory control systems

Solutions to practice questions

Solutions

Economic order quantity

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

Economic order quantity

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

Annual holding cost

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

Economic order quantity

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

Solutions

EOQ

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

Where:

CO = 605

D = 120,000

CH = 10% × 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 ($D/Q \times C_O$)			
(120,000/22,000) × ₦605	3,300		
(120,000/25,000) × ₦605		2,904	
(120,000/40,000) × ₦605			1,815
Holding costs ($Q/2 \times C_H$)			
(22,000/2) × ₦0.3	3,300		
(25,000/2) × ₦0.29		3,625	
,000/2) × ₦0.28			5,600
al costs	366,600	354,529	343,415

Conclusion

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

CHAPTER

7

ACCOUNTING FOR LABOUR

Contents

7 Accounting for Labour

7.0 Learning objective

To help readers to understand the accounting treatment of labour costs.

7.1 Learning outcomes

After studying this chapter, readers should be able to:

a. identify whether production labour cost should be classified as direct or indirect;
b. explain idle time and overtime premium;
c. explain different remuneration schemes including time-based systems and piecework systems and incentive schemes;
d. calculate labour costs arising from a variety of remuneration schemes;
e. account for payroll costs; and
f. calculate and comment on labour turnover.

7.2 Introduction

Labour is the second element of cost, and management is required to establish remuneration policy that will help the organisation control its labour cost. Therefore, to ensure that labour cost is controlled effectively, management must decide on appropriate remuneration method and incentive schemes for the organisation.

This chapter will look at the various remuneration methods, incentive schemes and policies and procedures, and documents required for recording labour cost accurately. The chapter will also discuss labour turnover and its effect on the cost of labour.

7.3 Labour costs

Labour cost consists of the following:

a. **Employees' basic wages and salaries**: This is the fixed amount paid to employees for their normal working hours. It includes time-based pay (hourly, daily, weekly, etc.) or monthly wages.
b. **Overtime**: Additional compensation for hours worked beyond the normal working hours. Often paid at a higher rate than regular pay (e.g., time-and-a-half or double time).
c. **Bonuses and Incentives**: These are performance-related payments made to motivate employees. These may include production bonuses, attendance bonuses, or profit-sharing schemes.
d. **Employer's contributions to pension fund**: These are payments made by the employer towards statutory contributory pension schemes and social security (e.g. Health insurance, provident funds, National Housing fund, etc.
e. **Fringe Benefits**: These include non-monetary benefits given to employees, often included as part of the cost of labour, such as free meals, transportation, accommodation, company car, mobile phone, paid holidays and sick leave.
f. **Training and development costs**: These are expenses incurred in improving the skills of employees, which include the cost of workshops, seminars, and on-the-job training.
g. **Employee welfare expenses**: These are costs related to ensuring the well-being and safety of workers, such as medical expenses, safety equipment, recreational facilities, etc.

7.3.1 Direct and indirect labour costs

In cost accounting there is distinction between direct labour employees and indirect labour employees. Direct labour costs refer to the wages and related expenses incurred for personnel whose efforts are directly attributable to the transformation of raw materials into finished goods or the provision of core services. These costs are traceable to specific cost units or jobs within the production or service delivery process.

Conversely, indirect labour costs pertain to compensation for employees whose roles support the production processes or administrative functions that are not directly engaged in the manufacturing or service execution. Such costs cannot be directly assigned to individual products or services, and they are, therefore, treated as overheads.

While these definitions generally apply, exceptions arise in practice. For instance, in cases of idle time or overtime premium, a portion of the labour costs associated with direct labour personnel may be reclassified and treated as indirect costs.

Idle time

Idle time is time when employees are paid and are available to work but are not doing any active work. due to various operational disruptions. This non-productive time constitutes a form of labour inefficiency and is typically classified under indirect labour costs, as it does not directly contribute to specific units of production.

Common causes of idle time include:

a. **Equipment downtime**: When plant machinery or production equipment fails or malfunctions, employees may be unable to proceed with their assigned tasks until repairs are completed.
b. **Material shortages**: Delays in the procurement or delivery of raw materials or components necessary for production can render labour idle.
c. **Ineffective production scheduling**: Poor coordination of production activities, bottlenecks, or miscommunication can result in gaps in workflow, leaving workers underutilised.
d. **Utility interruptions**: Disruptions such as power outages, internet failures, or water supply interruptions can cause temporary halts in operations.
e. **Operational delays**: Employees may be required to pause operations while awaiting managerial instructions, supervisory approvals, or decisions regarding next steps.

While idle time generally leads to adverse financial implications such as reduced labour efficiency, increased cost per unit, lower contribution margins, and potential employee disengagement, it may occasionally yield non-financial benefits. For example, it can serve as recovery time, reducing employee fatigue, or as an opportunity to conduct training, machinery servicing, or preventive maintenance.

From a cost accounting perspective, idle time is not traced to specific cost objects (e.g., jobs or units)and thus is categorised as an indirect labour cost. However, in order to allocate such costs accurately, idle time must be properly tracked and documented. This is commonly achieved through labour time records or time sheets, which form part of the internal control system over labour utilisation.

Overtime premium

Overtime arises when employees render services beyond their standard contractual working hours. Compensation for overtime includes an overtime premium, which is the incremental rate paid over and above the basic wage rate. The total hourly remuneration for overtime work is therefore calculated as:

Total Overtime Rate = Basic Hourly Rate + Overtime Premium

In managerial accounting, the treatment of overtime premiums varies based on the nature and origin of the overtime incurred. Generally, when overtime is worked due to routine workload variations or unanticipated production demands, the overtime premium is treated as an indirect labour cost, since attributing it directly to a specific job would distort product costing and violate the principle of cost fairness.

However, in instances where overtime is explicitly incurred for the fulfilment of a specific customer order—for example, to meet an urgent delivery deadline—the overtime cost, including the premium, may be directly assigned to the relevant job or cost unit. In such cases, it is appropriate to classify it under direct labour cost, provided the additional cost is clearly traceable and justified by the job requisition. Proper accounting treatment and classification of overtime premiums are essential for accurate cost allocation, variance analysis, and for ensuring reliable cost control measures within the organisation.

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 × 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

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	

Classified as:	Labour cost of direct labour employees	indirect labour employees
Indirect labour costs	Other overtime premium Cost of all hours recorded as 'idle time' Cost of other hours spent away from direct production work (e.g. time spent on training courses).	All labour costs of indirect labour employees

7.4 Recording labour costs

The accounting treatment of labour costs is a fundamental element in cost and management accounting, ensuring the precise attribution of labour expenditure to relevant cost objects, such as departments, cost centres, jobs, or products. There are various ways in which labour time might be recorded, but the main methods are:: Payroll records; and Timesheets.

a. Payroll records can be used to:
   i. identify employees as direct labour or indirect labour employees; and
   ii. charge the labour costs of each employee to the department (cost centre) where he or she is employed.

b. 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).

7.4.1 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.

a. 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.

b. The second records the payment of the various balances to the respective creditors

Illustration

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
	(1,191,228)
Net pay	3,433,772

This is accounted for using two journals as follows:

Journal1:To recognize 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

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

7.5 Remuneration methods

7.5.1 Introduction

Remuneration methodologies represent the structured frameworks through which organizations disburse financial compensation to their workforce in exchange for labour services rendered. From an accounting and cost control standpoint, it is imperative to accurately classify, quantify, and allocate these costs to ensure precise labour costing within managerial and financial accounting systems.

The choice of remuneration method, whether through fixed wages, variable piece rates, commissions, or hybrid incentive mechanisms, bears significant implications on payroll accounting, cost attribution, budget forecasting, and internal control measures. Selecting the optimal compensation model enhances operational efficiency, facilitates strategic cost management, and aligns workforce motivation with organisational objectives.

7.5.2 Calculating the cost of labour

Labour cost represents a component of prime or conversion costs in cost accounting, encapsulating the total economic outflow associated with remunerating employees for time and effort invested in productive tasks. This cost element must be systematically assigned to cost centres or cost units using a rational and consistent basis, typically through time tracking or output measurement. In standard costing systems, salaries and wages paid to employees are distributed across production departments or activities proportionally, based on the actual or estimated labour hours devoted to each task. For instance, if an employee allocates equal working time between two production processes, the payroll cost is apportioned on a 50:50 basis to the respective cost centres.

For employees remunerated on a time-rate basis (e.g., hourly wage earners), labour cost is computed by aggregating total hours worked multiplied by the prevailing hourly wage rate. Conversely, employees compensated on a piece-rate basis have their costs tied directly to units of output produced, necessitating precise tracking for unit cost allocation under job or batch costing systems.

7.5.3 Time-based systems

Under a time-rate system, compensation is determined by the formula:

Basic remuneration = Hours worked × Hourly pay rate

This approach necessitates detailed timekeeping and labour tracking to allocate labour charges to specific jobs, processes, or production orders. Accurate allocation is vital in job costing, process costing, or activity-based costing environments. While overtime premium typically fall under indirect labour costs being not attributable to a single cost unit.However, the overtime premium may be treated as a direct labour cost if incurred specifically to expedite delivery or meet a specific customer's order.

Advantages of time-based remuneration systems

a. **Budgetary predictability:** Labour costs become more foreseeable, facilitating more accurate cash flow forecasting and budget preparation, especially under stable work schedules.
b. **Emphasis on quality control:** By decoupling compensation from output volume, employees can focus on meticulous execution and adherence to quality standards, which is especially critical in process-intensive industries.

c. **Equitable compensation structure:** Ensures that employees are remunerated equitably for actual time rendered, thereby supporting labour legislation compliance and minimising potential ethical concerns surrounding underpayment.

d. **Administrative simplicity:** The payroll processing is relatively straightforward, reducing the risk of payroll errors and minimizing administrative overhead associated with performance-based calculations.

e. **Earnings stability:** Time-based pay structures offer employees income regularity, improving financial planning and contributing to workforce retention and job satisfaction.

Limitations of time-based remuneration systems

Although time-based remuneration systems provide consistency and perceived equity in compensation structures, they exhibit several operational and financial drawbacks, when assessed from a managerial accounting and labour cost optimisation perspective. These include:

a. Absence of performance-based incentives

Under a time-based wage framework, employees receive compensation based solely on time rendered, irrespective of output or productivity levels. This misalignment between effort and reward may result in suboptimal utilisation of human capital and reduced marginal labour productivity.

b. Idle time and underutilisation of capacity

The time-based system may lead to non-productive periods (idle time), which increase labour costs without a corresponding increase in output. This inefficiency results in a negative variance in labour efficiency when assessed through standard costing techniques.

c. Elevated labour overheads

Since compensation is time-bound and not tied to production volumes, total direct labour costs remain fixed regardless of operational throughput. This can result in higher unit labour costs and adverse cost-volume-profit (CVP) relationships, particularly in labour-intensive operations.

d. Restricted managerial flexibility

Employers may encounter rigidity in workforce deployment, as time-bound contracts often lack scalability in response to fluctuating demand levels. This inflexibility can inhibit lean staffing strategies and just-in-time (JIT) labour utilisation.

e. Risk of diminished employee motivation

A guaranteed wage structure, independent of output, may foster a complacent work culture, reducing employee motivation to exceed baseline performance expectations. From a behavioural accounting perspective, this undermines intrinsic and extrinsic motivation levers.

7.5.4 Piecework remuneration system

Under the piecework wage method, employee compensation is directly linked to quantifiable units of output produced. The earnings formula is expressed as:

Basic earnings = Output quantities × Piece rate

Example: Piecework

A worker in a textile company sews buttons on shirts. She is paid ₦20 for each shirt that she completes. For one week, she completes 800 shirts.

Her pay for the week, and the labour cost of sewing buttons on the 800 shirts, is:

800 × ₦20 = ₦16,000.

Merits of the piecework system

a. Enhanced output efficiency

This method drives higher labour productivity as remuneration is directly correlated with output volume. It establishes a strong performance-reward linkage, conducive to continuous improvement and favourable labour efficiency variances.

b. Transparent compensation mechanism

The deterministic nature of earnings allows for predictable income assessment Employees can perform cost-benefit analyses of their time investment and effort, enhancing job ownership and accountability.

c. Improved cost controllability

For employers, labour becomes a variable cost component, simplifying budget forecasting and aligning wage expenditure with production volume. This system reduces fixed labour overheads and supports contribution margin maximisation.

Demerits of the Piecework System

a. Quality dilution risk

A singular focus on output quantity may erode product quality, as employees could prioritise volume over compliance with quality control specifications. This introduces a risk of adverse quality variances and potential warranty liabilities.

b. Increased physical and mental strain

Sustained pressure to maximise output may lead to fatigue, absenteeism, and potential health-related productivity losses. From a human resource accounting perspective, this may increase indirect labour costs due to turnover or medical leave.

c. Disparities in income distribution

Earnings variability can result in significant intra-firm income inequality. Differences in skill levels, speed, or physical ability may skew compensation and affect team cohesion and morale.

d. Earnings volatility

Income under piecework systems is susceptible to fluctuations in production schedules, market demand, and material availability. This variability may introduce financial instability for employees, reducing job satisfaction and increasing labour unrest risk.

Differential piecework systems

The differential piecework system is designed to motivate employees to increase their output by offering higher rates of pay per unit as they produce more. Under this system, workers earn a standard rate for a set number of units produced, but if they exceed a certain production threshold, they are rewarded with a higher rate for the additional units. This structure encourages employees to work more efficiently and produce higher quantities, while also providing the incentive to maintain high levels of productivity.

It is common for employers to incorporate a guaranteed minimum wage in piecework schemes to protect employees from fluctuations in production because of circumstances outside of their control. This guaranteed minimum ensures that workers' earnings do not significantly drop when external factors, such as equipment failure or raw materials shortages , affect production. By guaranteeing a baseline income, employers help stabilise workers’ financial security, even during periods when the production pace is slower than usual. This creates a fair balance between incentivising productivity and providing a safety net for workers.

Example

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 ₦
	100	150	15,000
101 –200	100	175	17,500
201 –300	20	200	4,000
	220		36,500

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.

7.5.5 Incentive schemes

Incentive compensation structures are strategically implemented to enhance labour productivity through performance-linked remuneration. These schemes typically involve the disbursement of variable compensation such as productivity-based bonuses when employees attain predefined output benchmarks within a specified accounting period. The principal rationale for instituting incentive schemes is to drive operational efficiency by:

a. increasing production output without corresponding increases in the number of workers. This results in an improved output-to-labour ratio, thereby elevating labour efficiency metrics and lowering per-unit labour cost; and
b. compressing production cycle times for a fixed output volume. This enhances time efficiency, effectively reducing the direct labour hours per cost unit and yielding gains in throughput without compromising output quality.

Through the provision of performance-related financial incentives, entities aim to align employee interests with organisational efficiency targets. These incentive payments are contingent upon measurable improvements in operational productivity and are intended to cultivate a performance-driven culture. Such schemes often foster a quasi-ownership mindset among employees, encouraging active participation in the organisation's value-creation process.

Incentive plans may be:

a. **Individual-based incentive schemes:** These allocate remuneration on a per-employee basis, based on their personal contribution to output or adherence to quality metrics. In cost accounting, where traceability to a specific cost unit exists, such bonuses are recognised as direct labour costs, forming part of the prime cost of production, otherwise, it will be treated as indirect labour cost; and

b. **Group-based incentive schemes:** These allocate rewards collectively to teams or departments based on collective performance. Such arrangements promote interdependent workflows and foster collaborative efficiency. From a cost classification perspective, where the incentive cannot be allocated to a distinct cost unit or is based on general performance over time, it is accounted for as an indirect labour cost and absorbed into production overheads. But if the cost of a bonus payment can be traced directly to a cost unit it should be treated as a direct labour cost.

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.

7.6 Labour turnover

7.6.1 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.

Labour turnover encompasses both voluntary separations such as resignations, retirements, or transitions to superior employment opportunities and involuntary separations, which may include dismissals due to redundancy (retrenchment), performance-based terminations, medical incapacity, or mortality. A high labour turnover ratio may reflect underlying inefficiencies or negative internal dynamics such as suboptimal compensation structures, lack of employee engagement, or poor managerial practices. Conversely, a low turnover rate often indicates a well-retained and engaged workforce, contributing positively to continuity, institutional knowledge retention, and overall organisational productivity.

7.6.2 Causes of labour turnover

Voluntary reasons include:
a. resignation for career advancement; and
b. retirement due to age or personal choice.

Involuntary reasons include:
a. workforce downsizing (retrenchment); and
b. termination for underperformance

7.6.3 Measurement of labour turnover

Primary formula (Average-based approach):

Labour turnover rate (%) = $^{\text{Number of Employees leaving}} /_{\text{Average number of employees}} \times 100$

Employees leaving: Total headcount of employees who have exited during the reporting period.

Average number of employees: = $(^{\text{Opening employee headcount}} + {}_{\text{Closing employee headcount}}) / 2$

This method provides a normalised turnover ratio, smoothing out fluctuations in workforce size across the accounting period.

Alternative formula (Total workforce-based):

Labour turnover rate (%) = $(^{\text{Number of Employees leaving}}/_{\text{Total number of employees employed during the period}}) \times 100$

This variant considers the total cumulative headcount, which may include all individuals employed at any point during the period, offering a broader perspective in a dynamic hiring environments.

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. Average number of employees=(2,800+2,830)/2=2,815 Labour turnover rate = (420/2,815) x 100% = 14.9%.

7.6.4 Implications of high or low labour turnover

a. High labour turnover

An elevated labour turnover ratio represents a significant operational inefficiency and can result in increased labour costs. These costs include heightened expenditures related to recruitment (advertising vacancies, selection processes), induction, and training. A persistently high attrition rate may also impair organisational continuity, reduce overall labour productivity, and adversely affect workforce morale. From a cost accounting perspective, it may lead to volatility in direct and indirect labour costs and signal underlying structural inefficiencies such as suboptimal working conditions, inadequate employee value propositions (EVP), or non-competitive remuneration structures.

b. **Low labour turnover**

Conversely, a diminished turnover rate typically suggests high employee retention, indicating that the entity's employment practices are effective in maintaining workforce stability. This often correlates with enhanced employee morale, institutional knowledge retention, and lower human resource acquisition costs.

7.6.5 Managing labour turnover

To optimise labour turnover and mitigate its adverse financial and operational impacts, organisations should adopt a proactive labour management strategy. Measures may include:

a. enhancing employee engagement through participatory decision-making and continuous feedback mechanisms;
b. structuring competitive compensation and benefits packages aligned with market benchmarks and job evaluation;
c. creating transparent career progression pathways and investing in skill development initiative;
d. cultivating an inclusive corporate culture that supports psychological safety and employee well-being; and
e. Implementing structured exit interview protocols to extract actionable insights and identify systemic issues contributing to separations.

7.7 Chapter review

Chapter review

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

a. identify whether production labour cost should be classified as direct or indirect;
b. explain idle time and overtime premium;
c. explain different remuneration schemes including time-based systems, piecework
d. systems and incentive schemes;
e. calculate labour costs arising from a variety of remuneration schemes;
f. account for payroll costs; and
g. calculate and comment on labour turnover.

CHAPTER 8

ACCOUNTING FOR OVERHEADS

Contents

8 Accounting for Overheads

8.0 Learning objective

This chapter explains overheads in more detail and shows how manufacturing overheads can be included in production costs.

8.1 Learning outcomes

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

a. explain the meaning of overheads;
b. identify manufacturing and non-manufacturing overheads;
c. explain allocation and apportionment and apply the techniques to identify the total overhead costs associated with different departments (including techniques of secondary apportionment);
d. explain absorption;
e. calculate departmental overhead absorption rates from data supplied;
f. calculate the overhead costs absorbed by applying overhead absorption rate in an appropriate manner; and
g. calculate and account for over and under absorption of overhead.

8.2 Manufacturing overheads

8.2.1 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.)

	Part of inventory value?	Examples
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.

8.2.2 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.

The following are types of overhead and their classification:

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

8.4 Introduction to absorption costing

8.4.1 Introduction

Manufacturing companies are concerned about 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	78
Fixed production overhead	24
Total absorption cost	102

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, in the example above).

8.4.2 Absorption costing

Absorption costing measures cost of a product or a service as:

a. its direct costs (direct materials, direct labour and sometimes direct expenses and
b. variable production overheads); plus
c. 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. a full production cost; or
b. 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.

8.4.3 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:

a. the methods used to charge fixed production overhead costs to products often rely on fairly arbitrary assumptions; and
b. 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.

8.5 Stages in absorption costing

8.5.1 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:

Fixed production overheads/Number of units

= ₦1,000,000/20,000 of units = ₦50 per unit

Fixed production overheads/Number of hours

= ₦1,000,000/40,000 hours = ₦25 per hour

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, as follows, in order to arrive at meaningful rates:

a. identify the fixed production overheads;
b. 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
c. 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.

8.5.2 Cost centres

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 ($^{₦36,000}/_{4 \times 150}$).

In a system of absorption costing, each item of overhead cost is charged either:

a. to a cost centre; or
b. as a general expense.

The cost centres might be:

a. a cost centre in the production function (production overhead);
b. a cost centre in administration (administration overhead); and
c. a cost centre in sales and distribution (sales and distribution overhead).

The cost centres in the production function might be:

a. a department engaged directly in production work (a production department); or
b. 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.

8.5.3 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. These are

a. 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.

b. 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)

8.5.4 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:

a. production departments or production centres: these are cost centres that are directly engaged in manufacturing the products; or

b. 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'.

8.6 Overhead apportionment

8.6.1 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:

a. sharing (or dividing) general costs between production centres and service centres; and
b. 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:

a. costs allocated directly to the production centre; plus
b. shared costs apportioned to the production centre; plus
c. a share of the costs of each service department, apportioned to the production centre.

8.6.2 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				
	60,000				

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:

Explain how overheads can be allocated and apportioned between the four cost centres.

Suggested solution

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	₦14,400/1,800=	₦8 per square metre
Power costs	Kilowatt hours	₦4,800/800=	₦6 per kilowatt hour
Depreciation	Cost of plant & equipment	₦14,000/₦70,000=	20% of cost
Building insurance	Floor area	₦1,800/1,800=	₦1 per square metre
Equipment insurance	Cost of plant and equipment	₦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	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	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
	60,000	25,000	20,000	7,000	8,000

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		25,000

Note:

The same process is followed to arrive at the total overheads for the other departments.

8.7 Apportionment of service department costs

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).

8.7.1 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 not 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 not 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)
		325,000	345,000	nil	nil

8.7.2 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 not 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
Apportion canteen	(10:20:20)	30,000	60,000	(150,000)	60,000
					280,000
Apportion repairs	(75:25)	210,000	70,000	-	(280,000)
		340,000	330,000	nil	nil

Practice question

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

8.7.3 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. These are:

a. repeated distribution method; and
b. 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, that is, 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, that is 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 are 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)
	60,000	33,713	26,287	0	0

Comment

The total overhead costs of ₦60,000 have been apportioned.
(₦33,713 + ₦26,287 = ₦60,000).

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 = Original overheads of Repairs department + 20% of Quality Control costs.

Y = Original overheads of Quality Control department + 30% 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:

$$\begin{array}{rcrcrl} X & - & 0.2Y & = & 7{,}000 & \ldots\ldots\ldots(1) \\ -0.3X & + & Y & = & 8{,}000 & \ldots\ldots\ldots(2) \end{array}$$

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.

$$\begin{array}{rcrcrl} 5X & - & Y & = & 35{,}000 & \ldots\ldots\ldots(1) \times 5 = (3) \\ -0.3X & + & Y & = & 8{,}000 & \ldots\ldots\ldots(2) \\ \hline 4.7X & & & = & 43{,}000 & \ldots\ldots\ldots(2) + (3) \\ \hline \\ X & & & = & 9{,}149 & (= 43{,}000/4.7) \end{array}$$

Now substitute this value for X in equation (2)

$$\begin{array}{rrcr} -0.3X & Y & = & 8{,}000 \\ & Y & = & 8{,}000 + 0.3\,(9{,}149) \\ & Y & = & 10{,}745 \end{array}$$

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)	3,224	5,372
Final apportionment	33,713	26,287

This is the same as with the repeated distribution method.

Practice question

Nitrate Limited (NL), producing industrial chemicals, has three production and two service departments.

The annual overheads are as follows:

	Naira in'000
Production departments:	
A	56,000
B	50,000
C	38,000
Service departments:	
	16,500
	10,600
	171,100

e service departments' costs are apportioned as follows:

	'roduction departments			Service departments	
	A	B	C	X	Y
vice department X	20%	40%	30%	-	10%
vice department Y	40%	20%	20%	20%	

portion costs of service departments using the simultaneous equation method

8.8 Overhead absorption

8.8.1 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 *machine-intensive* 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	1,500

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

erheads absorbed by each product:	₦
duct A: (300 hours × ₦16)	4,800
duct B: (800 hours × ₦16)	12,800
duct C: (400 hours × ₦16)	6,400
al	24,000

	Product A	Product B	Product C
	₦	₦	₦
ne cost per unit	3.00	4.00	5.00
erhead at ₦16/direct labour hour	1.60	3.20	6.40
l production cost/unit	4.60	7.20	11.40

The choice of the basis for absorbing overheads can have a significant effect on the overheads charged to each product or cost unit.

8.8.2 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

Calculate the total production overhead cost/unit for Product X and Product Y using:

a. separate departmental overhead rates for departments P1 and P2
b. a single absorption rate for the entire factory.

Suggested solution

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)	14,000	(4,000 × 1.5)	6,000
		15,000		10,000
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)	18	13.50
Total production overhead cost/unit	20	27.50

Single departmental rate

$$\frac{(₦60{,}000 + ₦90{,}000)}{(15{,}000 + 10{,}000)\text{hours}} = ₦6 \text{ per direct labour hour}$$

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.

8.8.3 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.

Suggested solution

Budgeted administration overheads = ₦120,000
Budgeted production costs (₦200,000 + ₦100,000) = ₦300,000.
Absorption rate for administration overheads = (120,000/300,000) × 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	800,000
Budgeted sales and distribution costs	200,000

Absorption rate for sales and distribution overheads
= (200,000/800,000) × 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)	125,000		75,000	
Full cost of sale		405,000		215,000
Profit		95,000		85,000

8.9 Under-absorbed and over-absorbed overheads

8.9.1 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 management 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.

8.9.2 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:

a. budgeted (planned) overhead expenditure; and
b. 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.

8.9.3 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)	×	edetermined 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. That is, 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:

(**a**) Calculate the production overhead absorption rate.
(**b**) Calculate the over or under absorption of fixed overhead.
(**c**) Calculate the full production cost.
(**d**) Show how the profit or loss for the year will be reported.

Suggested solution

a The predetermined absorption rate is $^{₦150,000}/_{50,000 \text{ hours}}$ = ₦3 per direct labour hour.

Under absorption	₦
Overhead absorbed (40,000 hours @ ₦3 per hour)	120,000
Overhead incurred (actual cost)	(140,000)
Under absorption	(20,000)

The full production cost:	₦
Direct materials costs	130,000
Direct labour costs	160,000
Production overhead absorbed (40,000 hours ×₦3)	120,000
Full production cost (= cost of sales in this example)	410,000

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.

	₦	₦
Sales		630,000
Full production cost of sales		410,000
Under-absorbed overhead		20,000
		(430,000)
		200,000
Administration overhead	70,000	
Selling and distribution overhead	90,000	
		(160,000)
Profit for Year 6		40,000

8.9.4 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:

a. an overhead expenditure variance; and
b. 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	(E – A)	(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:
a. excessive spending on overhead items or
b. 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)	(E – A)	(favourable or adverse)
× Absorption rate per unit or hour (₦)	X	
Volume variance (in ₦)	X(E – A)	

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.

Suggested solution

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)	840,000
(Overheads included in product costs)	
Actual overhead expenditure	805,000
Over-absorbed overheads	35,000

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	805,000	
Expenditure variance	5,000	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)	105,000	
Volume variance (direct labour hours)	5,000	Favourable
Absorption rate/direct labour hour	₦8	
Volume variance in ₦	₦40,000	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	40,000	Favourable
Total over-absorbed overhead	35,000	Favourable

8.10 Fixed and variable overheads

8.10.1 Definitions 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.

8.10.2 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)	300,000
Total budgeted overhead expenditure	2,700,000

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	3
Total absorption rate per direct labour hour	27

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)	360,000
Total budgeted overhead expenditure	2,760,000

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	3
Total absorption rate/direct labour hour	23

8.10.3 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.

Suggested solution

Absorbed overheads	₦
Fixed overheads (62,000 hours × ₦10)	620,000
Variable overheads (62,000 hours × ₦2)	124,000
Total absorbed overheads	744,000
Actual overhead expenditure	790,000
Under-absorbed overheads	46,000

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:

a. the expected overhead expenditure is the budgeted fixed overhead expenditure plus the expected variable overhead expenditure for the hours actually worked; and
b. 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)	124,000	
Total expected overhead expenditure	724,000	
Actual overhead expenditure	790,000	
Expenditure variance	66,000	Adverse

	Hours	
Budgeted volume (direct labour hours)	60,000	
Actual volume (direct labour hours)	62,000	
Volume variance (direct labour hours)	2,000	Favourable
Fixed overhead absorption rate/hour	₦10	
Volume variance in ₦ (fixed overhead only)	₦20,000	Favourable

Summary	₦	
Expenditure variance	66,000	Adverse
Volume variance	20,000	Favourable
Total under-absorbed overhead	46,000	Adverse

8.11 Chapter review

Chapter review

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

a. explain the meaning of overheads;
b. identify manufacturing and non-manufacturing overheads;
c. explain allocation and apportionment and apply the techniques to identify the total overhead costs associated with different departments (including techniques of secondary apportionment);
d. explain absorption;
e. calculate departmental overhead absorption rates from data supplied;
f. calculate the overhead costs absorbed by applying overhead absorption rate in an appropriate manner; and
g. calculate and account for over and under absorption of overhead.

Solutions to practice questions

Solutions

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)	
		386,000	439,000	nil	nil

Solution

Let X represent total overheads of department X
Let Y represent 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 = 18620
X = 19,000
Y = 10,600 + (0.1 × 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
	64,800	60,100	46,200

CHAPTER 9

COSTING METHODS

Contents

9 Costing Methods

9.0 Learning objective

This chapter explains costing methods and procedures for recording costs.

9.1 Learning outcomes

At the end of this chapter, readers should be able to:

(a) explain the nature of job costing;
(b) calculate job cost from given data;
(c) explain the nature of batch costing;
(d) calculate batch cost from given data;
(e) explain process costing;
(f) explain when process costing is appropriate;
(g) determine the cost of a unit of output where there is normal loss, abnormal loss and abnormal gain;
(h) prepare process accounts (including accounting for normal loss, abnormal loss and abnormal gain)
(i) explain the concept of equivalent unit;
(j) calculate the cost of output from a process including losses and opening and closing WIP;
(k) differentiate between joint products and by-products;
(l) calculate the cost of joint products and by-products;
(m) explain the nature of service costing; and
(n) calculate cost of services rendered by a service organisation.

9.2 Introduction to costing methods

Costing methods are methods business organisations use to determine the cost of their products or services.

Introduction to specific order costing

Job and batch 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, for example, 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.
The two most common specific order costing methods are job and batch costing.

9.3 Job costing

9.3.1 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.

9.3.2 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 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	1,000
Production overhead absorbed	750
Production cost of the job	1,750
Non-production overheads	400
Total job cost	2,150

In many cases, job costs include not just direct materials costs and direct labour costs, but also **direct expenses**, such as:

a. the rental cost of equipment hired for the job;
b. the cost of work done for the job by sub-contractors; and
c. 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 either:
a. as a percentage of the prime cost of the job; or
b. 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	200
Production overhead (3 hours at ₦30)	90
Production cost of the job	290
Non-production overheads (40% of prime cost)	80
Total job cost	370

9.3.3 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:

a. 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;
b. 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;
c. 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;
d. 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
e. 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:

Prepare a schedule to show the resources used in the month.

Prepare journal entries to account for the utilisation of resources and to collect costs into the job accounts.

Prepare job cost accounts for each individual job in the costing ledger.

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.

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:			NA
Direct materials (all material X)	₦5,000	₦10,000	
Direct labour (all grade A)	₦10,000	₦18,000	
	₦15,000	₦28,000	
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)
	880	220	193,600
	1,880	220	413,600

Material Y	**Kgs**	**Cost per kg**	**₦**
Job 0503:	400	500	200,000
Job 0402	600	500	300,000
	1,000	500	500,000

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
	330	250	82,500

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
	145	400	58,000

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
		475	300	142,500

Fixed overhead	**Hours**	**Cost per hour**	**₦**
Job 0503:	85	320	27,200
Job 0402:	220	320	70,400
Job 0607:	170	320	54,400
	475	320	152,000

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	Cost of sales	336,700
	336,700		336,700

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	Balance c/d	715,400
	715,400		715,400

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
	348,900		348,900

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	715,400	344,500
Administration and marketing @ 20%	67,340		68,900
Cost of sale	404,040		413,400
Contract price	500,000		600,000
Profit	95,960		186,600

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
Issues of Material X		
WIP control account	418,000	
Inventory control account		418,000
Returns of Material X		
Inventory control account	4,400	
WIP control account		4,400
Issues of Material Y		
WIP control account	500,000	
Inventory control account		500,000
Grade A labour		
WIP control account	82,500	
Payroll control account		82,500
Grade B labour		
WIP control account	58,000	
Payroll control account		58,000
Variable overhead		
WIP control account	142,500	
Variable overhead account		142,500
Fixed overhead		
WIP control account	152,000	
Fixed production overhead account		152,000
Hire cost		
WIP control account	5,000	
Cash		5,000
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
		Balance c/d	715,400
	1,401,000		1,401,000
Balance b/d	715,400		

Cost of sales

	₦		₦
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
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)		
Transfer of balance on cost of sales to the income statement		
Income statement	817,440	
Cost of sales account		817,440
Under recovery of fixed production overhead		
Income statement (161,000 – 152,000)	9,000	
Fixed production overhead account		9,000
Over recovery of administration and marketing overhead		
Administration and marketing control a/c	6,240	
Income statement (136,240 – 130,000)		6,240
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
	817,440		817,440

Fixed production overhead

	₦		₦
Balance b/d (actual)	161,000	g) WIP control a/c	152,000
		i) Income statement	9,000
	161,000		161,000

Administration and marketing

	₦		₦
Balance b/d (actual)	130,000	j) Cost of sales	136,240
m) Income statement	6,240		
	136,240		136,240
Balance b/d			

Income statement

	₦		₦
k) Cost of sales	817,440	j) Cost of sales	
i) Fixed prod. O'hd	9,000	m) Admin and mkt.	6,240
		n) Receivables	1,100,000
Profit	279,800		
	1,106,240		1,106,240
Balance b/d			

9.4 Batch costing

9.4.1 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, where:

(a) 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;

(b) 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

(c) 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.

9.4.2 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 123

	₦
Direct materials	55,000
Direct labour	30,000
Production overhead absorbed	75,000
Total production cost, batch 123	160,000
Number of units made in the batch	÷2,000
Production cost per unit	₦80

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.

9.4.3 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	Cost of sales/inventory (1,000 units @ 328.75)	328,750
	328,750		328,750

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

9.5 Process costing

9.5.1 Introduction to 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 the 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.

Situations where process costing might be appropriate

Process costing might be appropriate in the following situation:

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:

a. chemicals manufacture;
b. the manufacture of liquids; and
c. 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.

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			
Conversion cost		500	Output	100	1,500
	100	1,500		100	1,500

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	
	100	1,500		100	1,500

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	
	100	1,500		100	1,500

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	
	110	1,600		110	1,600

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
	X	X		X	X

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:

a. identify the losses and output;
b. calculate the cost of good output, losses and WIP;
c. use the costs you have calculated to assign values to the good output, losses and WIP; and
d. complete the process account.

9.5.2 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.

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	₦2.50

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	–
	2,000	4,500		2,000	4,500

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.

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	₦2.40

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
	2,000	4,500		2,000	4,500

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

$$\text{Cost of good output per unit} = \frac{\text{Total process costs + Disposal costs of the normal loss}}{\text{Expected units of output}}$$

Example: Normal loss– with 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	₦2.6111

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	–
	2,000	4,700		2,000	4,700

9.5.3 Abnormal loss

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

Abnormal loss = Actual loss – Expected (normal) loss

From earlier:

Quantity of material input = Normal loss + Expected output

But:

Expected output = Actual output + Abnormal loss

Therefore:

Quantity of material input = Normal loss + Actual output + Abnormal loss

Total loss = Normal loss + 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.

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
Total production cost	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	₦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	–
	2,000	4,500		2,000	4,500

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.

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	4,320
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	₦2.4

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
	2,000	4,500		2,000	4,500

Example: Accounting for the losses

The double entry to account for the losses can be completed as follows

Abnormal loss account

	Litres	₦		Litres	₦
Process X account	100	240	Scrap account	100	90
			Income statement		150
	100	240		100	240

Scrap account

	Litres	₦		Litres	₦
Process X account (normal loss)	200	180	Cash	300	270
Abnormal loss account	100	90			
	300	270		300	270

9.5.4 Abnormal gain

Introduction to 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.

rmula: Abnormal gain

Abnormal gain = Expected (normal) loss –Actual loss

m earlier:

ected output = Actual output + Abnormal loss

in is opposite in sign so goes to the other side of the expression:

ected output + Abnormal gain = Actual output

Actual loss = Normal loss – Abnormal gain

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:

(a) 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;

(b) Abnormal gain is recorded as a debit entry in the process account, because it is a benefit; and

(c) 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	00 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	4,500
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	₦2.5

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
	2,050	4,625		2,050	4,625

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.

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 × 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 ×₦0.90)	(180)
Total production cost	4,320
Expected output (90% of 2,000)	÷1,800 litres
Cost per litre	₦2.4

Costing:

Cost of finished output = 1,850 units ×₦2.40 = ₦4,440.

Cost of abnormal gain = 50 units ×₦2.40 = ₦120.

Normal loss = 200 units ×₦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
	2,050	4,620		2,050	4,620

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			
	50	120		50	120

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
	200	180		200	180

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.

9.5.5 Process costing with closing work-in-progress

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.

9.5.6 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.

A three-stage calculation

We recommend a three-stage calculation:

a. 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;
b. next, prepare a statement of cost per equivalent unit for each type of cost; and
c. 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
Converison costs:	7,400

Answer

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**Direct materials**	**Conversion costs**
Finished output	3,500	100%	3,500	3,500
Closing WIP:				
Materials	500	100%	500	
Conversion		40%		200
	4,000		4,000	3,700

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 (₦)	6	2

Statement of evaluation

	₦
Cost of finished goods (3,500 × (₦6 + ₦2))	28,000
Cost of closing WIP	
Materials (500 units × ₦6)	3,000
Conversion (200 units × ₦2)	400
Cost per equivalent unit	3,400

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
	4,000	31,400		4,000	31,400

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, which can be .either of the following:

a. weighted average cost method treats all costs on the debit side of the account in the same way; or
b. first-in, first-out (FIFO) method allocates the costs in opening WIP to the finished goods and then spreads the remaining costs elsewhere.

9.5.7 Opening work-in-progress: Weighted average cost method

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.

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
Converison costs:	17,430

Answer

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**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
	10,000		10,000	9,200

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
	40,600	18,400
Equivalent units	÷ 10,000	÷ 9,200
Cost per equivalent unit (₦)	4.06	2

Statement of evaluation

	₦
Cost of finished goods (8,000 × (₦4.06 + ₦2))	48,480
Cost of closing WIP	
Materials (2,000 units × ₦4.06)	8,120
Conversion (1,200 units × ₦2)	2,400
Cost per equivalent unit	10,520

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
Opening WIP	3,000	13,570			
Direct materials	7,000	28,000	Finished goods	8,000	48,480
Conversion costs	-	17,430	Closing WIP	2,000	10,520
	10,000	59,000		10,000	59,000

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	(X_m/Y_m)	(X_{cc}/Y_{cc})

9.5.8 Opening work-in-progress: FIFO method

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:

a. The equivalent units of direct materials and conversion costs required to complete the opening WIP. These are the first units completed in the period; and

b. 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:

(a) the total finished output in the period; and
(b) **minus** the quantity of opening WIP (which are completed first).

The equivalent units of closing WIP (calculated in the normal way).

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:

(a) the costs in the opening WIP value at the start of the period; plus
(b) the costs in the current period to complete these units; plus
(c) 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
	₦13,570

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
Converison costs:	17,430

Answer

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**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
	10,000		7,000	8,300

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	₦4	₦2.1

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
	17,980
Started and finished in this period (5,000 ×₦4 + ₦2.1)	30,500
	48,480
Cost of closing WIP	
Materials (2,000 units ×₦4)	8,000
Conversion (1,200 units ×₦2.1)	2,520
Cost per equivalent unit	10,520

Process (WIP) account

	units	₦		units	₦
ening WIP	3,000	13,570			
ect materials	7,000	28,000	ished goods	8,000	48,480
nversion costs	-	17,430	sing WIP	2,000	10,520
	10,000	59,000		10,000	59,000

(**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.)

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	**Conversio n costs**
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	X_m	Y_{cc}
Cost per equivalent unit in the current period	TC_m / X_m	TC_c / Y_{cc}

These costs are used to apportion the process costs in the current period between:

a. the cost of completing the opening WIP;
b. the cost of units started and finished in the current period; and
c. 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

9.5.9 Work-in-progress and losses

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
Converison 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	4,000
Normal loss (10% of input)	(400)
Expected good output	3,600
Actual good output	(3,000)
Closing WIP	(500)
Abnormal loss	100

Example: Closing work-in-progress and losses

Statement of equivalent units

			Equivalent units	
Output	**Total units**	**Percentage complete**	**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
	3,600		3,600	3,350

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)	
	₦23,600	₦7,400
Equivalent units	÷ 3,600	÷ 3,350
Cost per equivalent unit	₦6.56	₦2.21

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 ($^{23,600}/_{3,600}$ and $^{7,400}/_{3,350}$)

	₦
Cost of finished goods (3,000 × (₦6.56 + ₦2.21))	26,294
Cost of closing WIP	
Materials (500 units ×₦6.56)	3,278
Conversion (300 units ×₦2.21)	662
Cost per equivalent unit	3,940
Cost of closing abnormal loss	
Materials (100 units ×₦6.56)	656
Conversion (50 units ×₦2.21)	110
Cost per equivalent unit	766

These costs would be recorded in the process account as follows.

Process (WIP) account

	units	₦		units	₦
ect materials	4,000	24,000	ished goods	3,000	26,294
			rmal loss	400	400
nversion costs	-	7,400	normal loss	100	766
			sing WIP	500	3,940
	4,000	31,400		3,600	31,400

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
Converison 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

			Equivalent units	
Output	**Total units**	**Percentage complete**	**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
	9,650		9,650	8,775

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)	
	40,250	18,400
Equivalent units	÷ 9,650	÷ 8,775
Cost per equivalent unit	4.17	2.10

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 ($^{40,250}/_{9,650}$ and $^{18,400}/_{8,775}$)

	₦
Cost of finished goods (7,500 × (₦4.17 + ₦2.1))	47,009
Cost of closing WIP	
Materials (2,000 units ×₦4.17)	8,342
Conversion (1,200 units ×₦2.1	2,516
	10,858
Abnormal loss	
Materials (150 units ×₦4.17)	626
Conversion (75 units ×₦2.1	157
	783

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
	10,000	59,000		10,000	59,000

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
Converison 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**	**Equivalent units 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
	9,650		6,650	7,875

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)	
	27,650	17,430
Equivalent units	÷ 6,650	÷ 7,875
Cost per equivalent unit	₦4.16	₦2.21

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 ($^{27,650}/_{6,650}$ and $^{17,430}/_{7,875}$)

	₦
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			
Direct materials	7,000	28,000	Finished goods	7,500	46,889
Conversion costs	-	17,430	Normal loss	350	350
			Abnormal loss	150	790
			Closing WIP	2,000	10,971
	10,000	59,000		10,000	59,000

9.6 Process costing: Joint products and by-products

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.

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:

(a) **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).

(b) **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').

(c) **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.

Suggested solution: Units basis

Output	**Units**
JP1	5,000
JP2	3,000
	8,000

Costs:	**₦**
JP1: $^{5,000\text{ units}}/_{8,000\text{ units}}$×₦135,880.	84,925
JP2: $^{3,000\text{ units}}/_{8,000\text{ units}}$×₦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
			JP2	3,000	50,955
	8,000	135,880		8,000	135,880

Suggested solution: Sales value at point of split-off

Sales value	**₦**
JP1 (5,000 units ×₦40)	200,000
JP2 (3,000 units ×₦55)	165,000
	365,000

Costs:	**₦**
JP1: $^{₦200,000}/_{₦365,000}$×₦135,880.	74,455
JP2: $^{₦165,000}/_{₦365,000}$×₦135,880.	61,425
	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	74,455
			JP2	3,000	61,425
	8,000	135,880		8,000	135,880

ggested solution: Net realisable value at the point of split-off

V value	**₦**
I (5,000 units ×₦120 –₦25)	475,000
2 (3,000 units ×₦80 –₦15)	195,000
	670,000

sts:	**₦**
1: $^{₦475,000}/_{₦670,000}$×₦135,880.	96,333
2: $^{₦195,000}/_{₦670,000}$×₦135,880.	39,547
	135,880

ese costs would be recorded in the process account as follows.

Process account

	units	₦		units	₦
ect materials	8,000	135,880	l	5,000	96,333
			2	3,000	39,547
	8,000	135,880		8,000	135,880

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.

Suggested solution: 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)	(1,580)
	134,300

Suggested solution: 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
	670,000

Costs:	**₦**
JP1: ₦475,000/₦670,000×₦134,300.	95,213
JP2: ₦195,000/₦670,000×₦134,300.	39,087
	134,300

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
	8,000	135,880		8,000	135,880

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.

Suggested solution: 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
	192,000

By-product deducted from costs

Costs:	**₦**
XX: ₦144,000/₦192,000×(₦100,000 – ₦1,000)	74,250
YY: ₦48,000/₦192,000×(₦100,000 – ₦1,000).	24,750
	99,000

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
	11,000	100,000		11,000	100,000

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)	
		(79,200)
Profit		74,400

Suggested solution: 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
	192,000

By-product deducted from costs

Costs:	**₦**
XX: ₦144,000/₦192,000×₦100,000	75,000
YY: ₦48,000/₦192,000×₦100,000	25,000
	100,000

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
	11,000	100,000		8,000	100,000

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)
	(80,000)
Gross profit	73,600
Other income	1,000
Profit	74,600

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.

9.7 Service costing

9.7.1 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:

a. **Intangibility**: They do not have a physical substance unlike goods. They cannot be held or seen.
b. **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.
c. **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.
d. **Perishability**: Services cannot be stored.
e. **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.

9.7.2 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.

a. There is no production system; therefore there are no production overheads.
b. 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).
c. In some service industries, direct labour costs are high (for example, in the film-making industry, accountancy and investment banking).
d. General overhead costs can be a very high proportion of total costs.

e. 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:

i. 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

ii. 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.

9.7.3 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:

a. The cost per room per day. This is a useful unit cost in the hotel services industry;
b. 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;
c. 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;
d. 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
e. 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.

9.7.4 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.

Required:

Explain what would be a useful measure of the cost of providing the hotel services.

Suggested solution

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?

Suggested solution

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 × 400) + (175,000 × 400) = 150 million.

Cost per passenger/mile = ₦60,000,000/150,000,000 = ₦0.40.

9.7 Chapter review

Chapter review

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

a. explain the nature of job costing;
b. calculate job cost from given data;
c. explain the nature of batch costing;
d. calculate batch cost from given data;
e. explain process costing;
f. explain when process costing is appropriate;
g. calculate the cost of output from a process including losses and opening and closing wip;
h. differentiate between joint products and by-products;
i. calculate the cost of joint products and by-products;
j. explain the nature of service costing; and
k. calculate cost of services rendered by a service organisation.

9.8 End of chapter questions and suggested solutions

9.8.1 Questions

Question 1:

Kuje Limited is a manufacturing company that specialises in plastic production and has a policy of making a profit of 20% of the total cost on every job. The budgeted costs for a year are:

	₦
Raw material	150,000
Direct wages - Department A	15,000
Direct wages – Department B	30,000
Production overhead – Department A	30,000
Production overhead – Department B	90,000
Selling and distribution overhead	63,000

The production overhead is charged on the basis of direct wages cost, and the selling and distribution overhead is charged on the basis of the total production cost.

The direct costs of Job A0003 are:

	₦
Raw material	37,500
Direct wages – Department A	7,500
Direct wages – Department B	9,000

Required:

Compute the selling price of Job A0003.

Question 2:

Nyanya Lines Ltd has just acquired 6 buses to be plying either Nyanya to Wuse or Gwagwalada. Each bus has 48 seats for passengers and 2 other seats to be used by the driver and his assistant (conductor). The journey from Nyanya to Wuse takes 1.5 hours whereas Gwagwalada is 4 hours from Nyanya. Each bus is ready to load by 6.00 a.m. and this takes approximately 1 hour at the Nyanya terminus, and the same amount of time at both Wuse and Gwagwalada. The buses park for each day at 9.00 a.m.

The passenger pays ₦500 to Wuse between Sunday – Thursday, and ₦700 on Fridays – Saturdays. The return journey fetches ₦700 per passenger on Sundays and Mondays, and ₦500 on the other days. Gwagwalada is ₦1,000 per passenger to and fro.

The following pieces of information are relevant:
Weekly operating charges (per vehicle):

	Nyanya-Wuse	Nyanya-Gwagwalada
	₦	₦
Petrol	350,000	495,000
Grease	15,000	14,000
Sundry expenses	230,000	220,000

Monthly maintenance charges (per vehicle)

	Nyanya-Wuse	Nyanya-Gwagwalada
	₦	₦
Tyres	200,000	280,000
Repairs	100,000	140,000

Fixed charges (per vehicle) per annum, irrespective of route

	₦
Insurance	1,950,000
Depreciation	1,850,000

Assume an occupancy rate of 85% to and 90% from Nyanya on the Nyanya – Wuse route, and 95% to and from on the Gwagwalada route. Assume also that the buses are operated 50 weeks a year.

Required:

Ascertain the more profitable route.

9.8.2 Suggested solutions

Suggested solution 1:

Kuje Limited

Computation of selling price of Job A0003

	₦	₦
Raw material		37,500
Direct wages – Department A	7,500	
Direct wages – Department B	9,000	16,500
Production overhead – Department A (wk 1)	15,000	
Production overhead – Department B (wk 1)	27,000	42,000
Total production cost		96,000
Selling and distribution overhead (wk 2)		19,200
Total cost		115,200
Profit (20% × 115,200)		23,040
Selling price		138,240

Working notes:

Production overhead

Production overhead absorption rate (POAR)

$$= \frac{\text{Budgeted Production overhead}}{\text{Budgeted direct wages cost}}$$

Department A $= \frac{30{,}000}{15{,}000}$ = ₦2/direct wages cost

:. Production overhead – Deparment A = ₦2 × ₦7,500 = ₦15,000

Department B $= \frac{90{,}000}{30{,}000}$ = ₦3/direct wages cost

:. Production overhead – Department B = ₦3 × ₦9,000 = ₦27,000

Selling and distribution overhead

Overhead absorption rate = $\frac{\text{Budgeted Selling and distribution overhead}}{\text{Budgeted total production cost}}$

$= \frac{63{,}000}{315{,}000}$ = ₦0.20/total production cost

:. Selling and distribution overhead = ₦0.2 × ₦96,000 = ₦19,200

CHAPTER 10

COSTING TECHNIQUES

Contents

10 Costing Techniques

10.0 Learning objective

This chapter explains the distinction between marginal and absorption costing techniques.

10.1 Learning outcomes

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

a. explain the concept of marginal costing;
b. calculate the marginal cost of an item from given data;
c. explain how marginal cost and the concept of contribution are important in decision-making;
d. describe absorption costing using examples;
e. calculate the absorption cost of an item from given data;
f. compare marginal costing and absorption costing; and
g. reconcile absorption costing and marginal costing profit figures.

10.2 Various types of costing techniques

10.2.1 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.

10.2.2 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, some of these are:

a. To measure profit (or loss), as an alternative to absorption costing;
b. To forecast what future profits will be;
c. To calculate what the minimum sales volume must be in order to make a profit;
d. It can also be used to provide management with information for decision
e. Making; and
f. Its main uses, however, are for planning (for example, budgeting), forecasting and decision-making.

10.2.3 Assumptions in marginal costing

For the purpose of marginal costing, the following assumptions are normally made:

a. 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;
b. Fixed costs are costs that remain the same in total in each period, regardless of how many units are produced and sold;
c. 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
d. 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.

10.2.4 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.

10.3 Reporting profit with marginal costing

10.3.1 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		(130,000)
Total contribution		230,000
Total fixed costs		(150,000)
Profit		80,000

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	290,000
Fixed costs for the period	(260,000)
Profit for the period	30,000

10.3.2 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

10.3.3 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)	70

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	3,000units

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 below. 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	
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

10.4 Reporting profit with absorption costing

10.4.1 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	
	198,000	
Closing inventory at full production cost	(14,000)	
Full production cost of sales		(184,000)
		246,000
(Under)/over-absorption		
Production overheads absorbed	100,000	
Production overheads incurred	(95,000)	
Over-absorbed overheads		5,000
		251,000
Administration, selling and distribution costs		(178,000)
Profit		73,000

10.4.2 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	₦110,000/2,200 units= ₦50 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	3,000units

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	(190,000)	(345,000)
Profit for the period	35,000	105,000

10.5 Reconciliation of profits or losses computed under absorption and marginal costing

10.5.1 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 implications of this are as follows (assume costs per unit remain constant):

a. when there is no change in the opening or closing inventory, exactly the same profit will be reported using marginal costing and absorption costing;
b. 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;
c. 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.
d. If inventory decreases in the period (closing inventory is less than opening inventory), the decrease is a debit to the income statement; and
e. 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 (MC = marginal costing)

Assuming cost per unit is constant across all periods under consideration.

Number of units' increase or decrease $\times$ 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

10.5.2 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:

a. Calculate the increase or decrease in inventory during the period, in units; and

b. 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.

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

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:
Ascertain what would have been the profit for the year if absorption costing had been used.

Practice question

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:
Ascertain what would have been the profit for the year if marginal costing had been used.

Practice question

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:
Ascertain what would have been the profit for the year if marginal costing had been used.

Practice question

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:
Ascertain what would be the budgeted profit if marginal costing is used, instead of absorption costing.

10.6 Advantages and disadvantages of absorption and 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.

10.6.1 Advantages and disadvantages of absorption costing

Absorption costing has a number of advantages and disadvantages.

Advantages of absorption costing

a. 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.
b. Calculating under/over absorption of overheads may be useful in controlling fixed overhead expenditure.
c. 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

a. Absorption costing is a more complex costing system than marginal costing.
b. Absorption costing does not provide information that is useful for decision making (like marginal costing does).

10.6.2 Advantages and disadvantages of marginal costing

Marginal costing has a number of advantages and disadvantages.

Advantages of marginal costing

a. 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.
b. 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.
c. Marginal costing provides useful information for decision making.
d. Contribution per unit is constant, unlike profit per unit which varies as the volume of activity varies.

Disadvantages of marginal costing

a. 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.)
b. 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.

10.7 Chapter review

Chapter review

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

a. Explain the concept of marginal costing;
b. Calculate the marginal cost of an item from given data;
c. Explain how marginal cost and the concept of contribution are important in decision
d. making;
e. Describe absorption costing using examples;
f. Calculate the absorption cost of an item from given data;
g. Compare marginal costing and absorption costing; and
h. Reconcile absorption costing and marginal costing profit figures.

Solutions to practice questions

Solution

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	19,000
Difference (profit higher with absorption costing)	12,000

Profit with marginal costing	96,000
Profit with absorption costing	108,000

The profit is higher with absorption costing because there has been an increase in inventory (production volume has been more than sales volume.)

Suggested solution

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	12,000
Difference (profit higher with marginal costing)	15,000
Profit with absorption costing	183,000
Profit with marginal costing	198,000

Profit is higher with marginal costing because there has been a reduction in inventory during the period.

Suggested solution

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

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.

CHAPTER 11

COST CONTROL AND COST REDUCTION

Contents

11. Cost Control and Cost Reduction

11.0 Learning objective

This chapter explains cost control and cost reduction, and the distinction between the two.

11.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain the meaning of cost control;
b. know the meaning of cost reduction;
c. the difference between cost control and cost reduction; and
d. the processes of cost reduction.

11.2 Introduction to cost control and cost reduction

In business and financial management, the ability to manage expenses efficiently is crucial for sustaining profitability and competitiveness. Two fundamental strategies that organisations employ to manage their expenditures are cost control and cost reduction. While they may seem similar at first glance, cost control and cost reduction differ in their objectives, implementation, and long-term impact.

11.3 The meaning of cost control

Cost control refers to the process of regulating and monitoring expenditures to ensure they remain within predetermined limits or budgets. It involves the establishment of standards, the comparison of actual performance against these standards, and the implementation of corrective actions when deviations occur. The primary aim of cost control is to prevent costs from exceeding authorized levels, thereby maintaining the financial discipline required for a business to operate as planned.

According to CIMA, cost control is "regulation by executive action of the cost of operating an undertaking particularly where such action is guided by cost accounting".

It involves identifying, reducing, or eliminating unnecessary expenses while maintaining the quality of products or services.

Key characteristics of cost control include:

a. **Setting standards**: Establishing target costs based on budgets, past performance, or industry benchmarks.
b. **monitoring:** regularly tracking and recording actual expenses.
c. **comparison:** comparing actual costs with budgeted or standard costs.
d. **corrective action:** investigating variances and taking steps to align actual performance with planned targets.

11.4 The meaning of cost reduction

Cost reduction is the process of actively seeking and implementing ways to lower existing costs and expenses without compromising on quality, efficiency, or output. Unlike cost control, which focuses on maintaining costs within set limits, cost reduction aims to permanently decrease costs by eliminating waste, improving processes, or adopting new technologies. The objective is not only to spend less but to do so sustainably and strategically.

The CIMA terminology defines cost reduction as "the real and permanent savings in project operation cost by achieving a reduced cost without impairing consumers' satisfaction".

Key features of cost reduction include:

a. **Continuous improvement:** Ongoing efforts to identify and eliminate unnecessary costs.
b. **Innovation:** Utilising new methods, technologies, or materials to achieve savings.
c. **Value analysis:** Systematic evaluation of functions and processes to find cost-effective alternatives.
d. **Permanent savings:** Achieving a lasting reduction in the cost structure of the organisation.

11.5 Distinction between cost control and cost reduction

Cost control ensures that predetermined budgets/standards are maintained through monitoring and corrective actions. The approach to cost control is reactive and preventive checking of the actual costs against planned costs and taking corrective action to stay within limits. The emphasis on cost control is that actual costs do not exceed planned costs.

Cost reduction is concerned with permanent reduction in cost without impairing the quality even though the operation is efficient. The major reason behind cost reduction is that the cost control established is not sufficient to enable a firm to survive the economy recession.

Although both cost control and cost reduction focus on managing expenses, several core differences set them apart:

a. Nature and approach
   i. Cost control: Reactive and regulatory in nature. It operates within established standards, seeking to prevent costs from exceeding limits.
   ii. Cost reduction: Proactive and innovative. It seeks to challenge existing standards and find better, more economical methods and processes.
b. Objective
   i. Cost control: To maintain costs within the set boundaries or budgets.
   ii. Cost reduction: To achieve a real and permanent reduction in unit costs or overall expenditure.
c. Time frame
   i. Cost control: Short-term focus, corresponding to budget cycles or specific projects.
   ii. Cost reduction: Long-term focus, aiming for sustainable improvements and savings.
d. Methods and tools
   i. Cost control: Employs budgeting, standard costing, variance analysis, and monitoring systems.
   ii. Cost reduction: Utilises value engineering, process reengineering, lean management, and adoption of new technologies.
e. Impact on standards
   i. Cost control: Works within existing cost structures and standards; does not question their validity.
   ii. Cost reduction: Challenges the current standards to find opportunities for improvement and innovation.
f. Scope
   i. Cost control: Limited to monitoring and managing expenses as per the budget.
   ii. Cost reduction: Broader, often involving the redesign of products, services, or processes to achieve savings.

11.6 Purpose of cost control and cost reduction

11.6.1 Purpose of cost control

The main purpose of cost control is to ensure that an organisation's expenditures do not exceed the budgeted or planned amounts. By exercising cost control, companies can:

a. maintain financial discipline and accountability within departments and teams;
b. safeguard profitability by preventing unnecessary or excessive spending;
c. enhance the reliability of financial forecasts and business planning;
d. ensure the efficient allocation and use of resources; and
e. support the achievement of strategic business objectives by keeping projects and operations within financial boundaries.

Cost control is particularly vital in industries with tight margins or in projects where overspending can lead to significant financial losses or even project failure.

11.6.2 Purpose of cost reduction

The purpose of cost reduction goes beyond mere compliance with budgets. It is about enhancing the financial performance of an organization by systematically minimizing costs. The key objectives include:

a. improving profitability by lowering the cost base and increasing margins;
b. creating a competitive advantage through lower production or operational costs;
c. freeing up resources for investment in innovation, research, or expansion;
d. responding proactively to market pressures, such as price competition or economic downturns; and
e. ensuring long-term sustainability by making efficient use of inputs and reducing waste.

Cost reduction initiatives are strategic and are often driven by the need to adapt to changing business environments, customer expectations, or technological advancements.

11.7 Processes of cost reduction

Cost reduction is a proactive process of optimizing spending to eliminate unnecessary expenses and improve efficiency, not just cutting budgets. It involves a strategic approach to identify and eliminate waste, improve operations, and reallocate resources more effectively. The process typically includes several steps, such as:

11.7.1 Improving efficiency and standards

This involves systematically identifying and eliminating waste and inefficiencies in various business processes to achieve significant cost savings. The process often includes optimizing supply chains and leveraging technology to automate tasks. By streamlining operations, enhancing resource utilization, and fostering a culture of continuous improvement, organizations can achieve substantial cost reductions while maintaining or even improving quality and productivity.

11.7.2 Reducing the labour costs

This process involves automating routine tasks or by outsourcing non-core business functions. Bringing down administrative expenses by eliminating unnecessary wage expense, control of overtime work, adoption of merit rating for promotion and removing non-value-added time.

11.7.3 Applying work study

This is a system of increasing or maximising the productivity of an operating unit by reorganising the work of that unit. Work study is sub-divided into two major methods namely methods study and work measurement.

a. Method study

This is the recording and critical examination of existing methods of doing work and comparing same with proposed methods with a view to coming up with easier methods which would be more effective and cheaper on the long run.

b. Work measurement

As the name suggests. Work measurement seeks to measure the time required for a qualified worker to complete a specific assignment at a specified level of performance.

11.7.4 Using organisation and methods (O & M):

Organisation and methods originally came from the pioneers of scientific management (Taylor and Gilbreth). Their work influenced the early approaches and establishment of the function.

O & M is defined as:

The systematic examination of activities in order to improve the effective use of human and other material resources.

Essentially, it is a specialist function that has a primary objective of improving an organisation's efficiency and control. In this way, it can be seen as an essential function that should be part of the make-up of any organisation.

O & M and its associated techniques can be seen to form the basis of business process re-engineering and business process improvement.

It is normally found as a consultative service to management, justified on the grounds that other line management do not have the time or skills to provide the service. Another factor in the application of O & M by trained; specialist staff other than the immediate line management is that it can bring a fresh outlook into a business process staff and management working on a process on a day-to-day basis may not be able to think very far beyond it and miss what may be obvious improvement opportunities.

Until recently, it was possible to find O & M departments established within most organisations. However, in recent years there has been a tendency for the O & M function to be renamed e.g. Project Management or Business Improvement. In some other organisation, O & M function has been subsumed into other functions, mostly IT.
O & M can provide a basis for the approach to almost any project. These are the steps to be followed:

a. select the area/process that requires attention;
b. record the current situation;
c. examine and analyse the existing situation;
d. develop, design and evaluate alternative solutions and recommend improvement opportunities;
e. implement the chosen solution; and
f. monitor and maintain the implemented solution.

11.7.5 Applying value analysis and value engineering:

Value analysis

Value analysis is an approach to improving the value of a product or process by understanding its constituent components and their associated costs. It then seeks to find improvements to the components by either reducing their cost or increasing the value of the functions. It is defined in the terminology as "A systematic interdisciplinary examination of factors affecting the cost of a product or service, in order to devise means of achieving the specific purpose most economically at the required standard of quality or reliability.

The following are the key concepts of value analysis:

a. value is the ratio between a function for customer satisfaction and the cost of that function;
b. function is the effect produced by a product or one of its elements, in order to satisfy customer needs; and
c. need is something that is necessary or desired by the customer.

Value analysis is therefore the methodology to increase the value of an object. The object to be analysed could be an existing or a new product or process, and it is usually accomplished by team following a work plan. The main purpose of value analysis is to improve every component in a product.

Value analysis follows the following process in steps:

a. orientation/preparation;
b. information;
c. analysis;
d. innovation/creativity;
e. evaluation; and
f. implementation and monitoring.

The application of value analysis only needs the use of basic techniques such as matrixes, Pareto chart, PERT and Gantt diagrams, etc.., in most of the steps.

The producer measures value analysis in terms of the relationship between product worth and product cost i.e. (product worth ÷ price paid). The higher the outcome, the higher is the satisfaction to the customer.

Advantages of using value analysis techniques include:

a. A high customer orientation, focusing on those aspects of the product/service that better satisfy customer needs;
b. Cost reduction by eliminating functions that do not supply specific advantages to satisfy customer requirements;
c. New ideas that arise from the creativity/innovation phase and may add radical changes and therefore competitive advantages that will be regarded by the market; and
d. A new systematic mentality to be taken into account for next designs of new products or to systematically improve the existing ones.

The problems that may arise during the application of value analysis can be of different nature. In order to arrive at a successful completion of the process, the following rules must be borne in mind:

a. avoid making generalisations and superficial statements. it is important to be precise at every moment;
b. collect, determine and examine all costs involved only when one is cost conscious will it be possible to determine the value of the thing being assessed; and
c. make use of information from the best possible sources.

11.7.6 Value engineering

Value engineering is a systematic methodology aimed at delivering essential functions at the lowest possible cost. Initially, it was perceived primarily as a cost verification process that did not compromise product quality. However, this view has since been identified as a limitation, leading to a broader and more comprehensive definition.

Currently, value engineering is understood as an organised approach focused on identifying and eliminating unnecessary costs. It is formally defined as "a redesign of an activity, product, or service so that customer value is enhanced while costs are reduced, or at minimum, increased by less than the corresponding price increase.

Unnecessary cost:

An unnecessary cost is any expense that does not contribute to usability, longevity, quality, appearance, customer features, or overall customer satisfaction.

Professional practice in value engineering encompasses the following responsibilities:

a. developing and managing maintenance programmes;
b. forecasting expenditure patterns;
c. providing guidance on cost limitations and preparing budgets;
d. advising on cash flow forecasting;
e. assessing life cycle costs;
f. conducting cost analysis;
g. performing cost-benefit analysis;
h. estimating costs;
i. evaluating alternative designs;
j. undertaking investment appraisals; and
k. measuring and describing construction work strictly for cost planning purposes.

11.8 Chapter review

Before moving to the next chapter, ensure that you can:

a. explain cost control;
b. explain cost reduction;
c. explain the purpose of cost reduction and cost control
d. explain the distinction between cost control and cost reduction; and
e. explain the process of cost reduction.

CHAPTER 12

FORECASTING TECHNIQUES

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12 Forecasting Techniques

12.0 Learning objective

This chapter enables readers to understand forecasting techniques and their business applications.

12.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain forecasting and forecasting techniques;
b. construct a time series;
c. identify and draw the trend line;
d. derive the line of best fit using centred moving averages or least squares linear regression analysis;
e. use the additive model to make forecasts; and
f. use the proportional model to make forecasts.

12.2 Introduction

Forecasting is the process of using historical data, current trends, and analytical models to estimate or predict future outcomes. In the context of management accounting, forecasting is applied to various financial and operational metrics—such as sales, revenue, costs, cash flow, and demand—with the aim of guiding decision-making, budgeting, and strategic planning.

It is not merely a guesswork activity; forecasting involves the use of logical assumptions, statistical tools, and models that help organisations form expectations about future performance. It supports both short-term and long-term planning and provides a foundation for creating financial plans, investment decisions, and performance benchmarks.

A **forecast** is the actual result or output of the forecasting process. It represents a quantitative or qualitative prediction of a future event or performance metric. For instance, a sales forecast may project that the company will sell 10,000 units in the next quarter. Similarly, a cash flow forecast might estimate the cash inflows and outflows for the upcoming month.

Forecasts can be expressed in numerical terms (for example, revenue, units sold, expenses) or as descriptive insights (for example, market trends, economic outlook). Regardless of the format, the key purpose of a forecast is to serve as a forward-looking guide for management.

12.3 Types of forecasts

Forecasts can be classified in several ways depending on their purpose, time horizon, or the nature of information used. The following are some major types of forecasts:

a) Based on time span:

i. **Short-term forecasts:** These usually cover periods from a few weeks to a year and are used for operational planning, inventory control, staffing, and cash flow management.
ii. **Medium-term forecasts:** Covering one to three years, these forecasts support budgeting, pricing strategies, and resource planning.

iii. **Long-term forecasts:** Extending beyond three years, long-term forecasts are typically used for strategic planning, investment decisions, and capital budgeting.

b) Based on function:

i. **Sales forecasts:** Predict future sales volume or revenue, often used to drive production and marketing plans.

ii. **Expenditure forecasts:** Estimate future spending on fixed and variable costs.

iii. **Cash flow forecasts:** Predict the timing and amount of cash inflows and outflows.

iv. **Profit forecasts:** Project expected profits by combining revenue and cost forecasts.

v. **Economic forecasts:** Examine macroeconomic variables like inflation, interest rates, or exchange rates that may impact business decisions.

c) Based on methodology:

i. **Qualitative forecasts:** Based on expert judgment, intuition, or market research, often used when historical data is limited.

ii. **Quantitative forecasts:** Use historical data and statistical methods to make predictions. These are more objective, and data driven.

12.4 Importance of forecasting and forecasts

Forecasting is vital for effective management accounting and decision-making. Their significance can be viewed from multiple perspectives:

a) **Strategic planning:** Forecasting helps organisations anticipate future trends, prepare for market changes, and set realistic long-term goals. It allows for the alignment of operations with strategic vision.

b) **Budgeting and financial planning:** Forecasts form the basis for preparing budgets. Accurate forecasts ensure that budgets reflect realistic assumptions and help prevent over- or underestimation of revenues and costs.

c) **Resource allocation:** Through forecasting, companies can determine how to allocate resources such as labour, materials, capital, and equipment to maximise efficiency and meet future demands.

d) **Risk management:** Forecasting helps identify potential risks and uncertainties, enabling organisations to develop contingency plans and mitigate adverse effects in advance.

e) **Performance evaluation:** Forecasts provide benchmarks against which actual performance can be measured. Deviations from forecasts help managers assess operational efficiency and control variances.

f) **Investment and financing decisions:** Whether deciding on a new project, capital investment, or funding requirement, forecasting provides the data necessary to evaluate the feasibility and profitability of such decisions.

g) **Communication and coordination:** Forecasts serve as communication tools within the organisation. They ensure that different departments and teams operate with a shared understanding of future expectations and targets.

12.5 Characteristics of a good forecast

A good forecast must have the following qualities:

a. Accuracy: A good forecast should closely match actual outcomes.

b. Reliability: It should produce consistent results under similar conditions.

c. Timeliness: Forecasts should be made early enough to influence decisions.

d. Relevance: The forecast must relate directly to the decision being made.
e. Simplicity vs. Complexity: The forecasting model should be as simple as possible while still capturing essential patterns.
f. Cost-effectiveness: The benefits should outweigh the cost of the process.

12.6 Forecasting process

Forecasting process is a structured sequence of steps that involves collecting data, analysing trends, applying forecasting techniques, and interpreting results to make informed decisions. In management accounting, the goal of the forecasting process is to provide reliable predictions that support planning, budgeting, and strategic operations.

An effective forecasting process combines both quantitative and qualitative elements, ensuring that decisions are grounded in data while also considering expert insight and judgment. Below is a detailed breakdown of the steps involved in the forecasting process:

a. The process begins with the **identification of the objective or purpose** of the forecast. This involves clearly defining what is to be forecasted,such as sales, costs, demand, or cash flows,and why it is needed. The objective guides every subsequent step and ensures that the forecast remains focused and relevant to management's goals.
b. Once the objective is set, the next step is the **collection of relevant data**. This includes gathering historical records, financial data, operational metrics, market research, and economic indicators. The quality of the forecast is directly tied to the quality of data used, so it is crucial to ensure the data is complete, accurate, and relevant to the forecast subject.
c. The next step after data collection is, the **analysis and preparation of data**. This step involves cleaning the data, identifying trends, removing outliers or one-off events, and adjusting for any anomalies. Data may be organised by periods, categories, or departments to enhance the clarity and precision of the forecast.
d. Next is the **selection of a forecasting method**. The method chosen depends on the nature of the forecast, the availability of historical data, and the desired level of accuracy. Forecasting methods may be qualitative, relying on expert judgment or market intuition, or quantitative, using statistical and mathematical models to project future outcomes, based on past patterns.
e. After selecting the appropriate method, the **application of the forecasting technique** takes place. This involves processing the data through the chosen model, whether it is a moving average, regression analysis, time series model, or another technique,to generate the forecasted figures.
f. The results are then subjected to **interpretation and evaluation**. Here, the forecast is examined in context, considering whether the results make sense, what assumptions were made, and how those assumptions align with current business conditions. Accountants also assess potential risks and limitations, ensuring that the forecast is not taken at face value, without critical evaluation.
g. Finally, the process includes **monitoring and revision**. Forecasts must be continually reviewed against actual results. If discrepancies arise, the model may need to be updated, or assumptions adjusted. This step ensures that the forecast remains a living, adaptable tool rather than a static document.

In summary, the forecasting process is a disciplined yet flexible cycle that helps businesses plan, manage resources wisely, and respond proactively to change. Its effectiveness relies on clarity of purpose, data integrity, thoughtful methodology, and ongoing evaluation.

12.7 The role of forecasting in budgeting

Forecasting plays a foundational role in budgeting by providing estimates and assumptions on which budgets are built. It involves predicting future business activities, such as sales, production, costs, and cash flows, based on historical data, trends, and market analysis. These forecasts help set realistic targets and allocate resources effectively.

In budgeting, forecasting serves the following key roles:

a. **Basis for planning:** Forecasts provide the data needed to prepare budget estimates. For example, a sales forecast helps determine production levels, resources needed, and revenue expectations.

b. **Risk reduction:** By anticipating future conditions and outcomes, forecasting helps minimise uncertainty and reduces the risk of budget variances.

c. **Resource allocation:** Forecasting identifies where resources will be needed most, aiding in their efficient allocation within the budget.

d. **Performance benchmarks:** Forecasts establish expectations that become benchmarks for evaluating actual performance during budgetary control.

e. **Flexibility and responsiveness:** Accurate forecasts enable the organisation to revise budgets proactively in response to changing conditions, ensuring continued alignment with goals.

12.8 Comparisons between forecasting and budgeting

Aspect	Budgeting	Forecasting
Definition	A detailed financial plan for a specific future period	An estimate or prediction of future financial outcomes
Purpose	Sets financial targets and guides operations	Predicts likely future outcomes based on current trends
Time Frame	Typically covers a fixed period (e.g., annually)	Can be short-term, medium-term, or long-term
Flexibility	Generally rigid once approved	More flexible and updated regularly
Formality	Part of a formal planning process	May be informal and used more for internal decision-making
Focus	Focuses on financial control and resource allocation	Focuses on predicting future trends and informing decisions
Use in Control	Used as a standard for performance evaluation (variance analysis)	Helps anticipate deviations and adjust plans
Relationship	Depends on forecasts to set targets	Provides input and basis for creating budgets

12.9 Limitations of forecasting

a. **Reliance on historical data**: Forecasts often assume that past trends will continue, which may not hold true in changing conditions.
b. **Uncertainty and external shocks**: Unexpected events (e.g. economic downturns, policy changes, pandemics) can render forecasts inaccurate.
c. **Model assumptions and simplification**: Forecasting models rely on assumptions that may not reflect real-world complexities, leading to errors.
d. **Bias and subjectivity**: Forecasts, especially qualitative ones, can be influenced by personal bias, over-optimism, or managerial pressure.
e. **Inflexibility to rapid changes**: Long-term forecasts may not adapt quickly to sudden market or environmental shifts.
f. **High cost and resource intensive**: Some methods require significant time, data, expertise, and technology, which may not be feasible for all firms.
g. **Overreliance on forecasts**: Treating forecasts as certainties rather than estimates can lead to flawed decisions and not taken into consideration inherent risks.
h. **Data and technology limitations**: Poor-quality or incomplete data, and overdependence on forecasting tools, can compromise results.

12.10 Methods of Forecasting

In management accounting, forecasting is critical for making informed financial decisions and planning future business activities. Various forecasting methods are employed to predict key financial metrics, such as sales, costs, profits, cash flow, and inventory levels. These methods can be categorised into **qualitative** and **quantitative** approaches, each useful in specific cases in a business context.

Qualitative forecasting methods

Qualitative forecasting methods are used primarily when there is insufficient historical data or when forecasting for new products, services, or market conditions. In management accounting, qualitative methods are often employed when new budgeting processes are being set, or when businesses face significant changes in the market environment. The **delphi method** is a key qualitative technique in this domain, where a panel of internal or external experts is consulted to generate forecasts based on their collective expertise. For example, when a company is launching a new product line, managers might use the Delphi Method to gather input from marketing experts, financial analysts, and industry specialists to estimate expected revenue or costs.

Market research also plays a significant role, especially in predicting demand, customer preferences, and sales projections based on surveys, focus groups, or customer feedback. Management accountants might use this data to forecast future revenue and adjust cost structures accordingly.

Another common qualitative method is **executive judgment**, where business leaders or senior managers provide their forecasts based on their experience and understanding of the market or economic environment.

Quantitative forecasting methods

Quantitative forecasting methods on the other hand, rely on historical data and statistical techniques to produce more objective and data-driven predictions. These methods are particularly effective in management accounting when businesses have access to reliable data over time and need to predict financial outcomes with a certain level of accuracy. One of the most widely used quantitative techniques is **time series analysis**, which examines historical data to identify recurring patterns or trends. In the context of management accounting, time series analysis might be applied to forecast future sales, production costs, or cash flows. Common methods in time series forecasting include **moving averages**, which smooth out fluctuations in data to reveal underlying trends, and **exponential smoothing**, which gives more weight to recent data points to predict future performance more accurately. These methods are particularly useful for short-term forecasts, such as predicting monthly sales or quarterly expenses.

For more complex or long-term forecasting, **ARIMA (Auto Regressive Integrated Moving Average)** models may be used in management accounting. ARIMA models are particularly useful when historical data shows intricate patterns or when there are trends with seasonality and irregular fluctuations. Management accountants might use ARIMA to forecast long-term financial metrics, such as annual revenues, expenses, or cash flow, thus accounting for various economic cycles and market shifts.

Causal forecasting methods are another quantitative approach used in management accounting, especially when the forecasted variable is influenced by external factors such as advertising expenditures, production levels, or economic indicators. For example, a company might forecast future sales based on a regression analysis that links sales volume to advertising expenditures or GDP growth. This method allows businesses to understand the relationships between various internal and external factors and make more precise financial predictions.

Additionally, **simulation models** like Monte Carlo simulations are sometimes used in management accounting to model and forecast financial outcomes under uncertainty. These methods use probabilities to predict a range of possible outcomes rather than a single forecast, making them valuable in scenarios where there are many variables at play, such as in risk management or investment decision-making.

In the context of **short-term forecasting**, methods like **moving averages** and **exponential smoothing** are commonly applied in management accounting to estimate short-term financial performance, like monthly sales or expense forecasts. These techniques help ensure that businesses can adjust their operations quickly, managing cash flows and inventory efficiently. For **long-term forecasting**, techniques such as **Causal forecasting** and **ARIMA** models are more appropriate, as they can incorporate broader economic factors and long-term trends that affect the business's financial performance.

12.11 Time series analysis

12.11.1 The nature of a time series

A **time series** is a sequential record of data points collected or recorded at **regular time intervals**, such as monthly sales revenue or quarterly profit. It serves not only as a structured representation of historical data but also as a valuable tool for making informed predictions about the future. By analysing the past behaviour of a variable over time, accountants and managers can extend the series into the future to forecast upcoming trends. However, for effective forecasting, the time series must first be broken down into its **component parts**, such as trend, seasonality, and irregular variations, to identify the underlying patterns that influence the data.

Components of a time series

Understanding the underlying structure of a time series helps in choosing the appropriate forecasting model. A time series can be broken down into the following key components:

Trend

Trend represents the general, long-term direction of the data. It shows the persistent increase or decrease in the variable over time. In business contexts. Trends can result from factors like economic growth, inflation, technological improvement, or expansion strategies. For example, a consistent increase in quarterly profits over five years indicates a positive trend.

Seasonality

Seasonality refers to periodic fluctuations that occur at regular intervals within a year. These are caused by recurring factors such as weather, holidays, or customer preferences. For example, retail businesses often experience increased sales in December due to holiday shopping, or ice cream sales peak during summer.

Cyclical variations

Cyclical components reflect patterns that occur over a period longer than a year. Unlike seasonality, cycles do not have a fixed, predictable period. They are influenced by broader economic or business cycles—such as expansion, recession, and recovery.

Example:

A company may experience strong sales growth during an economic boom and a decline during a recession, even if the long-term trend is upward.

Random / Irregular Variations

These are unpredictable, non-recurring variations caused by unusual or random events. They do not follow any pattern and are considered noise within the data. A sudden drop in production due to a flood or strike is a good example of irregular variation

Time series models

The two main models time series models are discussed below:

a. Additive model

The additive model is used when the components of a time series (trend, seasonal, cyclical, and irregular) are **independent** of one another. This means that the overall value of the time series is simply the sum of the individual components. The assumption in the additive model is that the effect of seasonality or any cyclical or irregular fluctuations is constant across time periods. This model is appropriate when the seasonal variations or irregular fluctuations are **constant** in magnitude over time.

For example, if the seasonal effect in a business is relatively stable, regardless of the overall size of the business or economic conditions, the additive model is a good fit.

b. **Multiplicative model**

The **multiplicative model** assumes that the components of the time series interact with each other and their effects are **proportional** rather than independent. In this model, the trend, seasonal, cyclical, and irregular components are multiplied together to yield the observed value. The multiplicative model is appropriate when the seasonal fluctuations, cyclical patterns, or irregular variations are **proportional** to the trend and increase or decrease as the level of the time series changes. For instance, when larger values of the trend lead to larger seasonal effects or more significant cyclical variations, the multiplicative model is a better choice.

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 over time.

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 that might cause changes over longer periods, typically tied to economic or business cycles.

R = Random Fluctuations – Unpredictable variations that occur due to unforeseen events or irregularities in the data.

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.

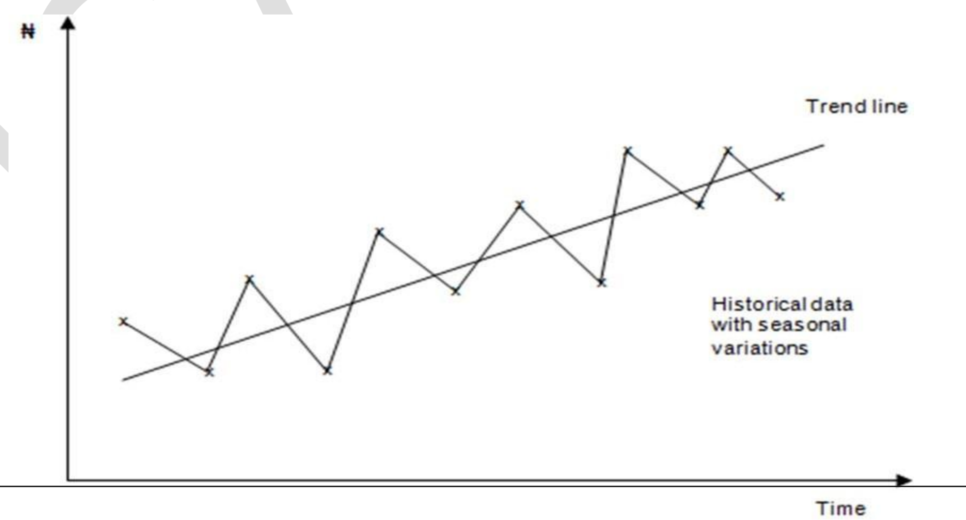
Questions requiring analysis of a time series will require the identification of a trend and seasonal variations.

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,

Illustration: Histogram of a time series



the actual value in each time period is above or below the trend, because of the seasonal variations.

12.11.2 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 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:

a. Moving averages; and
b. Linear regression analysis.

Linear regression analysis is a technique that produces a line of best fit for observed data. 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.

Note that both might be used together.

12.12 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 4gives 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
2	83
3	89
4	85
5	85

= 420 ÷ 5 days = 84 per day

84 represents the sales on the middle day of the period (day 3)

Day	**Sales**
2	83
3	89
4	85
5	85
	88

= 430 ÷ 5 days = 86 per day

86 represents the sales on the middle day of the period (day 4)

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

convenience, it is assumed that Week 1 consists of Days 1 – 5, Week 2 nsists of Days 6 – 10, and Week 3 consists of Days 11 – 15.

s sales data can be used to estimate a trend line. A weekly cycle in this mple is 5 days. Moving averages are calculated for five-day periods, as ows:

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:

$$\textit{Daily sales} = 78 + 2x.$$

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:

Daily sales = 78 + 50x = 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.

12.13 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**	**4 quarter total**	**Moving average (trend found by dividing the 4 quarter total by 4)**
	₦000	₦000	₦000
1	20		
2	24		
		102	25.5
3	27		
		117	29.25
4	31		
		132	33.00
5	35		
		149	37.25
6	39		
		165	41.25
7	44		
		179	44.75
8	47		
		196	49.00
9	49		
		212	53.00
10	56		
		229	57.25
11	60		
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.

12.14 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)
	27.75
Number of periods between Q10 and Q3	÷7
	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.

$$y \text{ (Sales)} = 27.38 + 3.96x$$

$$y \text{ (Sales in Q4 of year 4)} = 27.38 + 3.96\,(13) = 78.86$$

12.15 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
$= \sum x$	$= \sum y$	$= \sum x^2$	$= \sum xy$

$$b = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2} \qquad b = \frac{12(3{,}795) - (78)(496)}{12(650) - (78^2)}$$

$$b = \frac{45{,}540 - 38{,}688}{7{,}800 - 6{,}084} = \frac{6{,}852}{1{,}716} = 3.99$$

$$a = \frac{\sum y}{n} - \frac{b\sum x}{n} \qquad a = \frac{496}{12} - \frac{3.99(78)}{12}$$

$$a = 41.33 - 25.94 = 15.39$$

of best fit:

$$y = a + bx$$

$$y = 15.39 + 3.99x$$

12.16 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 = 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 = 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
	x	y = 15.39 + 3.99x	x^1	y = 27.38 + 3.96x
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 = 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.

12.17 Seasonal variations

12.17.1 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:

a. 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

b. 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:

a. the additive model; and
b. the proportional model

12.17.2 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:

a. calculate the difference between the moving average value and the actual historical figure for each time period;
b. group these seasonal variations into the different seasons of the year (days of the week; months or quarters of the year);
c. calculate the average of these seasonal variations for each season (or day; month; quarter);
d. 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
e. 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	Actual sales in the quarter	Variation (Actual – Moving average)
	₦000	₦000	₦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	Q2	Q3	Q4	Total
	₦000	₦000	₦000	₦000	₦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	78.97

12.17.3 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:

arter	Trend	ıctual sales in the quarter	easonal variation: actual sales as a proportion of the moving average
	₦000	₦000	₦000
ar 1: Q3	27.375	27	0.986
ar 1: Q4	31.125	31	0.996
ar 2: Q1	35.125	35	0.996
ar 2: Q2	39.250	39	0.994
ar 2: Q3	43.000	44	1.023
ar 2: Q4	46.875	47	1.003
ar 3: Q1	51.000	49	0.961
ar 3: Q2	55.125	56	1.016

e seasonal variation (daily variation) is now calculated as the average
asonal 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

ample: Forecast sales

e forecast for the trend value of sales in Q4 in year 4 is 78.86.

e estimated sales in this quarter are:

	₦000
Trend value	78.86
Quarter 4 adjustment (rounded)	×1.003
Sales forecast	79.01

12.18 Chapter review

Before moving on to the next chapter, check that you can:

a. explain forecasting techniques;
b. construct a time series;
c. identify and draw the trend line;
d. derive the line of best fit using centred moving averages or least squares linear regression analysis;
e. use the additive model to make forecasts; and
f. use the proportional model to make forecasts.

CHAPTER 13

BUDGETING

ontents

13. Budgeting

13.0 Learning objective

This chapter discusses budget and budgeting.

13.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain the purposes of budgeting;
b. construct functional budgets from information provided;
c. construct a cash budget from information provided; and
d. construct a master budget from information provided.

13.2 Introduction

Budgeting is a fundamental tool in management accounting that facilitates effective planning, control, and decision-making within an organisation. It involves the preparation of detailed financial plans that outline expected income, expenditure, and resources allocation over a specific period, often a financial year. These financial plans, known as budgets, serve as blueprints that guide managerial actions and ensure that organisational objectives are achieved efficiently and economically.

In management accounting, budgeting is more than just a financial exercise, it is a strategic process that aligns resources with business goals. By setting financial targets and performance expectations, budgets provide a framework for evaluating progress and holding managers accountable for their areas of responsibility. The process of budgeting encourages forward-thinking, prompts critical analysis of operations, and fosters coordination across various departments.

Furthermore, budgeting supports the control function by enabling variance analysis, comparing actual performance with budgeted figures. This comparison helps identify deviations, uncover inefficiencies, and implement corrective actions promptly. It also promotes a culture of financial discipline and continuous improvement across the organisation.

13.3 Planning framework

A business entity must engage in planning across three key time horizons: **long-term**, **medium-term**, and **short-term**. Each of these serves a unique purpose in guiding the organisation toward its goals.

a. **Long-term planning (strategic planning)**: This focuses on achieving the business's overall mission and long-term objectives. It typically covers a period of 3 to 5 years or even longer. Strategic planning is critical for setting the vision, determining core activities, and aligning resources with major initiatives and goals. It also involves evaluating external factors like market trends, competition, and economic conditions that might impact the organisation in the long run.
b. **Medium-term planning (tactical planning)**: Medium-term planning generally spans 1 to 2 years and focuses on how the long-term strategies will be executed in the short term. This planning phase identifies specific actions, resource requirements, and key performance indicators (KPIs) to ensure the strategic goals are met. It serves as a bridge between long-term strategies and day-to-day operations. 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.

c. **Short-term planning (operational planning)**: This type of planning addresses the immediate and day-to-day activities required to keep the business running efficiently. It typically covers periods of weeks or months and involves detailed, operational goals. Examples include managing daily sales targets, weekly production schedules, and staff assignments

13.4 The nature of budget

A budget is a formal, financial plan that covers all activities of an organisation for a specific period, typically one year. It outlines expected revenues, expenses, and resource allocations to guide decision-making and performance. While the overall budget period is usually one year, it can be subdivided into shorter control periods, such as monthly or quarterly, for easier tracking and adjustment. Budgets are primarily used to predict financial outcomes, manage resources, and monitor performance to ensure organisational goals are met.

13.5 Importance of the budgeting system

The budgeting system is integral to an organisation's financial health, operational efficiency, and strategic alignment. It serves several key purposes that guide and control the organisation's financial and operational activities:

a. **Converting long-term plans into short-term actions**: Budgets help to break down long-term strategic plans into detailed, actionable annual plans. This ensures that the organisation's day-to-day activities are aligned with its long-term goals, creating a clear path toward achieving broader objectives.
b. **Linking planning to organisational strategies**: The budgeting process ensures that short-term plans are aligned with the long-term objectives and strategies of the organisation. By doing so, budgets maintain the focus on overarching goals and ensure all efforts contribute toward the strategic direction.
c. **Coordinating organizational actions (goal congruence)**: Budgets serve to coordinate the actions of various departments and units within the organisation. This is known as **goal congruence**, ensuring that all areas are working together toward the same goals. By integrating all activities into a unified budget, businesses ensure that every part of the organisation contributes to the achievement of the overall objective.
d. **Communication of plans**: Budgets act as a tool for communicating the organisation's plans to managers and employees who are responsible for executing them. This transparency fosters alignment, ensuring that all team members understand their roles, targets, and expectations.
e. **Motivating employees and managers**: Budgets set clear targets for performance, providing a basis for motivation. Employees and managers are incentivised to meet budgetary goals, often with the possibility of bonuses or other rewards if targets are achieved. This helps align individual efforts with organisational success.
f. **Providing guidelines for expenditure authorisation**: Budgets set clear limits on spending, ensuring that any expenditure is authorised only if it falls within the pre-approved budgeted amounts. This promotes financial discipline, as departments and managers are required to operate within the established budgetary framework.
g. **Defining responsibility for plan implementation**: The budgeting process identifies individuals responsible for achieving specific budgetary targets. Each manager is

accountable for ensuring that their area meets the financial and operational objectives laid out in the budget, reinforcing responsibility and accountability.

h. **Providing a benchmark for performance evaluation**: Budgets serve as a benchmark against which actual performance is measured. By comparing actual results with budgeted figures, variances can be identified, and corrective actions can be taken. This evaluation process helps businesses stay on track and make necessary adjustments to meet financial goals.
i. **Resource allocation**: Budgets help ensure that resources are allocated efficiently across various departments and activities. This allocation prevents overspending, directs funds toward priority areas, and ensures that financial resources are used effectively to achieve business goals.
j. **Cost control and efficiency**: By setting spending limits and tracking actual performance against the budget, businesses can identify inefficiencies, reduce waste, and ensure that costs remain under control. This helps maintain financial stability and operational efficiency.
k. **Strategic decision-making**: Budgets provide valuable financial data that support strategic decisions. From launching new products to entering new markets, budgets ensure that decisions are based on solid financial insights, aligning business activities with long-term strategic objectives.

13.6 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

The **budget officer** is typically the management accountant or the head of the accounting function, tasked with coordinating the budgeting process on behalf of the budget committee. The functions of a the budget officer include:

a. One of the primary responsibilities of the budget officer is to circulate the budget guidelines established by the budget committee to all functional managers. This ensures that all managers understand the framework within which they need to prepare their budgets, aligning departmental goals with organisational objectives.
b. Additionally, the budget officer serves as the secretary of the budget committee. In this role, the budget officer is responsible for recording the minutes of meetings, maintaining all communications, and ensuring that decisions and actions taken by the committee are documented for future reference.

c. The budget officer also plays a key role in updating and revising the budget manual as directed by the committee, ensuring that it reflects current operational realities and any changes in business strategy or external conditions.

d. A crucial part of the budget officer's duties is designing the necessary forms, schedules, and reports that streamline the budgeting process. These tools are essential for collecting and consolidating budget data across departments in a standardised format.
e. The budget officer is also responsible for receiving and scrutinising the budgets submitted by functional managers, ensuring they comply with the established budget guidelines. If necessary, the budget officer provides guidance or request adjustments to ensure the final budgets are in line with the overall organisational goals.
f. Once the functional budgets are reviewed and finalised, the budget officer compiles them into a master budget. This comprehensive budget provides an overview of the entire organisation's financial plan for the period, combining all departmental budgets into one cohesive document.
g. After the budget is approved by the budget committee, the budget officer circulates the approved budget to the relevant functional managers, ensuring that they have the necessary information to implement the plan.
h. Finally, the budget officer is responsible for preparing monthly budgetary control reports. These reports compare actual performance against the budget, highlighting any variances. The budget officer submits these reports to both the budget committee and functional managers, enabling them to monitor financial performance and take corrective actions when necessary.

Budget manual
A **budget manual** is a comprehensive document that provides detailed guidelines, instructions, and procedures for the entire budgeting process within an organisation. It serves as the primary reference for everyone involved in the preparation, approval, and monitoring of budgets. The manual is designed to standardiae and streamline the budgeting process, ensuring consistency, accuracy, and alignment with organisational goals.

The budget manual typically includes several key sections:
a. **Purpose and objectives**: It outlines the overall purpose of the budget, emphasising its role in achieving the organisation's financial and strategic goals. It also explains how the budgeting process contributes to better planning, control, and decision-making.
b. **Budgeting policies and principles**: This section provides the guiding principles and policies that govern the budgeting process, such as the time frame for budgeting (e.g., annual budgets), the budgeting methods to be used (e.g., zero-based budgeting, incremental budgeting), and the expectations for financial reporting and accountability.
c. **Roles and responsibilities**: The manual outlines the roles and responsibilities of each participant in the budgeting process, including the budget committee, budget officers, department heads, and other relevant stakeholders. It clarifies who is responsible for preparing, reviewing, approving, and monitoring the budget.
d. **Budget Preparation Process**: It provides step-by-step instructions on how to prepare departmental and organisational budgets. This section may include details on gathering financial data, setting assumptions, forecasting revenues and expenses, and completing budget forms. It also highlights the process for submitting and reviewing budgets before they are finalised.
e. **Budget control procedures**: This section outlines how budgets will be monitored and controlled throughout the budget period. It includes instructions for comparing actual performance to budgeted figures, identifying variances, and implementing corrective

actions. It includes how budget holders are to manage their allocated resources effectively and stay within budget limits.

f. **Reporting requirements**: The manual specifies the types of reports that must be submitted, the frequency of reporting, and the format of reports. These reports might include periodic budgetary control reports, variance analysis, and updates to the budget committee or senior management.

g. **Approval and amendment procedures**: This section explains how the budget will be approved and who has the authority to make changes to the budget during its lifecycle. If necessary, it also includes instructions for revising or amending the budget in response to unforeseen circumstances or changes in the business environment.

h. **Tools and templates**: The budget manual often includes standardised templates, forms, and schedules that need to be used during the budgeting process. These tools help to ensure that budget preparation is uniform and that all necessary information are captured.

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. a sales budget;
b. a production budget;
c. a budget for production resources and resource costs (such as a materials cost budget and a labour cost budget);
d. a materials purchases budget; and
e. expenditure budgets for every overhead cost centre and general overhead costs.

13.7 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.

13.8 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: Identification of the Principal Budget Factor

The first step is to recognise the principal budget factor, which is the element that limits the organisation's activities during the budgeting period. This is often the volume of sales. It acts as a constraint around which the rest of the budgets are developed.

Stage 2: Preparation of the budget for the key factor

Once the limiting factor has been identified, usually sales, the relevant functional budget would be prepared. This means that the sales budget is often the first budget to be drawn up. All other functional budgets must be developed within the limits set by this key factor. For instance, even if the production department has more capacity, it should not plan to produce more than the projected sales, unless there is a strategic decision to increase inventory levels.

Stage 3: Preparation of other functional budgets

After finalising the sales budget, the business can proceed to prepare the other functional budgets. These include:

a. inventory budgets (for planning inventory increases or reductions)
b. production budgets
c. labour budgets
d. materials usage and purchases budgets
e. expenditure budgets, covering:
   i. Production overheads
   ii. Administrative overheads
   iii. Selling and distribution overheads

These budgets are usually prepared by individual cost centres and should follow a logical sequence.

Stage 4: Submission and review by the budget committee

The functional budgets are then submitted to the budget committee for scrutiny. The committee ensures that each budget is realistic and aligns properly with others. The aim is to maintain internal consistency and feasibility.

Stage 5: Compilation of the master budget

After the functional budgets are reviewed, a master budget is prepared. This summarises the entire plan for the period and typically includes:

a. a budgeted income statement for the next financial year;

b. A budgeted statement of financial position (balance sheet) at the end of the next financial year

c. A cash budget or cash flow forecast for the next financial year

The master budget is a consolidation of all functional budgets and presents an overall financial plan.

Stage 6: Final Approval by the Board of Directors

Once prepared, the master budget along with the supporting functional budgets is submitted to the board for approval. The board reviews and formally authorises the entire budget.

Stage 7: Communication to responsible managers

Following approval, the detailed budgets are distributed to relevant departmental or functional managers. These individuals are responsible for implementing the budgets in their respective areas.

Stage 8: Control Process: Monitoring and variance analysis

After the budgeting period begins, actual performance is tracked and compared against the approved budget. Differences (known as variances) are investigated. The reasons for these variances are determined, and appropriate corrective actions are taken. This ensures effective budgetary control, holding managers accountable for deviations and allowing continuous monitoring and performance improvement.

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.

13.9 Preparing functional budgets

13.9.1 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			2,300,000

A sales budget may be prepared by making adjustments to actual sales from 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).

13.9.2 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

13.9.3 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	X

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
	2,300	3,100
Opening inventory	(200)	(150)
Production budget	2,100	2,950

1

Practice question

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.

Required:

Prepare a production budget.

13.9.4 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			₦869,000

Practice question

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.

13.9.5 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)
Purchases budget	X

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
	6,275	10,300	2,350
Opening inventory	(500)	(550)	(100)
Purchases (kgs)	5,775	9,750	2,250
Cost per kg (₦)	40	50	70
Purchases (₦)	231,000	487,500	157,500
Total cost			₦876,000

Practice question

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

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 per unit	**Product B** 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	**Raw material** Y
Opening inventory	10,000	8,000
Closing inventory	8,000	4,000

Required

Prepare the materials usage and purchases budget for the year.

13.9.6 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 (hrs)	Usage (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 and1,000 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

Required:
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.

13.9.7 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**	
Direct materials	Usage (kgs)	Cost (₦)	Usage (kgs)	Cost (₦)
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	-	-
		175		170
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
		45		110
Unit cost		220		280

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
			86,000		94,000
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
			54,500		61,500
Total inventory			140,500		155,500

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

13.10 Cash budgets and cash flow forecasts

13.10.1 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.

Uses of cash budgets

a) **Ensures liquidity:** Helps the business plan to have enough cash available to meet day-to-day expenses and financial obligations when they fall due.
b) **Forecasts cash surpluses and shortages:** Identifies periods of expected cash excess or deficits, allowing proactive decisions such as investing surplus cash or arranging short-term financing.
c) **Supports decision-making:** Provides crucial information for making informed financial decisions regarding borrowing, lending, or delaying certain expenditures.
d) **Assists in planning financing needs:** Helps determine when external funding (e.g., bank loans or overdrafts) might be needed and how much.
e) **Improves cash flow control:** Acts as a control mechanism by comparing actual cash flows with projected figures, highlighting variances for further investigation.
f) **Coordinates activities:** Encourages coordination among departments by ensuring that spending plans align with expected income and organisational priorities.
g) **Facilitates short-term planning:** Complements the master budget by focusing on the timing and availability of cash, particularly useful for short-term operational planning.
h) **Enhances financial discipline:** Promotes better financial discipline and accountability among managers by setting clear cash targets and limits.

13.10.2 Cash flow forecasts

Cash flow forecasts, like cash budgets, are used to estimate future cash needs or surpluses. However, unlike cash budgets, which are typically part of the formal, structured budgeting process, cash flow forecasts are often prepared on a rolling basis throughout the financial year. They provide up-to-date insight into short-term liquidity and are especially useful for managing day-to-day cash requirements.

Objectives of cash flow forecasts

a) Ensure liquidity: The main objective is to ensure that the organization has enough cash to meet its obligations when they fall due—such as paying suppliers, wages, taxes, and other operating expenses.
b) Identify surpluses and shortages: Cash flow forecasts help in identifying future periods of cash surplus (excess funds) or shortage (potential cash deficits), allowing for timely decisions like investing surplus cash or arranging financing.
c) Support financial planning and decision-making: They provide a foundation for making informed financial decisions such as when to expand operations, delay purchases, or seek additional funding.
d) Facilitate external communication: Forecasts may be shared with external stakeholders like banks or investors to demonstrate the business's ability to manage cash and meet financial obligations.
e) Monitor and control cash flows: Regular comparison between forecasted and actual cash flows helps in controlling spending, adjusting projections, and improving accuracy over time.
f) Aid in budgetary control: Although not formally part of the annual budget, they complement the budgeting process by providing continuous feedback on cash positions, improving the effectiveness of budgetary control.

13.10.3 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

Cash receipts	**January ₦**	**February ₦**	**March ₦**
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:

a. Cash from issuing shares;
b. Interest or dividends received from investments;
c. Interest payments, but only in the months that interest is actually paid;
d. Taxation payments but only in the months that tax is actually paid; and
e. 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.

13.10.4 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

	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.

Required:
Calculate the cash receipts expected in January, February and March.

13.10.5 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 is expected to lead to a month on month increase in sales of ₦10,000 per month for the first 6 months of next year.

The 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 the cost of sale working.

This will be done in stages to allow you to understand the process.

Costofsalesineachmonthis60%ofthesalesfigureforthatmonth.

	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.

Sales	100.0	100.0	110.0	120.0	130.0
Opening inventory					
Purchases					
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

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.

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**
Dec	60.6	30.3	30.3	
Jan	66.6		33.3	33.3
Feb	72.6			36.3
Mar	78.6			
			63.3	69.6

13.11 Master budget

13.11.1 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. a budgeted income statement for the next financial year;
b. a budgeted statement of financial position as at the end of the next financial year; and
c. 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.

13.11.2 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

13.11.3 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:

a. Use of collection and payment periods; and
b. 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:

a. the budgeted receivables collection period (the length of credit taken by, or given to, credit customers).
b. 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:	
Sales□3m/12m=1,200,000□3m/12m	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:	
COS x 2m/12m = 600,000 x 2m/12m	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 x 4m/12m = 900,000 x 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):

	Sales	Dec	Collected after the year-end 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

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	3monthsofdemand
Monthly operating expenses (excluding depreciation	1,000

At the start of the budget period anon-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.

Required:

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).

13.12 Chapter review

Chapter review

Before moving on to the next chapter, check that you can:

a. explain the purposes of budgeting;
b. construct functional budgets from information provided;
c. construct a cash budget from information provided; and
d. construct a master budget from information provided.

SOLUTIONS TO PRACTICE QUESTIONS

Solution **1**

	Product P	Product Q
	units	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	Material M2	Total
	kilos	kilos	
To make 40,000S	80,000	100,000	
To make 10,000T	30,000	15,000	
Total quantities	110,000	115,000	
Price per kilo(₦)	400	600	
Total cost(₦)	44,000,000	69,000,000	113,000,00

Solution **3**

	Material3	MaterialM4	Total
	litres	litres	
Tomake20,000X	10,000	20,000	
Tomake15,000Y	22,500	30,000	
Material usage quantities	32,500	50,000	
Closing inventory	3,500	1,200	
Opening inventory	(3,000)	(2,000)	
	33,000	49,200	
Price per litre(₦)	3	4	
Total cost(₦)	99,000	196,800	29 5,800

Solution **4**

Materials usage budget	Raw material X (kgs)	Raw material Y (kgs)	Total(kgs)
Tomake5,000A	25,000	35,000	60,000
Tomake10,000B	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	65,0000	
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

A direct labour usage budget can be prepared as follows, after a production budget has been established.

	Product S	**Product T**
	units	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	**Grade G2**	**Total**
	hours	hours	
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

The total sales in each month must be calculated.

	Sales of product P			**Sales of product Q**			**'otal 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

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%)	25,200
Expenses:	
Depreciation (60,000/6 years)	(10,000)
Operating expenses (12 × 1,000)	(12,000)
Budgeted profit	3,200

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 liabilites (2m × 11,000 × 80%)	(17,600)
	103,200
Capital	
Opening capital (60,000 + 40,000)	100,000
Budgeted profit for the year	3,200
	103,200

Note: m means month.

CHAPTER 14

VARIANCE ANALYSIS

Contents

14 Variance Analysis

14.0 Learning objective

This chapter explains standard costing techniques and variance analysis.

14.1 Learning outcomes

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

(a) explain standard costing using examples;
(b) state the purposes of standard costing;
(c) describe the operation of a standard costing system;
(d) prepare standards cost card;
(e) state the types of cost standard;
(f) calculate basic variances and their analyses;
(g) interpret the various variances;
(h) state the causes and remedies for the variances; and
(i) reconcile the budgeted and actual profits under standard, marginal and absorption costing methods.

14.2 Introduction

Standard costing is defined by the CIMA official Terminology as "a control technique which compares standard costs and revenues with actual results to obtain variances which are used to stimulate improved performance."

A standard cost is defined as a predetermined estimated costs under specified working conditions. Its main purposes are to provide basis for control through variance accounting for evaluation of stock and work-in-progress and in some cases, for fixing selling prices.

Standards costing can be applied under both absorption and marginal costing.

14.3 Purposes of standard costing

Standard costing serves several key purposes in management accounting. The two major uses of standard costing are:

a. it is used for valuation of inventory and cost of production; and
b. it is used as a cost control technique, by establishing standards and analysing variances, deviations from plans and thus enable management to take corrective action to improve performance.

14.4 Operation of a standard costing system

The operation of standard costing technique involves the following:

a. establishment of a predetermined cost estimates of products and services;
b. collection of actual costs of products or services; and
c. comparison of actual costs with standard costs to determine variations.

The detail steps of a standard costing system operation are:

a. **Setting standard costs of products or services:** Determining the standard quantity of materials needed per unit of output and the standard price to be paid for those materials. Equally, establishing the standard hours required to produce a unit and the standard wage rate; and calculating the standard fixed and variable overhead costs per unit of output.

b. **Recording actual costs:** Tracking actual materials purchased and used, actual labour hours worked, and actual overhead incurred.

c. **Comparing standard costs with actual costs:** Calculating variances by comparing standard costs with actual costs. Variances can be favourable when standard cost is higher than the actual cost or adverse (unfavourable) when standard cost is lower than the actual cost

d. **Variance analysis:** Investigating the reasons for variances, to identify areas where improvements can be made. For example, an adverse material usage variance could indicate inefficiency in material handling.

e. **Using the information:** Standard costing helps identify the areas where management needs to investigate and where cost saving measures can be implemented. The information can also be used for performance evaluation, budgeting, and decision making.

Students are to take note that:

a. 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;

b. actual costs will differ from standard costs. A cost variance is the difference between the actual cost and the standard cost;

c. when actual cost is higher than standard cost, the cost variance is adverse (A) or unfavourable (U);

d. when actual cost is less than standard cost, the cost variance is favourable (F).

e. different variances are calculated, relating to direct materials, direct labour, variable production overhead and fixed production overhead. (There are also sales variances;

f. in a cost accounting system, cost variances are adjustments to the profit in an accounting period;

g. favourable variances increase the reported profit;

h. adverse variances reduce the reported profit;

i. the method of calculating cost variances is similar for all variable production cost items (direct materials, direct labour and variable production overhead);

j. a different method of calculating cost variances is required for fixed production overhead; and

k. standard costs technique may be used in both absorption and marginal costing systems.

14.5 Preparation of standard cost card

A standard cost card explains the details of the standard cost of each unit of product or service.

The standard cost card of product XEE per unit is shown below.

		₦	₦
Direct material A	25kg @ ₦2/kg		50
Direct material B	40kg @ ₦3/kg		120
Direct material C	60kg @ ₦4/kg		240
			410
Direct labour – Skilled	5hrs @ ₦20/hr	100	
Direct labour – Unskilled	10hrs @ ₦10/hr	100	200
Standard direct cost			610
Variable production overhead	5hrs @ ₦5/hr		25
Standard variable cost of production			635
Fixed production overhead	5hrs @ ₦15		75
Standard full production cost			710
Standard profit			40
Standard selling price			750

Note that the standard full production cost is the addition of the cost elements and it is to be determined by management by noting the following in the computations:

a. the budgeted prices of materials, labour and expenses;
b. the efficiency of the employees in the use of materials;
c. the skills of the workforce; and
d. the budgeted overhead costs and budgeted volumes of activity.

14.6 Types of cost standard

Setting standards introduces a number of issues that management needs to consider. Should the standard be a perfect performance under a perfect condition? Or should it be an easily attainable standard? Each of these standards has its own behavioural implications.

The possible standards are:

a. **Attainable standard:** This refers to a standard that can be achieved under normal efficient operating conditions. It makes allowance for normal losses and normal wastages. This kind of standard may appear difficult to attain but not impossible to achieve. This standard provides employees with useful psychological incentive that propels them to achieve the target set, because it is a realistic target under an efficient working environment.
b. **Ideal standard:** This is a standard that can be achieved only under perfect working conditions. No allowance is made for losses or wastages, idle time and breakdown of machinery. It does not provide any incentive for workers to work efficiently as it often results in adverse variance. However, it could be a useful tool for management as it will reveal areas management needs to focus on to improve performance.
c. **Basic standard :** This is a standard that is kept constant from year to year as it is designed to measure the changes that have taken place over a longer time. This standard is the least useful and least used of the type of standards.
d. **Current standard:** It represents a standard that is applicable within a short period of time and is based on the current working conditions. In view of the frequent changes in prices and methods of production, standards should be subject to review from time to time, if it is to provide an incentive for workers to work efficiently. However, the drawback of this type of standard is that it does not attempt to improve on current level of efficiency.

14.7 Direct materials variances

14.7.1 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)
	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: Direct material – Total cost variance (Kaduna Manufacturing Limited)

Standard material A cost per unit: (5kgs ×₦1,000 per kg) = ₦5,000 per unit

Standard material B cost per unit: (4kgs ×₦1,500 per kg) = ₦6,000 per unit

Actual production in period = 1,000 units.
Materials A purchased and used: 4,850 kgs at a cost of ₦4,608,000
Materials B purchased and used: 4,200 kgs at a cost of ₦6,092,000

Direct materials total cost variance is calculated as follows:

	Mat. A	Mat. B
	₦'000	₦'000
Standard cost(standard cost/unit x actual production)	5,000	6,000
Actual cost of the materials	(4,608)	(6,092)
Material cost variances	392(F)	92(A)
Direct materials total cost variance	₦300,000 (F)	

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

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.

Required:
Calculate the total direct material cost variance.

14.7.2 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

Example: Direct materials – price variance (Kaduna Manufacturing Limited)

Standard material A cost per unit: (5kgs ×₦1,000 per kg) = ₦5,000 per unit

Standard material B cost per unit: (4kgs ×₦1,500 per kg) = ₦6,000 per unit

Actual production in period = 1,000 units.
Materials A purchased and used: 4,850 kgs at a cost of ₦4,608,000
Materials B purchased and used: 4,200 kgs at a cost of ₦6,092,000

Direct materials price variance is calculated as follows:

	Mat. A	Mat. B
	₦'000	₦'000
Standard should cost (AQ purchased x SP)	4,850	6,300
Actual did cost	(4,608)	(6,092)
Materials price variance	242(F)	208(F)
Total materials price variance	₦450,000 (F)	

Practice question

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.

Required:

Calculate the direct material price variance.

14.7.3 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)	X
Standard cost per kg (multiply by)	X
Usage variance (₦)	X

Example: Direct materials – Usage variance (Kaduna Manufacturing Limited)

Standard material A cost per unit: (5kgs ×₦1,000 per kg) = ₦5,000 per unit

Standard material B cost per unit: (4kgs ×₦1,500 per kg) = ₦6,000 per unit

Actual production in period = 1,000 units.

Materials A purchased and used: 4,850 kgs at a cost of ₦4,608,000
Materials B purchased and used: 4,200 kgs at a cost of ₦6,092,000

Direct materials usage variance is calculated as follows:

	Mat. A	Mat. B
	Kgs	Kgs
Standard:		
Making 1,000 units should have used	5,000	4,000
Actual: Making 1,000 units did use	(4,850)	(4,200)
Usage variance (kgs)	150 (F)	200 (A)
Standard cost per kg	₦1,000	₦5,000
Usage variance (₦)	₦150,000 (F)	₦300,000 A
Total materials usage variance	₦150,000 (A)	

Practice question

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.

Required:

Calculate the direct materials usage variance.

14.7.4 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

$AQ_{purchased} \times AC$

} Price variance

$AQ_{purchased} \times SC$

} Inventory movement

$AQ_{used} \times SC$

} usage variance

$SQ_{used} \times SC$

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 (Kaduna Manufacturing Limited)

Standard material A cost per unit: (5kgs ×₦1,000 per kg) = ₦5,000 per unit
Standard material B cost per unit: (4kgs ×₦1,500 per kg) = ₦6,000 per unit

Actual production in period = 1,000 units.

Materials A purchased and used: 4,850 kgs at a cost of ₦4,608,000
Materials B purchased and used: 4,200 kgs at a cost of ₦6,092,000

Material		₦'000	₦'000
	$AQ_{purchased} \times AC$		
A	4,850 kgs ×₦X/kg	4,608	
	$AQ_{purchased} \times SC$		242 (F) Price variance
	4,850 kgs ×₦1,000/kg	4,850	
	$AQ_{used} \times SC$		nil inventory movement
	4,850 kgs ×₦1,000/kg	4,850	
	$SQ_{used} \times SC$		150 (F) Usage variance
	5,000 kgs ×₦1,000/kg	5,000	

SQ = 1,000 units × 5 kgs per unit = 5,000 kgs

Material	$AQ_{purchased} \times AC$		
B	4,200 kgs ×₦X/kg	6,092	
	$AQ_{purchased} \times SC$		208 (F) Price variance
	4,200 kgs ×₦1,500/kg	6,300	
	$AQ_{used} \times SC$		nil inventory movement
	4,200 kgs ×₦1,500/kg	6,300	
	$SQ_{used} \times SC$		300 (A) Usage variance
	4,000 kgs ×₦1,500/kg	6,000	

SQ = 1,000 units × 4 kgs per unit = 4,000 kgs

Practice question

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.

Required:

Calculate the direct materials price and usage variances using the alternative approach.

14.7.5 Direct materials mix variance

The materials mix variance measures how much of the total usage variance is attributable to the fact that the actual combination or mixture of materials that was used was more expensive or less expensive than the standard mixture for the materials.

The mix component of the usage variance therefore indicates the effect on costs of changing the combination (or mix or proportions) of material inputs in the production process.

The material mix variance indicates the effect on profits of having an actual materials mix that is different from the standard material mix.

The materials mix variance is calculated as follows (making reference to Kaduna Manufacturing Limited's information):

a. take the total quantity of all the materials used (9,050 kgs) and calculate what the quantities of each material in the mix should be if the total usage had been in the standard proportions or standard mix (5:4 in the above example);
b. compare the actual quantities of each individual material that were used, and the standard quantities that would have been used (the standard mix) if the total usage had been in the standard proportions or standard mix;
c. the mix variance for each material (expressed in kgs) is the difference between the quantity of each material actually used and the quantity of that material that should have been used in the standard mix. The total mix variance in material quantities is always zero;
d. convert the mix variance for each individual material into a money value by multiplying by the standard price per unit of the material; and
e. these figures are summed up to give the total mix variance.

Example: Mix variance

Material	**Standard mix (kgs)**	**Actual mix (kgs)**	**Mix variance (kgs)**	**Std price per kg**	**Mix variance (₦'000)**
A	(5/9 X 9,050)				
	5,028	4,850	178 (F)	1,000	178 (F)
B	(4/9 X 9,050)				
	4,022	4,200	178 (A)	1,500	267 (A)
	9,050	9,050	0		89 (A)

For each individual item of material, the mix variance is favourable when the actual mix is less than the standard mix, and the mix variance is adverse when actual usage exceeds the standard mix.

The total mix variance is adverse in this example because the actual mix of materials used is expensive than the standard mix.

14.7.6 Direct materials yield variance

The materials yield variance is the difference between the actual yield from a given input and the yield that the actual input should have given in standard terms. It indicates the effect on the costs of the total materials inputs yielding more or less output than expected.

The yield variance can be calculated in several ways. No one method is better than any other (use the one that makes most sense to you). However, note that the output and input methods often lead to a number of approximations.

Working

Based on the above example note that:

a. The standard cost of each unit (kg) of input = ₦11,000/9kgs = ₦1,222.22/kg
b. The standard cost of each unit of output = ₦11,000 per unit

Method 1: Based on output

This compares the actual yield to the expected yield from the material used. The difference is then valued at the standard cost of output.

In the above example 9 kgs of material should result in 1,005.56 units of output.

The difference between this figure and the actual output is the yield variance in number of units. This is then multiplied by the standard cost of a unit of output.

ample: Yield variance

	Units
50 kgs of input should yield (@ 9 kgs/unit)	1,005.56
50 kgs of input did yield	1,000
ld variance	5.56 (A)
ndard cost of output	11,000
terial yield variance (₦)	61,000 (A)

te the approximations

Method 2: Based on inputs

This compares the actual usage to achieve the yield to the expected usage to achieve the actual yield. The difference is then valued at the standard cost of input.

In the above example, 1 unit should use 9 kgs of input.

Therefore, 1,000 units should use 9,000 kgs of input.

The difference between this figure and the actual input is the yield variance in number of units. This is then multiplied by the expected cost of a unit of output.

Example: Yield variance

	Units
1,000 units of product X should use (x 9 kgs/unit)	9,000
1,000 units did yield	9,050
Yield variance in quantities	50 (A)
Standard cost of input	1,222.22/kg
Material yield variance (₦)	61,000 (A)

Note the approximations

14.7.7 Summary

Example: Mix variance + Yield variance = Usage variance

	₦'000
Mix variance	89 (A)
Yield variance	61 (A)
Usage variance (= mix + yield variances)	150 (A)

14.7.8 Alternative method

An alternative approach is to use a line by line method.

This starts with the standard cost of the actual quantity used in the actual mix.

This figure is made up as follows:

(a) Actual Quantity (AQ) in the Actual Mix (AM) at the standard Cost per unit (SC)

(b) Elements of this are then changed in sequence to identify the variances. In the table below the element that changes have been written in **bold**.

Example: Mix and Yield variances

Materials AQ in AM	Kgs	@	SC ₦	₦'000	₦'000
A	4,850	x	1,000	4,850	
B	4,200	x	1,500	6,300	
	9,050			11,150	
Materials AQ in SM		@	SC		
A (5/9)	**5,028**	x	1,000	5,028	**89 (A) MIX**
B (4/9)	**4,022**	x	1,500	6,033	
	9,050			11,061	
Materials SQ in SM		@	SC		
A (5/9)	**5,000**	x	1,000	5,000	**61(A) YIELD**
B (4/9)	**4,000**	x	1,500	6,000	
	9,000 *			11,000	

* This figure is the number of kgs that making 1,000 units should have used.

At first sight this seems to be very long-winded technique. However, some of the calculations can be simplified by using the standard costs of input or output.

The calculation then becomes:

Example: Mix and Yield variances

Materials	AQ in AM	@	SC		
	Kgs		**₦**	**₦'000**	**₦'000**
A	4,850	x	1,000	4,850	
B	4,200	x	1,500	6,300	
	9,050			11,150	
	AQ in SM	@	SC of		89 (A)
MIX					
			Input		
	9,050		1,222.22	11,061	
	SQ in SM	@	SC		
	9,000		1,222.22	11,000	61(A)
YIELD					

or	SC of output	
1,000 units	11,000	11,000

Students are encouraged to master and use the above method as it is much quicker.

14.7.9 Factors to consider when changing the mix

Analysis of the material usage variance into the mix and yield components is worthwhile, if management have control of the proportion of each material used. Management will seek to find the optimum mix for the product and ensure that the process operates as near to this optimum as possible.

Identification of the optimum mix involves consideration of several factors:

a. Cost: The cheapest mix may not be the most cost effective. Often a favourable mix variance is offset by an adverse yield variance and the total cost per unit may increase.
b. Quality: Using a cheaper mix may result in a lower quality product and the customer may not be prepared to pay the same price. A cheaper product may also result in higher sales returns and loss of repeat business.

Practice question

Product X is produced from two direct materials, A and B that are mixed together in a process.

The following relates to the budget and output for the month of April.

Standard				**Actual**
Material	Quantity	Standard price per litre	Standard cost	Quantity used
	litres	₦	₦	litres
A	20	150	3,000	994
B	30	200	6,000	1,240
	50		9,000	2,234
Output	1 unit			80 units

Required:

Calculate the direct materials mix and yield variances using the line-by-line method.

14.7.10 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:

a. different suppliers were used, and they charged a lower price (favourable price variance) than the usual supplier;
b. materials were purchased in sufficient quantities to obtain a bulk purchase discount (a quantity discount), resulting in a favourable price variance; and
c. Materials bought were of lower quality than standard and so cheaper than expected.

Possible causes of adverse materials price variances include:

a. different suppliers were used, and they charged a higher price (adverse price variance) than the usual supplier;
b. suppliers increased their prices by more than expected. (Higher prices might be caused by an unexpected increase in the rate of inflation);
c. There was a severe shortage of the materials, so that prices in the market were much higher than expected; and
d. 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:

a. wastage rates were lower than expected; and
b. improvements in production methods resulted in more efficient usage of materials (favourable usage variance).

Possible causes of adverse materials usage variances include:

a. wastage rates were higher than expected;
b. poor materials handling resulted in a large number of breakages (adverse usage variance). Breakages mean that a quantity of materials input to the production process is wasted; and
c. materials used were of cheaper quality than standard, with the result that more materials had to be thrown away as waste.

14.8 Direct labour variances

14.8.1 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)
	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: Direct labour – Total cost variance (Kaduna 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)	(121)

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).

14.8.2 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)
	X

Example: Direct labour – rate variance (Kaduna 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)
Labour rate variance (A)	(21)

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.

14.8.3 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)	X
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	X

Example Direct labour – Efficiency variance (Kaduna 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	(4,200)
Efficiency variance (hours) (A)	(200)
Standard rate per hour	₦500
Efficiency variance (₦) (A)	(₦100,000)

Practice question

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.

14.8.4 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. a breakdown in production, for example a machine breakdown that halts the production process;
b. time spent waiting for work due to a bottleneck or hold-up at an earlier stage in the production process;
c. running out of a vital direct material, and having to wait for a new delivery of the materials from a supplier; and
d. 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)	X
Standard rate per hour (multiply by)	X
Idle time (₦)	X

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 (Kaduna 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)
Idle time (hours) (A)	(100)
Standard rate per hour	₦500
Idle time (₦) (A)	(₦50,000)

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	(4,100)
Efficiency variance (hours) (A)	(100)
Standard rate per hour	₦500
Efficiency variance (₦) (A)	(₦50,000)

14.8.5 Alternative calculations

The following shows the line-by-line approach for labour variances.

Formula: Alternative method for calculating labour variances

$AH_{paid\ for} \times AR$

Rate variance

$AH_{paid\ for} \times SR$

Idle time variance

$AH_{worked} \times SR$		Efficiency variance
$SH_{worked} \times SR$		

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 (Kaduna 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

	₦'000	₦'000
$AH_{\text{paid for}} \times AR$		
4,200 hours ×₦X per hour	2,121	
$AH_{\text{paid for}} \times SR$		21 (A) Price variance
4,200 hours ×₦500 per hour	2,100	
$AH_{\text{worked}} \times SR$		50 (A) Idle time
4,100 hours ×₦500 per hour	2,050	
$SH_{\text{worked}} \times SR$		50 (A) Efficiency
4,000 hours ×₦500 per hour	2,000	

SQ = 1,000 units × 4 hours per unit = 4,000 hours

Practice question

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.

Required:

Calculate the direct labour rate variance and the direct labour efficiency variance for the month using the alternative approach.

14.8.6 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 (Kaduna 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

Method 2		₦
Labour	4 hours ×₦500 per hour	2,000

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) (Kaduna 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)
Idle time (hours)	300
Standard rate per hour (multiply by)	₦500
Idle time (₦)	₦150,000

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)
Efficiency variance (hours)	(500)
Standard rate per hour	₦500
Efficiency variance (₦)	(₦250,000)

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) (Kaduna 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 2		₦
Labour	4 hours ×₦500 per hour	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 (10% of 4,200 hours paid for)	420
Actual idle time (4,200 hours – 4,100 hours)	(100)
Idle time (hours)	320
Standard rate per hour (multiply by)	₦500
Idle time (₦)	₦160,000

Direct labour efficiency variance is calculated as follows:

	Hours
Standard:	
Making 1,000 units should have used (4 hours per unit less10% 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)	(520)
Standard rate per hour	₦500
Efficiency variance (₦)	(₦260,000)

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 (Kaduna 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)

14.8.7 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:

a. 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
b. actual pay increase turning out to be less than expected.

Possible causes of adverse labour rate variances include:

a. an increase in pay for employees;
b. working overtime hours paid at a premium above the basic rate; and
c. 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:

a. more efficient methods of working;
b. good morale amongst the workforce and good management with the result that the work force is more productive;
c. 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
d. 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:

a. using employees who are less experienced than 'standard', resulting in adverse efficiency variances; and
b. an event causing poor morale.

14.9 Variable production overhead variances

14.9.1 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 (Kaduna 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.

14.9.2 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

Example: Variable production overhead expenditure variance (Kaduna 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)
Expenditure variance (A)	(125)

14.9.3 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)	X
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	X

Example Variable production overhead efficiency variance (Kaduna 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)
Efficiency variance (hours) (A)	(100)
Standard rate per hour	₦200
Efficiency variance (₦) (A)	(₦20,000)

Practice question

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.

Required:

Calculate the total variable production overhead cost variance, the variable production overhead expenditure variance and the variable production overhead efficiency variance for the month.

14.9.4 Alternative calculations

The following shows the line by line approach for variable production overhead variances.

Formula: Alternative method for calculating variable production overhead variances

$$\left.\begin{array}{l} AH_{\text{worked}} \times AR \\ AH_{\text{worked}} \times SR \end{array}\right\} \text{Rate variance}$$

$$\left.\begin{array}{l} AH_{\text{worked}} \times SR \\ SH_{\text{worked}} \times SR \end{array}\right\} \text{Efficiency variance}$$

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 (Kaduna 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.

	₦'000	₦'000
$AH_{worked} \times AR$		
4,100 hours ×₦X per hour	945	
$AH_{worked} \times SR$		125 (A) Expenditure
4,100 hours ×₦200 per hour	820	
$SH_{worked} \times SR$		20 (A) Efficiency
4,000 hours ×₦200 per hour	800	

SH = 1,000 units × 4 hours per unit = 4,000 hours

ctice question

duct P123 has a standard variable production overhead cost per unit of: 1.5 rs × ₦2 per direct labour hour = ₦3 per unit.

ring a particular month, 2,000 units of Product 123 were manufactured. These k 2,780 hours to make and the variable production overhead cost was 550.

culate the variable production overhead expenditure variance and the iable production overhead efficiency variance for the month using the rnative approach.

14.9.5 Variable production overhead: possible causes of variances

Possible causes of favourable variable production overhead expenditure variances include:

a. Forecast increase in costs not materialising; and
b. 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;

a. Good morale amongst the workforce and good management with the result that the work force is more productive;
b. 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
c. 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:

a. Using employees who are less experienced than ‘standard’, resulting in adverse efficiency variances; and
b. An event causing poor morale.

14.10 Fixed production overhead cost variances: absorption costing

14.10.1 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.

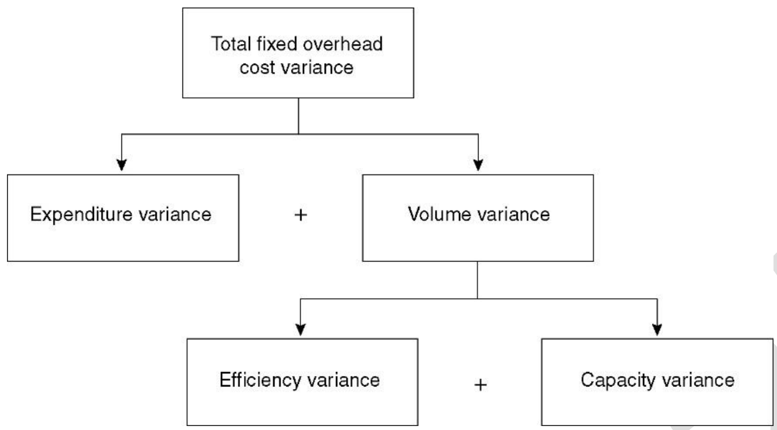
The total fixed overhead cost variance is the total amount of under-absorbed or over-absorbed overheads, where overheads are absorbed at the standard fixed overhead cost per unit.

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



14.10.2 Total fixed production overhead cost variance

The total fixed overhead cost variance is the amount of:

a. under-absorbed fixed production overhead (= adverse variance) or
b. 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	(X)
Total fixed production overhead variance (Over/(under) absorption)	X

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) (Kaduna 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 ₦2,880,000/4,800 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	(2,500)
Under absorption (adverse cost variance)	(100)

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.

14.10.3 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	X

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 (Kaduna Manufacturing Limited)

	₦'000
Budgeted fixed production overhead	2,880
Actual fixed production overhead	(2,500)
Fixed production overhead expenditure variance (F)	380

Fixed overhead expenditure variances can be calculated, for control reporting, for other overheads as well as production overheads. For example:

a. an administration fixed overheads expenditure variance is the difference between budgeted and actual fixed administration overhead costs; and
b. a sales and distribution fixed overhead expenditure variance is the difference between budgeted and actual fixed sales and distribution overhead costs.

14.10.4 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	(X)
Fixed production overhead volume variance (units)	X
Standard absorption rate per unit	X
Fixed production overhead volume variance (₦)	X

Example Fixed production overhead – volume variance (Kaduna 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 ₦2,880,000/4,800 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	(1,200)
Fixed production overhead volume variance(units) (A)	(200)
Fixed production overhead per unit	₦2,400
Fixed production overhead volume variance(₦) (A)	(₦480,000)

Practice questions

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.

Required:

Calculate the total fixed production overhead cost variance, the fixed overhead expenditure variance and the fixed overhead volume variance for the year.

14.10.5 Fixed production overhead efficiency and capacity variances

Any volume variance might be due to two reasons:

a. The company has worked a different number of hours than budgeted. They have operated at a different capacity; and

b. 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)	X
Standard rate per hour (multiply by)	X
Efficiency variance (₦)	X

Example: Fixed production overhead efficiency variance (Kaduna 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)
Efficiency variance (hours) (A)	100
Standard rate per hour	₦600
Efficiency variance (₦) (A)	₦60,000

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)
Capacity variance (hours)	X
Standard rate per hour (multiply by)	X
Capacity variance (₦)	X

Example: Fixed production overhead capacity variance (Kaduna 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 ₦2,880,000/4,800 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)
Capacity variance (hours) (A)	700
Standard rate per hour (multiply by)	₦600
Capacity variance (₦) (A)	₦420,000

Practice questions

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 in 10,250 hours of work, and fixed production overhead was ₦40,500.

Required:

Calculate the fixed overhead efficiency variance and the fixed overhead capacity variance for the year.

14.10.6 Fixed production overheads: possible causes of variances

Some of the possible causes of fixed production overhead variances include the following.

Fixed overhead expenditure variance

a. Poor control over overhead spending (adverse variance) or good control of overhead spending (favourable variance).
b. 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.
c. 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:

a. efficient working by direct labour: a favourable labour efficiency variance results in a favourable fixed overhead efficiency variance;
b. working more hours or less hours than budgeted (capacity variance);
c. 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
d. extensive breakdowns in machinery, resulting in lost production (adverse capacity variance).

14.11 Sales variances

14.11.1 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. a sales price variance; and
b. a sales volume variance

14.11.2 Sales price variance

A sales price variance shows the difference between:

a. the actual sales prices achieved for items that were sold; and
b. 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)
	X

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 (Kaduna Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦20,000
Actual sales volume	900 units
Actual revenue	₦17,100,000

Sales price variance is calculated as follows:

	₦'000
Standard revenue for actual sales	
900 units ×₦20,000 per unit	18,000
Actual revenue	
Actual sales × Actual selling price per unit	(17,100)
Sales price variance (A)	900

14.11.3 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.

When a company sells more than one product a volume variance can be calculated for each individual product in the usual way. In such cases the total sales volume variance is then the sum of the individual sales volume variances.

Illustration: Sales volume variance

	Units
Budgeted sales volume	X
Actual sales volume	(X)
Sales volume variance (units)	X
Standard profit per unit (multiply by)	X
Sales volume variance (₦)	X

Example: Sales volume variance (Kaduna Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦20,000
Standard cost per unit (from the standard cost card)	₦16,200
Therefore, standard profit per unit	₦3,800
Actual sales volume	900 units
Actual revenue	₦17,100,000

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)	₦3,800
Sales volume variance (A)	₦380,000

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

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.

Required:

Calculate the sales price variance and sales volume variance.

14.11.4 Sales quantity variance

A sales quantity variance is the difference between the actual number of units sold and the budgeted number of units sold. It reflects the impact on profits (or contribution) due to changes in the actual volume of sales compared to the planned volume. Essentially, it measures how much the actual sales quantity deviates from the expected quantity.

The sales quantity variance is calculated as follows:

Illustration: Sales quantity variance

	Units
Budgeted quantity sold in total	X
Actual quantity sold in total	(X)
Sales quantity variance (units)	X
Weighted average standard contribution per unit (₦)	X
Sales quantity variance (in standard contribution) (₦)	X

Example: Sales quantity variance

The following information relates to the sales budget and actual sales volume results for X Ltd for the month of March.

Product	**X**	**Y**	**Z**	**Total**
Budgeted sales (units)	240	140	120	500
Unit contribution	₦50	₦70	₦60	
Total contribution	₦12,000	₦9,800	₦7,200	₦29,000
Standard average contribution per unit (₦29,000/500 units)				₦58
Actual sales (units)	200	220	180	600

Sales quantity variance is calculated as follows:

	Units	
Budgeted sales in total	500	
Actual sales in total	600	
Sales quantity variance in units	100	(F)
Weighted average standard contribution per unit	₦58	
Sales quantity variance (in standard contribution)	₦58,000	

14.11.5 Sales mix variance

The sales mix variance indicates the effect on profits of having an actual sales mix that is different from the budgeted sales mix.

The sales mix variance is calculated as follows (referring to the example above):

a. Find the budgeted mix in percentage terms by summing the budgeted sales of each individual product and calculating the percentage that each bears to the total (**X:** ₦240/500 = 48%; **Y:** ₦140/500 = 28%; **Z:** ₦120/500 = 24%).

b. Apply the percentage to the actual total sales to give the actual number of each that would have been sold if the actual sales were made in the standard mix. (For X this figure is 48% of 600 = 288 units).

c. The mix variance (in units) for each product is the difference between this number and the actual sales of that product. (For X this is 240 – 288 = 48 units. This means that the company has sold 48 units of X less than it would have if the actual sales were made in the standard mix).

d. The variance for each product expressed as units is multiplied by the standard contribution per unit of that product to give the impact on contribution.

e. These figures are summed up to give the total mix variance.

Example: Sales mix variance

Returning to the facts from the previous example the sales mix variance is calculated as follows:

Product	Actual mix	Standard mix	Mix variance (units)	Std. contr. per unit	Mix variance (Std cont.)
	units	units	units	₦	₦
X (48%)	200	288	88 (A)	50	4,400 (A)
Y (28%)	220	168	52 (F)	70	3,640 (F)
Z (24%)	180	144	36 (F)	60	2,160 (F)
	600	600	0		1,400 (F)

The total mix variance in units must come to zero.

In this illustration the total mix variance is favourable because the company has sold more high contribution items and less low contribution items.

14.11.6 Alternative method

An alternative approach is to use a line by line method.

This starts with the expected contribution from the actual sales of each unit.

This figure is Actual Quantity (AQ) in the Actual Mix (AM) at the Standard Contribution per unit (SC)

Elements of this are then changed in sequence to identify the variances. In the table below the element that changes have been written in **bold.**

Example: Sales mix and quantity variances

Products	AQ in AM	@	SC		
	units		₦	₦	₦
X	200	x	50	10,000	
Y	220	x	70	15,400	
Z	180	x	60	10,800	
	600			36,200	
Products	AQ in SM	@	SC		
X (0.48)	**288**	x	50	14,400	1,400 (F) MIX
Y (0.28)	**168**	x	70	11,760	
Z (0.24)	**144**	x	60	8,640	
	600			34,800	
ducts	SQ in SM	@	SC		
.48)	**240**	x	50	12,000	5,800 (F) QTY
.28)	**140**	x	70	9,800	
.24)	**120**	x	60	7,200	
	500			29,000	

At first sight this seems to be a very long winded technique. However, some of the calculations can be simplified by using the budgeted average standard contribution per unit (₦58).

The figure can be used whenever the contribution from a total quantity is to be expressed in Standard Mix @ Standard Contribution per unit. The calculation then becomes:

Example: Sales mix and quantity variances

Products	AQ in AM	@	SC		
	units		₦	₦	₦
X	200	x	50	10,000	
Y	220	x	70	15,400	
Z	180	x	60	10,800	
	600			36,200	
	AQ in SM	@	SC		1,400 (F) MIX
	600		58	34,800	
	SQ in SM	@	SC		5,800 (F) QTY
	500		58	29,000	

14.11.7 Sales: possible causes of variances

Possible causes of sales variances include the following:

Sales price variance

a. Actual increases in prices charged for products were higher or less than expected due to market conditions.
b. Actual sales prices were less than standard because major customers were given an unplanned price discount.
c. Competitors reduced their prices, forcing the company to reduce the prices of its own products.

Sales volume variance

a. Actual sales demand was more or less than expected.
b. The sales force worked well and achieved more sales than budgeted.
c. An advertising campaign had more success than expected.
d. A competitor went into liquidation, and the company attracted some of the former competitor's customers.
e. The products that the company makes and sells are going out of fashion earlier than expected; therefore, the sales volume variance was adverse.

14.12 Interrelationships between variances

14.12.1 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.

14.12.2 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.

14.12.3 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.

14.12.4 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.

14.12.5 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.

14.12.6 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.

14.12.7 Remedies for the variances

Analyse the root causes:

Investigate the reasons behind variances using variance analysis tools.

Implement corrective measures:
Address the underlying causes by taking actions such as renegotiating supplier contracts, improving training programme, or optimizing production processes.

Refine the standard costing systems:
Regularly review and adjust standard costs to reflect changes in market conditions, and production efficiency.

Monitor performance:
Continuously track and analyse variances to identify trends and areas for improvement.

14.13 Reconciling budgeted and actual profit: standard absorption costing

14.13.1 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.

14.13.2 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 Kaduna Manufacturing Limited will be used.

Example: Operating statement for Kaduna Manufacturing Limited (standard total absorption costing)

	₦'000	₦'000	₦'000
Budgeted profit			3,800
Sales price variance			(900)
Sales volume variance			(380)
			2,520
Cost variances	(F)	(A)	
Direct material price:			
Material A	242		
Material B	20		
Direct materials mix:			
Material A	178		
Material B		267	
Direct materials yield:		28	
Material A		33	
Material B			
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	
Fixed production overhead expenditure	380		
Fixed production overhead efficiency		60	
Fixed production overhead capacity		420	
Total cost variances	1,008	1,074	66
Actual profit			2,454

Note: Other overhead expenditure variances, assuming administration overheads and selling and distribution overheads are all fixed costs, are the difference between:
a. other budgeted overheads expenditure, and
b. other actual overheads expenditure.

In a system of absorption costing:

a. the operating statement begins with the budgeted profit;
b. 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 actualsales revenue in the period minus the standard production cost of sales.
c. the cost variances are listed next. they can be listed in any format, but showing eparate 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.
d. the cost variances are added up and then shown as a total.

e. the actual profit is shown as the final figure, at the bottom of the operating statement.

14.13.3 Standard marginal costing

The Kaduna 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:

a. 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
b. there is no fixed overhead volume variance.

The Kaduna Manufacturing Limited example will be used to illustrate the approach.

Example: Standard cost card (Kaduna Manufacturing Limited)

		₦
Direct materials A	5 kg @ ₦1,000 per kg	5,000
Direct materials B	4 kg @ ₦1,500 per kg	6,000
Direct labour	4 hours @ ₦500 per hour	2,000
Variable overhead	4 hours @ ₦200 per hour	800
Marginal production cost		13,800

14.13.4 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.

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)	X
Standard contribution per unit (multiply by)	X
Sales volume variance (₦)	X

Example: Sales volume variance (Kaduna Manufacturing Limited)

Budgeted sales volume	1,000 units
Budgeted selling price per unit	₦20,000
Standard cost per unit (from the standard cost card)	₦13,800
Therefore, standard contribution per unit	₦6,200

Sales volume variance is calculated as follows:

	Units
Budgeted sales volume	1,000
Actual sales volume	900
Sales volume variance (units) (A)	100
Standard contribution per unit (multiply by)	₦6,200
Sales volume variance (A)	₦620,000

14.13.5 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 Kaduna Manufacturing Limited (standard marginal costing)

	₦'000	₦'000	₦'000
Budgeted contibution			6,200
Sales price variance			(900)
Sales volume variance			(620)
			4,680
Cost variances	(F)	(A)	
Direct materials price:			
Material A	242		
Material B	208		
Direct materials mix:			
Material A	178		
Material B		267	
Direct materials yield:			
Material A		28	
Material B		33	
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	628	594	34
			4,714
Budgeted fixed production overhead		2,880	
Fixed production overhead expenditure variance (F)		(380)	
Less: Actual fixed production overheads			(2,500)
			2,214

14.14 Chapter review

Chapter review

Before moving on to the next chapter, check that you can:

a. explain standard costing using examples;
b. calculate, analyse and interpret various variances relating to material, labour and
c. factory overhead (both variable and fixed);
d. calculate sales volume variance; and
e. prepare an operating statement (TAC and MC) to reconcile budgeted profit to actual profit.

14.15 Solutions to practice questions

Solutions

The total direct material cost variance is calculated as follows:

	₦
2,000 units of output should cost (×₦15)	30,000
They did cost	33,600
Total direct materials cost variance	3,600

The variance is adverse, because actual costs were higher than the standard cost.

Solutions

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	33,600
Material price variance	2,400

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

Materials usage variance

	litres
2,000 units of Product P123 should use (× 5 litres)	10,000
They did use	10,400
Material usage variance in litres	400
Standard price per litre of Material A	₦3
Material usage variance in ₦	₦1,200

The usage variance is adverse because more materials were used than expected, which has added to costs.

Solutions

AQ $_{purchased}$ × AC		
10,400 litres ×₦X 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	
		1,200 (A) Usage variance
SQ $_{used}$ × SC		
10,000 litres ×₦3 per kg	30,000	

SQ = 2,000 units × 5 litres per unit = 10,000 litres

Solutions **5**

Materials	AQ in AM	@	SC		
	litres		**₦**	**₦**	**₦**
A	994	x	150	149,100	
B	1,240	x	200	248,000	
	2,234			397,100	
					5,020(F) MIX
	AQ in SM	@	SC		
A (0.4)	893.6		150	134,040	
B (0.6)	1,340.4		200	268,080	
	2,234			402,120	
	SQ in SM	@	SC		
A (0.4)	1,600		150	240,000	317,880(F) YI
B (0.6)	2,400		200	480,000	
	4,000			720,000	

Making 80 units should use 80 units x 50 litres per unit = 4,000 units

Quicker version

	AQ in AM	@	SC		
A	994		150	149,100	
B	1,240		200	248,000	
	2,234			397,100	
	AQ in SM	@	SC of input		5,020(F) MIX
	2,234		9,000/50 litres	402,120	
	SQ in SM	@	SC of input		317,880(F) YI
	4,000		9,000/50 litres	720,000	

or	SC of output	
80 units	9,000	720,000

Solutions

Total direct labour cost variance	**₦**
3,000 units of output should cost (×₦6)	18,000
They did cost	16,200
Direct labour total cost variance	1,800

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 (×₦12)	16,800
They did cost	16,200
Direct labour rate variance	600

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 (× 0.5 hours)	1,500
They did take	1,400
Efficiency variance in hours	100
Standard direct labour rate per hour	₦12
Direct labour efficiency variance in ₦	₦1,200

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Labour cost variances: summary	**₦**
Labour rate variance	600
Labour efficiency variance	1,200
Total direct labour cost variance	1,800

Solutions

	₦'000	₦'000
AH $_{\text{paid for}}$ × AR		
1,400 hours ×₦X per hour	16,200	
AH $_{\text{paid for}}$ × SR		600 (F) Price variance
1,400 hours ×₦12 per hour	16,800	
AH $_{\text{worked}}$ × SR		zero idle time
1,400 hours ×₦12 per hour	16,800	
SH $_{\text{worked}}$ × SR		1,200 (F) Efficiency
1,500 hours ×₦12 per hour	18,000	

SQ = 3,000 units × 0.5 hours per unit = 1,500 hours

Solutions

Total variable production overhead cost variance	**₦**
2,000 units of output should cost (×₦3)	6,000
They did cost	6,550
Total variable production overhead cost variance	550

Variable production overhead expenditure variance	**₦**
2,780 hours should cost (×₦2)	5,560
They did cost	6,550
Variable production overhead expenditure variance	990

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	2,780
Efficiency variance in hours	220
Standard variable production overhead rate per hour	₦2
Variable production overhead efficiency variance in	₦440

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

Variable production overhead cost variances: summary

	₦
Variable production overhead expenditure variance	990
Variable production overhead efficiency variance	440
Total variable production overhead cost variance	550

Solutions

	₦'000	₦'000
AH $_{worked}$ × AR		
2,780 hours ×₦X per hour	6,550	
AH $_{worked}$ × SR		990 (A) Expenditure
2,780 hours ×₦2 per hour	5,560	
SH $_{worked}$ × SR		440 (F) Efficiency
3,000 hours ×₦2 per hour	6,000	

SH = 2,000 units × 1.5 hours per unit = 3,000 hours

Solutions

Standard fixed overhead cost per unit = ₦8 (₦40,000/₦5,000 units)

Fixed production overhead total cost variance

	₦
5,200 units @ standard fixed cost (×₦8) = fixed overhead absorbed	41,600
Actual fixed overhead cost expenditure	40,500
Fixed production overhead total cost variance	1,100

The variance is favourable, because fixed overhead costs have been over absorbed.

Fixed overhead expenditure variance

	₦
Budgeted fixed production overhead expenditure	40,000
Actual fixed production overhead expenditure	40,500
Fixed overhead expenditure variance	500

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	5,200
Fixed overhead volume variance in units	200
Standard fixed production overhead cost per unit	₦8
Fixed overhead volume variance in ₦	₦1,600

This variance is favourable because actual production volume exceeded the budgeted volume.

Summary	₦
Fixed overhead expenditure variance	500
Fixed overhead volume variance	1,600
Fixed overhead total cost variance	1,100

Solutions

The standard direct labour hours per unit = 10,000 hours/5,000 units = 2 hours per unit.

The standard fixed overhead rate per hour = ₦40,000/10,000 hours = ₦4 per hour.

The standard fixed overhead cost per unit is 2 hours ×₦4 per hour = ₦8 (or ₦40,000/5,000 units).

Fixed overhead efficiency variance

	hours
5,200 units should take (× 2 hours)	10,400
They did take	10,250
Efficiency variance in hours	150
Standard fixed overhead rate per hour	₦4
Fixed overhead efficiency variance in ₦	₦600

Fixed overhead capacity variance

	hours
Budgeted hours of work	10,000
Actual hours of work	10,250
Capacity variance in hours	250
Standard fixed overhead rate per hour	₦4
Fixed overhead capacity variance in ₦	₦1,000

The capacity variance is favourable because actual hours worked exceeded the budgeted hours (therefore more units should have been produced).

Summary	₦
Fixed overhead efficiency variance	600
Fixed overhead capacity variance	1,000
Fixed overhead volume variance	1,600

Solutions

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	351,400
Sales price variance	8,600

The sales price variance is adverse because actual sales revenue from the units sold was less than expected.

Sales volume variance:

	units
Actual sales volume (units)	7,200
Budgeted sales volume (units)	7,000
Sales volume variance in units	200
Standard profit per unit (₦50 – ₦42 = ₦8)	₦8
Sales volume variance (profit variance)	₦1,600

The sales volume variance is favourable because actual sales exceeded budgeted sales.

14.16 Questions and suggested solutions

14.16.1 Question

estion:

A manufacturing company that with factory in Ota, Ogun State makes quality wooden benches for both indoor and outdoor use. The management is reviewing operations for the last month. The company operates a standard absorption costing system and has the following standards, revenue and cost data per unit of each product:

Selling price	₦25.00
Direct Material X	3.5kg at ₦2.70 per kg
Direct Material Y	2.5kg at ₦2.20 per kg
Direct Labour	0.45hrs at ₦9.00 per hour

Fixed production overheads for month were expected to be ₦83,200.

Actual data for the month were as follows:

Sales and production: 50,000 units were produced and sold for ₦1,350,000
Direct material A: 120,000 kg were used at a cost of ₦240,000
Direct material B: 67,150 kg were used at a cost of ₦94,000
Employees worked for 15,000 hours, but 15,380 hours were paid at a cost of ₦120,000
Fixed production overheads ₦84,000

Budgeted sales for the month were 52,000 units of the product.

Required:

a. Calculate the following variances:
   i. Sales volume and sales price variances;
   ii. Price, mix and yield variances for each material;
   iii. Labour rate, labour efficiency and idle time variances; and
   iv. Fixed production overhead expenditure and volume variances.

b. Prepare an operating statement that reconciles budgeted profit to actual profit with each variance clearly shown.

c. Explain what is meant by basic standards and ideal standards and their effect on employee motivation.

4.16.2 Suggested solution

Suggested solution

(a) i. Sales volume variance (SVV):

	units
Actual sales volume (units)	50,000
Budgeted sales volume (units)	52,000
Sales volume variance in units	2,000
Standard profit per unit	₦4.40
Sales volume variance	₦8,800

or

SVV = (BQS – AQS) Standard profit

= (52,000 – 50,000) ₦4.4

= ₦8,800 (A)

Sales price variance (SPV):	**₦**	
50,000 units should sell for (× ₦25)	1,250,000	
They did sell for	1,350,000	
Sales price variance	100,000	(F)

or

SPV = (SSP – ASP) AQS

= ₦ (25 – 27) 50,000 units

= ₦100,000 (F)

ii. Materials price variance (MPV):

MPV = (SP – AP) AQp

Materials	SP	AP	AQp	MPV	
	₦	₦	kg	₦	
X	2.70	2	120,000	84,000	(F)
Y	2.20	1.40	67,150	53,730	(F)
				137,730	(F)

Materials mix variance (MMV):

MMV = {(AQ in AM) – (AQ in SM)} SP

Materials	AQ in AM	AQ in SM	Difference	SP	MMV
	Kg	kg	kg	₦	₦
X	120,000	109,171	10,829 (A)	2.70	29,238 (A)
Y	67,150	77,979	10,829 (F)	2.20	23,824 (F)
	187,150	187,150	0		5,414 (F)

AQ in SM was calculated as below:

X = 3.5 kg / 6 kg x 187,150 = 109,171 kg

Y = 2.5 kg / 6 kg x 187,150 = 77,979 kg

Materials yield variance (MYV):

Materials	AQ in SM	SQ in Actual production	Difference	SP	MMV
	Kg	kg	kg	₦	₦
X	109,171	175,000	65,829 (F)	2.70	177,738 (F)
Y	77,979	125,000	47,021 (F)	2.20	103,446 (F)
	187,150	300,000	112,850 (F)		281,184(F)

iii. **Labour rate variance (LRV):**

LRV = (SR – AR) AHp

= ₦(9 – 7.80) 15,380 hours

= ₦18,420 (F)

where AR = 120,000 / 15,380 = 7.80

Labour efficiency variance (LEV):

LEV = {(SH x Actual production) – AHw)} SR

= {(0.45hrs x 50,000 units) – 15,000 hrs} ₦9

= (22,500 hrs – 15,000 hrs) ₦9

= ₦67,500 (F)

Idle time variance (ITV):

ITV = (AHp – AHw) x SR

= (15,380 hrs – 15,000 hrs) ₦9

= ₦3,420 (A)

iv. **Fixed production overhead expenditure variance (FPOEV):**

FPOEV = BFE – AFE

= ₦(83,200 – 84,000)

= ₦800 (A)

Fixed production overhead volume variance (FPOVV):

FPOVV = (BQp – AQp) FOAR / unit

= (52,000 – 50,000) ₦1.60

= ₦3,200 (A)

Standard cost card:	₦
Direct material X: 3.5 kg x ₦2.70 =	9.45
Direct material Y: 2.5 kg x ₦2.20 =	5.50
Direct labour 0.45 hrs x ₦9 =	4.05
Fixed prod. o/h 0.45 hrs x ₦3.56 =	1.60
Standard costs	20.60
Standard selling price	25.00
Standard profit	4.40

where fixed o/h absorption rate (FOAR) per unit = Budgeted fixed production o/h / Budgeted quantity produced

= 83,200 / 52,000 = ₦1.60

where:

BQS = Budgeted Quantity Sold

AQS = Actual Quantity Sold

SSP = Standard Selling Price

ASP = Actual Selling Price

SP = Standard Price

AP = Actual Price

AQP = Actual Quantity Purchased

AQ = Actual Quantity Used

SM = Standard Mix

SQ = Standard Quantity per unit

SR = Standard Rate

AR = Actual Rate

AHp = Actual Hours paid for

AHw =Actual Hours worked

SH = Standard Hour/unit

BFE = Budgeted fixed production o/h

AFE = Actual fixed production o/h

BQp = Budgeted Quantity produced

AQp = Actual Quantity produced

F = Favourable

A = Adverse

(b) Operating statement reconciling budgeted profit with actual profit for the month:

	₦	₦	₦
Budgeted profit (₦4.4 x 52,000 units)			228,800
SPV		100,000 (F)	
SVV		8,800 (A)	91,200 (F)
			320,000
	(F)	(A)	
MPV:			
Material X	84,000		
Material Y	53,730		
MMV:			
Material X		29,238	
Material Y	23,824		
MYV:			
Material X	177.738		
Material Y	103,446		
LRV	18,420		
LEV	67,500		
ITV		3,420	
FPOEV		800	
FPOVV		3,200	
	528,658	36,658	492,000 (F)
Actual profit			812,000

Check – Actual Result:	₦	₦
Actual Revenue		1,350,000
Less cost of sales:		
Material A	240,000	
Material B	94,000	
Labour	120,000	
Fixed production overhead	84,000	538,000
Actual profit		812,000

c An ideal standard is one which can be attained under perfect operating conditions: no wastage, no inefficiencies, no idle time, no breakdowns.

A basic standard is a long-term standard which remains unchanged over the years and is used to show trends.

Ideal standards can be seen as long-term targets but are not very useful for day-to-day control purposes as they cannot be achieved. It is claimed that they provide employees with an incentive to be more efficient. However, they may have an adverse effect on employee motivation as variances will always be unfavourable.

Basic standards may have an unfavourable effect on motivation as employees Is cover over time that they are easily able to achieve the standards. It often leads to little or no improvement on productivity.

CHAPTER 15

COST VOLUME PROFIT (CVP) ANALYSIS

Contents

15 Cost Volume Profit (Cvp) Analysis

15.0 Learning objective

To help readers understand the concept of cost volume profit (CVP) analysis as a useful decision-making tool when an organisation faces short term economic decisions.

15.1 Learning outcomes

At the end of this chapter, readers should be able to calculate the:

a. number of units that must be sold to achieve break-even;
b. revenue that must be earned to achieve break-even;
c. margin of safety associated with a given level of production in terms of the number of units sold or revenue earned;
d. number of units that must be sold to achieve a target profit; and
e. revenue that must be earned to achieve a target profit.

15.2 Introduction to CVP analysis

Cost-volume-profit (CVP) analysis is a management accounting technique used to analyse how changes in costs and sales volume affect a company's profit. 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. It examines the relationship among selling price, sales volume, fixed costs, variable costs, and profit to support decision-making, planning, and control.

CVP analysis helps answer critical questions such as:

a. how many units must be sold to break even?
b. what sales volume is needed to achieve a target profit?
c. how will profits change with variations in selling price or cost structure?

15.3 Objectives/Applications of CVP analysis

Cost-Volume-Profit (CVP) analysis plays a vital role in managerial planning, decision-making, and control. Its primary objective is to help managers understand the interplay between costs, sales volume and profit. The following are the usefulness of CVP analysis:

a. **Profit planning**: CVP analysis assists in determining how many units of a product must be sold to earn a desired level of profit. It allows managers to set sales targets aligned with profit goals by evaluating how changes in price, cost, or volume affect profitability.
b. **Break-even analysis:** One of the core uses of CVP is to calculate the break-even point—where total revenue equals total costs, and the business neither makes a profit nor incurs a loss. This is crucial for understanding the minimum performance required to avoid losses.
c. **Decision-making support**: Managers use CVP to assess how business decisions, such as changes in price, introduction of a new product, or altering cost structures, will impact profitability. It helps in choosing among alternatives by analysing their financial consequences.
d. **Cost control and efficiency:** By highlighting the relationship between variable and fixed costs, CVP encourages businesses to examine their cost structures. This insight supports more informed cost control and operational efficiency strategies. **Budgeting and forecasting:** CVP analysis provides a foundation for budgeting and short-term forecasting. It helps estimate future profits based on projected sales volumes and cost behaviour, making it easier to align operational plans with financial goals.

e. **Risk assessment:** CVP tools like the margin of safety help assess the risk of not achieving break-even or target profit levels, giving managers a clearer picture of business stability under varying conditions.

15.4 Assumptions in CVP analysis

Cost-Volume-Profit (CVP) analysis is based on several simplifying assumptions that help make the analysis manageable and understandable.

a. First, it assumes that all costs can be clearly categorised as either fixed or variable. Fixed costs, such as rent or managerial salaries, do not change with the level of output, while variable costs, like raw materials or direct labor, increase in direct proportion to the level of production or sales. Mixed costs must be separated into fixed and variable elements before CVP analysis can be applied.

b. Another assumption is that the selling price per unit remains constant throughout the period under analysis. This means that the business does not apply discounts or experience price fluctuations, ensuring a linear relationship between revenue and sales volume.

c. Similarly, variable cost per unit is also assumed to remain unchanged, implying that there are no changes in production efficiency or input prices.

d. CVP analysis further assumes that total fixed costs remain constant over the relevant range of activity. This relevant range is the level of activity within which all cost behaviours are assumed to be valid; outside of this range, cost patterns may change, making the analysis less reliable.

e. In addition, the analysis presumes that the number of units produced equals the number of units sold. This eliminates the impact of inventory changes on the analysis, ensuring that all costs and revenues are tied directly to sales activity.

f. For businesses that offer multiple products, CVP assumes a constant sales mix, the ratio in which different products are sold remains unchanged. Any change in this mix could affect the overall contribution margin and potentially distort the results of the analysis.

15.5 Limitations of CVP analysis

a. **Assumption of constant selling price and costs**
CVP analysis assumes that selling prices and variable costs remain constant. However, in reality, these can fluctuate due to market conditions, competition, or supplier changes, making this assumption unrealistic in a dynamic business environment.

b. **Linear relationship between costs, volume, and profit**
CVP assumes a linear relationship, meaning that the increase in costs and profits is proportional to changes in production volume. In practice, this relationship may not be linear, as costs may not increase proportionally or may change in different stages of production.

c. **Focus on a single product (or constant sales mix)**
CVP analysis generally assumes that a business sells a single product or that the sales mix remains constant. In multi-product businesses, variations in the product mix can significantly affect the overall profitability, which CVP does not fully address without adjustments.

d. **ignores external factors**
The model focuses solely on internal variables like sales volume, costs, and prices, ignoring external factors such as changes in the economy, regulations, or consumer

preferences. These factors can significantly impact profitability but are not accounted for in standard CVP analysis.

e. **Fixed costs are assumed to be constant**
CVP analysis assumes that fixed costs remain constant within the relevant range. However, fixed costs may change when a company scales production beyond certain thresholds, such as the need for additional facilities, equipment, or employees, which CVP does not capture.

15.6 Contribution

In **Cost-volume-profit (CVP) analysis**, **contribution** refers to the **contribution margin**, which is the amount remaining from sales revenue after deducting **variable costs**. It is called "contribution" because it **contributes** toward covering **fixed costs**, and once those are covered, it contributes to **profit**.

Contribution = sales revenue – variable costs

The contribution can be calculated **per unit** (contribution per unit = selling price per unit – variable cost per unit) or **in total** (total contribution = total sales – total variable costs).

Role of contribution in CVP analysis

a. **Break-even analysis**: CVP uses contribution to determine how many units must be sold to cover all fixed costs. At the break-even point, total contribution equals total fixed costs.

b. **Profit planning**: Beyond the break-even point, each additional unit sold contributes directly to profit, since fixed costs are already covered.

c. **Decision making**: By understanding the contribution margin, management can evaluate the impact of changes in price, costs, or volume on overall profitability.
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 overall sales volume.

Illustration:

	₦
Sales (Units sold × sales price per unit)	X
Variable costs (Units sold × variable cost price per unit)	(X)
Contribution	X
Fixed costs	(X)
Profit	X

Total contribution = Contribution per unit × Number of units sold.

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 increase 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 contribution per unit (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	(1)
Contribution per unit	7

	70,000 units ₦	80,000 units ₦	90,000 units ₦
70,000×₦7perunit	490,000		
80,000×₦7perunit		560,000	
90,000×₦7perunit			630,000
Fixed costs	(500,000)	(500,000)	(500,000)
Profit/(loss)	(10,000)	60,000	130,000

Contribution/Sales (CS) () 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:

Contribution per unit/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	÷0.4375	÷0.4375	÷0.4375
Sales revenue	1,120,000	1,280,000	1,440,000

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.

15.7 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.

Assumptions of Break-Even Analysis

Break-even analysis makes several key assumptions that can limit its applicability in some real-world scenarios. These assumptions include:

a. **Constant Selling Price**: The analysis assumes that the selling price per unit remains constant, regardless of the quantity sold. In reality, pricing might vary based on volume discounts, market conditions, or customer negotiations. This assumption may not always hold in competitive markets or businesses with dynamic pricing strategies.
b. **Linear Cost Behavior**: It assumes that both fixed and variable costs behave in a linear manner. Fixed costs remain constant regardless of the level of production, while variable costs change in direct proportion to the number of units produced. However, in real life, variable costs might not increase linearly due to factors such as bulk discounts or changing input prices. Similarly, fixed costs might increase in stepped increments (e.g., if additional production capacity is required).
c. **One Product or Constant Sales Mix**: Break-even analysis is typically applied to a single product or assumes that the sales mix (in a multi-product company) remains constant. If a company sells multiple products, each with different contribution margins, the break-even point will change depending on the relative sales of each product. The assumption of a consistent sales mix may not hold if product preferences or market conditions shift.
d. **No Inventory Changes**: Break-even analysis assumes that all units produced are sold within the period, meaning there is no inventory buildup or depletion. In reality, businesses might face variations in demand, leading to unsold inventory, which could distort the analysis.

Applications of Break-Even Analysis

Break-even analysis serves several strategic and operational purposes for businesses, including:

a. **Pricing Decisions**: By understanding the break-even point, businesses can make informed decisions on setting product prices. If the company knows its fixed costs and the variable cost per unit, it can calculate the minimum price needed to cover all costs and achieve profitability. This analysis helps ensure that the company doesn't set prices too low to cover costs.
b. **Cost Control**: Break-even analysis helps identify the impact of cost changes on profitability. If fixed or variable costs increase, the break-even point will also increase, meaning the company will need to sell more units to cover the new costs. This encourages managers to look for cost-saving opportunities and implement effective cost controls.
c. **Sales Targets**: Companies can use break-even analysis to set sales targets. By determining how many units need to be sold to break even, businesses can set realistic sales goals for different levels of profit. This helps focus efforts on achieving the required sales volume to cover both fixed and variable costs.
d. **Profitability Forecasting**: Break-even analysis can also help forecast profitability at various sales levels. By considering different scenarios (e.g., varying sales volumes or pricing), businesses can assess how much profit they can expect under different conditions, helping them make better strategic decisions.
e. **Assessing Risk**: Break-even analysis allows businesses to assess the risk associated with their operations. If the break-even point is high, it means the company needs to sell a large

volume to cover costs, making it more vulnerable to demand fluctuations or economic downturns. A low break-even point might indicate a more flexible business model with lower financial risk.

Limitations of Break-Even Analysis

While break-even analysis is a powerful tool, it comes with several limitations that should be considered:

a. **Unrealistic Assumptions**: As mentioned earlier, break-even analysis assumes constant pricing, linear costs, and no changes in inventory, among other things. In reality, businesses often face fluctuations in prices, costs, and sales volumes, which can make the results of the analysis less reliable. For instance, cost structures might change as production scales up, or selling prices might need to be adjusted based on market conditions.

b. **Not Suitable for Dynamic Environments**: Break-even analysis works best in relatively stable environments where costs and sales are predictable. In industries with rapidly changing market conditions, technological innovations, or shifting consumer preferences, break-even analysis might not provide an accurate reflection of future performance.

c. **Difficulty with Multiple Products**: When dealing with multiple products, each with different contribution margins, applying break-even analysis becomes more complex. The weighted average contribution margin must be used, but determining the right sales mix is often difficult. As a result, businesses may find it challenging to accurately calculate the break-even point when they have a diverse range of products.

d. **Ignores Non-Financial Factors**: Break-even analysis focuses exclusively on financial data and ignores other factors that might affect business decisions, such as customer satisfaction, brand strength, or market positioning. While profitability is important, non-financial metrics can also play a significant role in decision-making.

e. **Limited Use in Long-Term Decision-Making**: Break-even analysis is often used for short-term decisions, especially those related to pricing and cost control. However, it is less useful for long-term strategic planning, as it does not account for factors such as market growth, technological advancements, or competitive pressures that may affect future business viability.

15.8 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 few 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 Break-even point in sales units = $\dfrac{\text{Total fixed costs}}{\text{Contribution per unit}}$

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?

Method1

Break-even point in sales units = $\dfrac{\text{Total fixed costs}}{\text{Contribution per unit}}$

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 Break-even point in revenue= $\dfrac{\text{Fixed costs}}{\text{Contribution to sales ratio}}$

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?

Method2

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)=75,000units.

15.9 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. a quantity of units (= the difference between the budgeted sales volume in units and the break-even sales volume); or
b. 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.

The margin of safety serves as a critical risk management tool, offering businesses a buffer against fluctuations in market conditions, competition, and economic factors. A larger margin of safety signals greater financial health, as the company has more flexibility to handle sales declines without incurring losses. Conversely, a smaller margin of safety indicates higher vulnerability and requires more careful monitoring. This metric also helps inform decision-making, as businesses with a low margin of safety may need to adjust pricing strategies, reduce costs, or improve sales efforts to protect profitability.

Additionally, the margin of safety is influenced by a company's fixed and variable costs, with higher fixed costs typically resulting in a lower margin of safety. As a dynamic measure, it can change overtime in response to shifts in sales, costs, or pricing. The margin of safety is often used in conjunction with break-even analysis, providing businesses with valuable insights into risk levels and profitability. It can also be applied to specific products or departments, offering more focused insights for targeted decision-making.

Example:

A company budgets to sell 25,000 units of its product. The selling price of each unit is ₦16, and the variable cost per unit is ₦4. The fixed costs for the period are expected to be ₦240,000.

The break-even point=₦240,000/(₦16–4)=20,000units.

The budgeted sales are 25,000 units.

Margin of safety =Budgeted sales–break-even sales

=25,000–20,000=5,000units

The margin of safety is often expressed as a percentage of budgeted sales.

Formula: Margin of safety ratio

$$\text{Margin of safety ratio} = \frac{\text{Margin of safety(units)}}{\text{Budgeted sales(units)}}$$

$$\text{Margin of safety ratio} = \frac{\text{Margin of safety(revenue)}}{\text{Budgeted revenue}}$$

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 $^{5,000\text{units}}/_{25,000\text{units}}$ = 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.

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

$$\text{Target volume(units)} = \frac{\text{Total fixed costs + target profit}}{\text{Contribution per unit}}$$

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

$$\text{Volume target in revenue} = \frac{\text{Total fixed costs + target profit}}{\text{Contribution to sales ratio}}$$

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:

(i) The budgeted contribution per unit

(ii) 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: (i) The monthly fixed costs (ii) The level of monthly sales needed to increase the monthly profit to ₦5,000.

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	100,000
Total contribution required	700,000

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 units × ₦9 = ₦1,575,000

Alternatively:
C/S ratio = 4/9
Sales revenue required to make a profit of ₦100,000
=₦700,000 x (4/9) = ₦1,575,000.
Therefore, the number of units required to achieve target profit
₦1,575,000 ÷ ₦9 = 175,000units

15.10 Break-even chart

A **break-even chart** is a visual tool used to represent the relationship between costs, sales revenue, and profit at different levels of production or sales. It illustrates the point at which a company's total revenue equals its total costs, resulting in neither profit nor loss, known as the **break-even point (BEP)**. The break-even chart is a valuable management tool in cost-volume-profit (CVP) analysis because it allows businesses to see how changes in production volume affect profitability.

Types of Break-even Charts

a. **Single-product Break-even Chart**: This is the most straightforward type, where the company produces and sells only one product. The chart shows how changes in production and sales volume of this single product affect the company's financials.
b. **Multi-product Break-even Chart**: When a company produces multiple products, the break-even chart needs to account for the sales mix and varying contribution margins of each product. The analysis becomes more complex, and the break-even point is determined for the overall business rather than individual products.

Key Elements of a Break-even Chart:

a. **Total Revenue Line**: The total revenue line represents the income generated from selling products. It is a straight line starting from the origin (0 units and 0 revenue) and slopes upward as sales volume increases. The slope of this line is determined by the selling price per unit. The steeper the slope, the higher the selling price per unit.
b. **Total Costs Line**: The total costs line represents the sum of fixed and variable costs. It starts at the point of fixed costs on the vertical axis (since fixed costs are incurred even if no units are sold) and increases as production and sales volume rise. The line has an upward slope due to the inclusion of variable costs, which increase with each unit produced.

c. **Fixed Costs**: The horizontal line on the chart represents fixed costs. These costs do not change with the level of production or sales volume. Fixed costs include things like rent, salaries, insurance, and other overheads. These costs remain constant regardless of whether the company produces one unit or thousands of units.

d. **Variable Costs**: Variable costs are the costs that increase with production volume. These include costs like materials, direct labor, and energy. On the break-even chart, variable costs are reflected by the slope of the total costs line, which becomes steeper as production increases.

e. **Break-even Point (BEP)**: The break-even point is the level of sales or production where total revenue equals total costs, resulting in zero profit. On the chart, this is the point where the total revenue line intersects the total costs line. Beyond this point, the company starts to generate a profit. Before the break-even point, the company incurs a loss.

f. **Profit Area**: The area above the break-even point, where total revenue exceeds total costs, represents the company's profit. The larger the gap between the total revenue line and total costs line, the higher the profit.

g. **Loss Area**: The area below the break-even point represents a loss. As sales volume decreases and the total revenue line falls below the total costs line, the company experiences losses.

How to interpret a break-even chart

The interpretation of a break-even chart can be broken down into three key areas: **before the break-even point**, **at the break-even point**, and **after the break-even point**.

Before the break-even point: In this section of the chart, total revenue is less than total costs, meaning the company is operating at a loss. The distance between the total revenue line and the total cost line represents the loss. As sales volume decreases and moves further from the break-even point, the company continues to experience a loss. This area is critical for businesses to monitor because it highlights the sales threshold that must be surpassed to begin covering costs.

At the break-even point: This point on the chart is where total revenue exactly equals total costs, resulting in neither profit nor loss. The break-even point represents the minimum level of sales or production required to cover both fixed and variable costs. At this point, the business has "broken even" and is not generating any profit yet. For a company to start making a profit, it must exceed this point. Understanding this point is essential for business owners, as it determines the minimum sales targets that need to be met for financial stability.

After the break-even point: Once the company surpasses the break-even point, total revenue exceeds total costs, resulting in profit. This area above the break-even point indicates profitability. The greater the distance between the total revenue line and the total cost line, the higher the profit. Businesses can use this section of the chart to assess how changes in production or sales volume can positively impact their profit margins.

Examples of break-even charts

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.

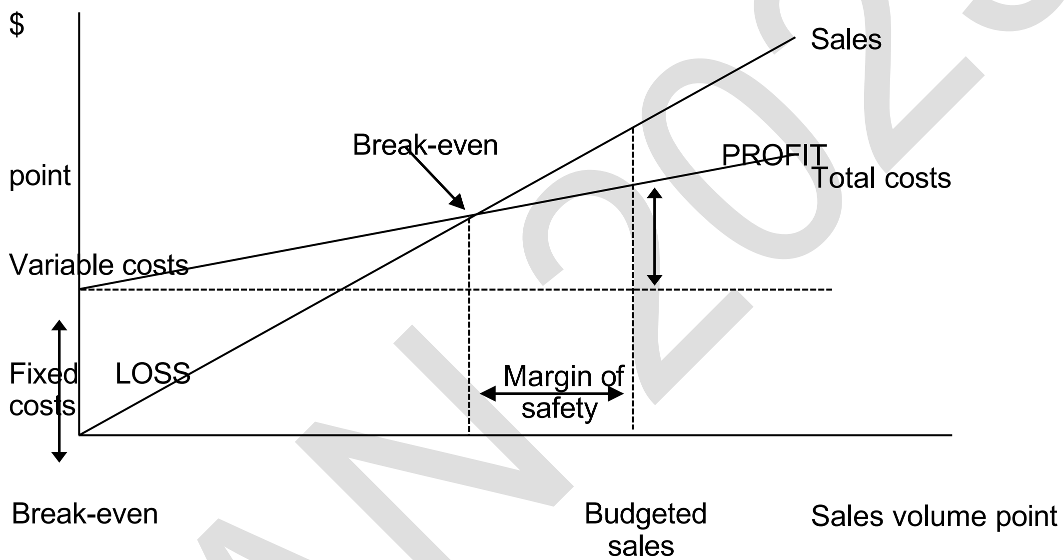
In the first diagram, variable costs are shown on top of fixed costs. Fixed costs are represented by the horizontal line of dashes. Fixed costs are the same amount at all volumes of sales.

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).

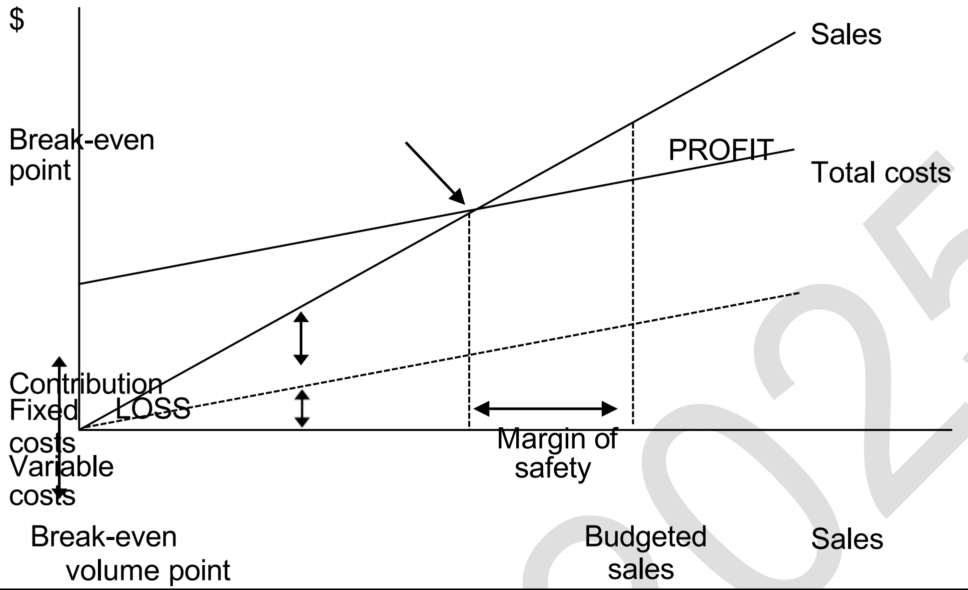
First break-even chart: Variable costs on top of fixed costs.

Illustration:



Second break-even chart: fixed costs on top of variable costs

Illustration:



Note

You should be able to identify the following points on these charts.

a. The break-even point is shown on both charts as the volume of sales at which total revenue equals total costs.

b. In the second chart, total contribution at the break-even point is shown as exactly equal to fixed costs.

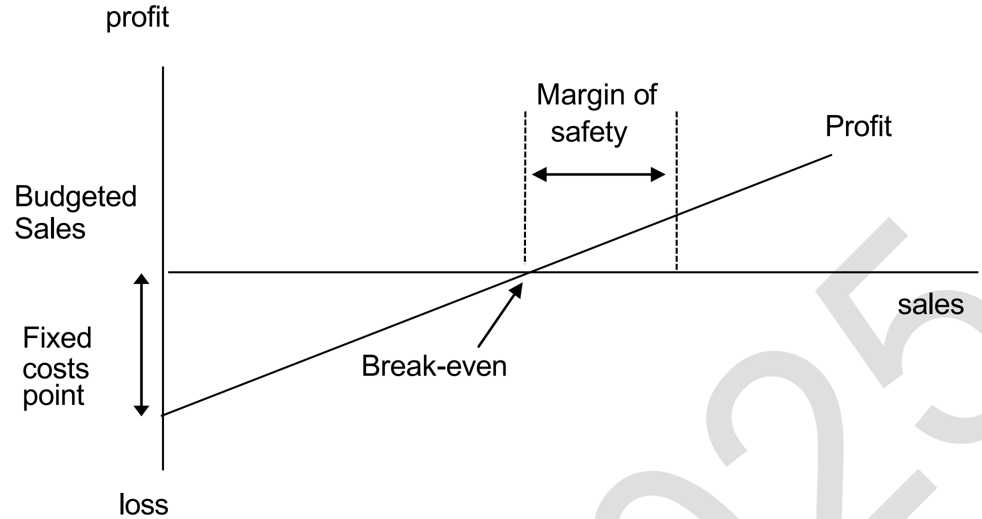
c. If budgeted sales are shown on the chart, the margin of safety can also be shown, as the difference between budgeted sales and the break-even point.

15.11 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.

Illustration:



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

(a) Prepare a traditional break-even chart using the information given above.

(b) Calculate the margin of safety if annual sales are expected to be 15,000 units.

15.12 Chapter review

Before moving on to the next chapter check that you can calculate the:

a. number of units that must be sold to achieve break-even;
b. revenue that must be earned to achieve break-even;
c. margin of safety associated with a given level of production in terms of the number of units sold or revenue earned;
d. number of units that must be sold to achieve a target profit; and
e. revenue that must be earned to achieve a target profit.

Solutions to practice questions

Solutions **1**

1 Contribution per unit=60%×₦80=₦48 Fixed costs = ₦360,000

Break-even point=₦360,000/₦48perunit=7,500units Budgeted sales = 8,000 units

Margin of safety=(8,000–7,500)units=500units

As a percentage of budgeted sales, the margin of safety is (500/8,000) ×100%= 6.25%.

2 (a) Contribution/sales ratio=60%

Therefore, variable costs/sales ratio=40%. Variable cost per unit = ₦20

Therefore, sales price per unit=₦20/0.40=₦50.

Contribution per unit=₦50–₦20=₦30.

	₦
Budgeted contribution(8,000×₦30)	240,000
Budgeted fixed costs(8,000×₦25)	200,000
Budgeted profit, current year	40,000

(b) Sales price next year = ₦50 × 1.06= ₦53 per unit Variable cost per unit next year=₦20×1.05=₦21

Therefore, contribution per unit next year =₦53–₦21=₦32

	₦
Target profit next year	40,000
Fixed costs next year(200,000×1.10)	220,000
Target contribution for same profit as in the current year	260,000

Therefore, target sales next year=₦260,000/₦32perunit=8,125 units.

Solutions (continued) 1

3 Break-even point=₦48,000/0.40=₦120,000 (sales revenue).

Margin of safety (in sales revenue)=₦140,000–₦120,000= ₦20,000.

Selling price per unit= ₦10.

Margin of safety (in units)=₦20,000/₦10=2,000units.

(i) The margin of safety is 6.25%.Therefore the break-even volume of sales = 93.75% of budgeted sales = 0.9375 × ₦128,000=₦120,000

	Budget	**Break-even**
	₦	₦
Sales	128,000	120,000
Profit	(2,000)	(0)
Total costs	126,000	120,000

This gives us the information to calculate fixed and variable costs, using high/low analysis.

	₦ Revenue		**₦Cost**
High: Total cost at	128,000	=	126,000
Low: Total cost at	120,000	=	120,000
Difference: Variable cost of	8,000	=	6,000

Therefore, variable costs = ₦6,000/₦8,000 = 0.75 or 75% of sales revenue.

Substitute in high or low equation	**Cost**
	₦
Total cost at ₦128,000 revenue	126,000
Variable cost at ₦128,000 revenue (×0.75)	96,000
Therefore, fixed costs	30,000

Solution (continued) Alternative approach **1**

(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) ÷ C/S ratio

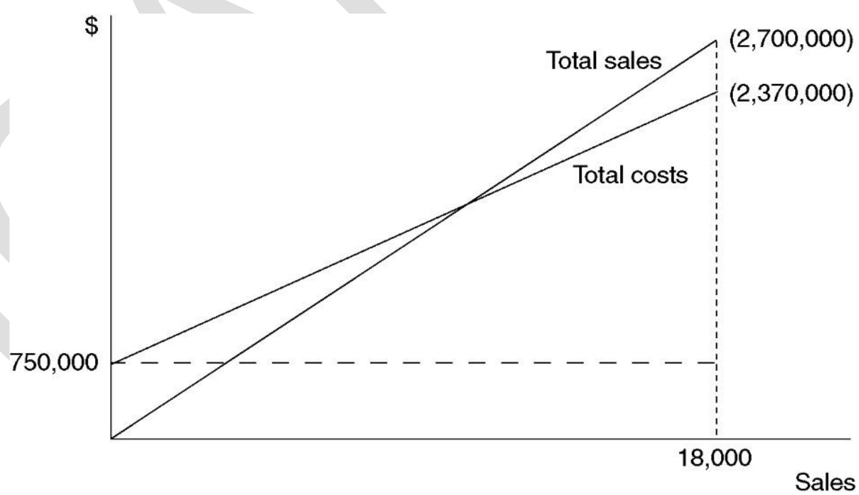
= ₦3,000/0.25 = ₦12,000.

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	30,000
Target contribution	35,000
C/S ratio	0.25
Therefore, sales required (₦35,000/0.25)	₦140,000

Solutions **2**



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

Whensalesare18,000 units:	
Sales (at ₦150 each)	2,700,000
Variable cost (sales x 60%)	1,620,000
Contribution (sales x 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**

Break-even point = Fixed costs ÷ C/S ratio

=₦750,000/0.40 = ₦1,875,000

Break-even point in units = ₦1,875,000/₦150 per unit = 12,500 units.

If budgeted sales are15,000units, the margin of safety is 2,500units. This is 1/6 or 16.7% of the budgeted sales volume.

CHAPTER 16

RELEVANT COST ANALYSIS

Contents

16 Relevant Cost Analysis

16.0 Learning objective

This chapter introduced the readers to the concept of relevant costs and revenue as a tool for management short term decisions.

16.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain the characteristics of relevant costs;
b. explain and differentiate between avoidable and unavoidable costs;
c. explain the meaning of incremental cost (revenue), differential costs (revenue), sunk costs and opportunity costs (revenue); and
d. measure relevant costs and revenue associated with a particular decision.

16.2 Information for decision-making

Management makes 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 were 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.

16.2.1 Marginal costing and decision-making

Marginal costing might be used for decision-making. 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.

16.2.2 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:

a. relevant costs are costs that will occur in the future. they cannot include any costs that have already occurred in the past;
b. 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
c. 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.

16.2.3 Relevant and Irrelevant costs

Relevant costs are those that have a direct impact on specific business decisions. They are future-oriented and differ between alternatives. These costs are crucial for decision-making, as they enable managers to focus on the costs that will change or can be avoided depending on the chosen option. Relevant costs include variable costs, incremental costs, and opportunity costs, and should be the focus in decisions such as accepting special orders, make-or-buy choices, or discontinuing a product. The defining feature of relevant costs is their direct association with the decision and their variability with the selected course of action.

Conversely, irrelevant costs have no effect on the decision-making process. These costs do not differ between alternatives and are usually past costs or fixed costs that remain unchanged regardless of the decision. Irrelevant costs include sunk costs—costs already incurred and unrecoverable—and unavoidable fixed costs. Since these costs do not change with the decision at hand, they should not influence the decision-making process and are excluded from relevant cost analysis.

Key differences

Aspect	Relevant Costs	Irrelevant Costs
Impact on Decision	Affect the decision being made	Do not affect the decision being made
Timing	Future-oriented	Past-oriented or unchanged
Avoidability	Can be avoided if a decision changes	Cannot be avoided regardless of the decision

Aspect	Relevant Costs	Irrelevant Costs
Differential (Incremental)	Vary between decision alternatives	Do not vary between decision alternatives
Examples	Variable costs, incremental costs, opportunity costs	Sunk costs, fixed costs (if unchanged)
evance to Decision	ectly influence the decision-king process	not influence the decision-king process

16.2.4 Effect of relevant costing on pricing decisions

Special order pricing
Relevant costing plays a vital role in determining the pricing decisions of a company, especially when considering special order pricing. Here, a company may receive an order at a price different from its usual selling price. Relevant costing helps assess whether the special order is profitable by focusing on the incremental costs associated with fulfilling the order. If the company has excess production capacity, only the variable costs for the special order may need to be considered, as fixed costs will not change. This enables the company to decide if the lower price is acceptable, provided it covers relevant costs and contributes to fixed cost recovery.

Make or buy decisions
Relevant costing is also crucial in make or buy decisions, where a company must decide whether to produce a product in-house or purchase it from an external supplier. The analysis compares the incremental costs of internal production versus the supplier's price. Only avoidable costs, those that would be incurred based on the decision, are considered. Fixed costs that remain unchanged are irrelevant, making it easier to determine the most cost-effective option based on variable and differential costs.

Cost-plus pricing strategy
In a cost-plus pricing strategy, where a company sets prices by adding a markup to its costs, relevant costing ensures the price covers only the variable costs and a portion of fixed costs that are relevant. The focus is on variable costs such as direct materials and labour, which change with production levels. By using relevant costs, the company ensures the price covers costs incurred by production, resulting in more accurate pricing and maintained profitability.

Pricing under limited capacity
Relevant costing aids in pricing decisions when a company faces production constraints. With limited resources, contribution margin analysis allows the company to prioritise products that offer the highest contribution per unit of constrained resource. Pricing decisions must then maximise the contribution to fixed costs, with relevant costs determining which products to produce or prioritise.

Competitive market pricing
In competitive markets, relevant costing is essential for setting target prices that are both competitive and profitable. The company must consider market conditions and competitor prices, while ensuring its price covers relevant costs, particularly variable costs. This approach allows the company to remain competitive, while ensuring all relevant costs are covered and profitability is maintained.

Discontinuation decisions
Relevant costing is also used to determine whether to discontinue a product or service. Only the relevant costs that would be saved by discontinuing are considered, such as variable costs directly tied to production. Fixed costs that remain unchanged are irrelevant. If a product is not

positively contributing to fixed cost coverage, discontinuing it may improve overall profitability by reallocating resources to more profitable products.

16.3 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

Acompanyhasidentifiedthateachcostunititproduceshasthefollowingcosts:

	₦000
Direct materials	50
Direct labour	20
	70
Fixed production overhead	30
Total absorption cost	100

Making one extra unit would not affect the fixed cost base. The incremental cost of making one extra unit is ₦70,000.

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 ₦2,000 each month

It is considering switching to a larger photocopier that will cost ₦3,600 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₦1,600 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 on 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.

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.

Note
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 2

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 (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 resources 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).

16.4 Identifying relevant costs

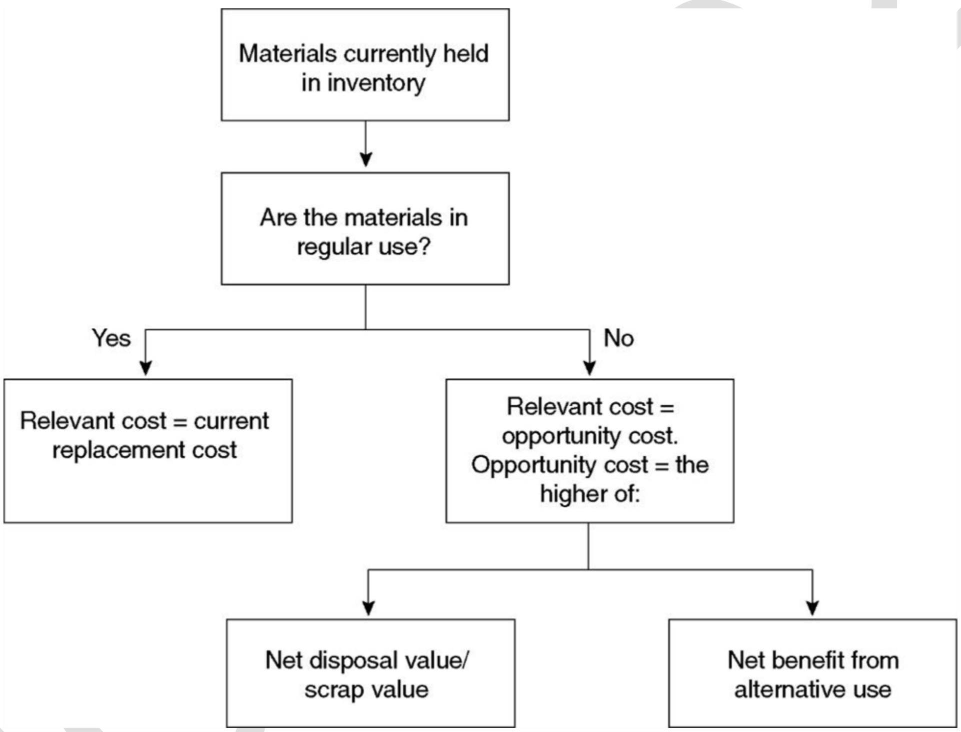
16.4.1 Relevant cost of materials

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	800,600

16.4.2 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 f 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

Aproposednewcontractwouldrequire100hoursofworkindepartment2. 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 hours × ₦320 per hour = ₦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
	(780)
Contribution per unit of product Z	200

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	340

Relevant cost of 300 hours = 300 × ₦340 = ₦102,000.

16.4.3 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 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 will 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, 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.

16.5 Chapter review

Chapter review

Before moving on to the next chapter, check that you can:

a. explain the characteristics of relevant costs;
b. explain and differentiate between avoidable and unavoidable costs;
c. explain the meaning of incremental cost (revenue), differential costs (revenue), sunk costs and opportunity costs (revenue); and
d. measure relevant costs and revenue associated with a particular decision.

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.

Relevant cost= ₦17,500-₦10,000= ₦7,500.

2 A total of 900 hours would have to be found by either working overtime at a cost of ₦15×150%=₦22.50 per hour, Or diverting labour from other work that earns a contribution of ₦5 per hour after labour costs of ₦15 per hour. The opportunity cost of diverting labour from other work is therefore ₦20 per hour. This is less than the cost of working overtime. If the contribution 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 ₦0.

Relevant cost of labour	**₦**
500 hours	0
900 hours(×₦20)	18,000
Total relevant cost of labour	18,000

CHAPTER 17

LIMITING FACTORS

Contents

17 Limiting Factors

17.0 Learning objective

This chapter introduced the concept of limiting factor in short term management decision making

17.1 Learning outcomes

At the end of this chapter, readers should be able to:

a. explain the issue of limiting factors;
b. 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
c. analyse relevant costs to decide whether to make or buy a good.

17.2 Introduction

In management accounting, a **limiting factor** refers to any resource or condition that restricts an organisation's ability to achieve its objectives or maximise profit. Common examples include limited materials, labour hours, machine time, or market demand. When such constraints exist, businesses must prioritise how they use their scarce resources. Limiting factor analysis helps in identifying the most efficient allocation by focusing on products or activities that generate the highest **contribution per unit of the limiting factor**. This approach supports better short-term decision-making and optimal resource utilisation.

17.3 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.

Types of limiting factor in organisations

Organisations may encounter various limiting factors that restrict their ability to meet production or sales targets. These constraints can arise from internal resources or external conditions. The main types include:

a. **Labour hours**: When there is a shortage of skilled labour or limited available working hours, production capacity may be restricted;
b. **Raw materials**: Limited availability of essential materials can halt or delay production, especially when suppliers cannot meet demand;

c. **Machine capacity**: Insufficient machine hours due to breakdowns, maintenance, or outdated equipment can limit output.
d. **Financial resources**: A lack of funds or restricted budgets can prevent investment in inventory, marketing, or additional capacity.
e. **Sales demand**: If the market demand is lower than production capacity, sales become the limiting factor, and excess production leads to inefficiencies.

Impact of limiting factors on business decisions

When resources such as labour, materials, or capital are constrained, management must prioritise how these scarce inputs are allocated. This often leads to the use of **limiting factor analysis** to determine which products or services yield the **highest contribution per unit of the limiting factor**. As a result, businesses may choose to **focus on the most profitable products**, postpone or reject less profitable projects, or seek ways to **increase capacity of the** constraint.

In production planning, limiting factors affect decisions such as **product mix**, **order acceptance**, and **outsourcing**. In pricing, firms may adjust prices to reflect the scarcity of resources. Additionally, investment decisions might be influenced by a need to relieve the constraint, such as acquiring more machinery or hiring additional staff. Ultimately, recognising and responding to limiting factors helps businesses **optimize profitability**, manage risks, and maintain efficient operations despite resource shortages.

17.4 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	3,500	4,000
Total hours available	3,000	4,200

Therefore, machine 1 time is the limiting factor

17.5 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 (1st)	15,000 (maximum)	1,500	5	75,000
X (2nd)	9,000	1,500 (balance)	7	63,000
		3,000		138,000

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 hours at 6 units per hour or 12,000 units $\times$ $^{1,500 \text{ hours}}/_{2,000 \text{ hours}}$).

Practice question

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

Required:

Calculate the optimal production plan

Practice question **2**

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.

17.6 Make or buy decisions:

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:

a. 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);

b. Make-or-buy decisions;
c. Shutdown decisions; and
d. Joint product further processing decisions.

17.7 Make-or-buy (outsource) decisions

A make-or-buy decision is a decision about:

a. whether to make an item internally or to buy it from an external supplier; or
b. 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:

a. the costs that would be saved if the work is outsourced or sub-contracted; and
b. 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	48,000
Net benefit from external purchasing (outsourcing) per year	18,000

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.

17.8 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:

a. seek to maximise its profits, and therefore;

b. 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	Budgeted number of jobs	Variable cost per job (₦)	Sub-contractor quote 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	1st	2nd	3rd
Priority for doing work with own resources	3rd	2nd	1st

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

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?

Required:

Calculate the total cost associated with the optimal plan.

17.9 Other short term decisions

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:

a. One-off contract decisions; and

b. Shutdown decisions.

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	359,000

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 x 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 x ₦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 x 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	77,000

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).

17.10 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
	800	1,500	1,100	1,200	4,600
Sales	1,800	1,650	2,200	1,550	7,200
Contribution	1,000	150	1,100	350	2,600
Directly attributable fixed costs	(400)	(250)	(300)	(300)	(1,250)
Share of general fixed costs	(200)	(200)	(300)	(400)	(1,100)
Profit/(loss)	400	(300)	500	(350)	250

'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	400	250	300	300
Increase/(reduction) in annual cash flows	(600)	100	(800)	(50)

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.

17.11 Chapter review

Chapter review

Before moving on to the next chapter, check that you can:

a. explain the issue of limiting factors;
b. identify limiting factors;
c. carry out limiting factor analysis to formulate an optimal production plan (that is, production plan that maximises contribution and hence profit); and
d. analyse relevant costs to decide whether to make or buy a good.

17.12 Solutions to practice questions

Solution

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				
($^{\text{total labour cost per unit}}/_{\text{labour cost perhour}}$)	$^{6}/_{12}$	$^{12}/_{12}$	$^{3}/_{12}$	$^{9}/_{12}$
	0.5	1	0.25	0.75
Step 4: Contribution per hour				
($^{\text{contribution per unit}}/_{\text{labour hours per unit}}$	$^{4.5}/_{0.5}$	$^{7}/_{1}$	$^{2.5}/_{0.25}$	$^{9}/_{0.75}$
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 (1st)	4,000 (maximum)	3,000	9.0	36,000
C (2nd)	8,000 (maximum)	2,000	2.5	20,000
A (3rd)	2,000 (balance)	1,000	4.5	9,000
		6,000		65,000

Solution (continued)

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

	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

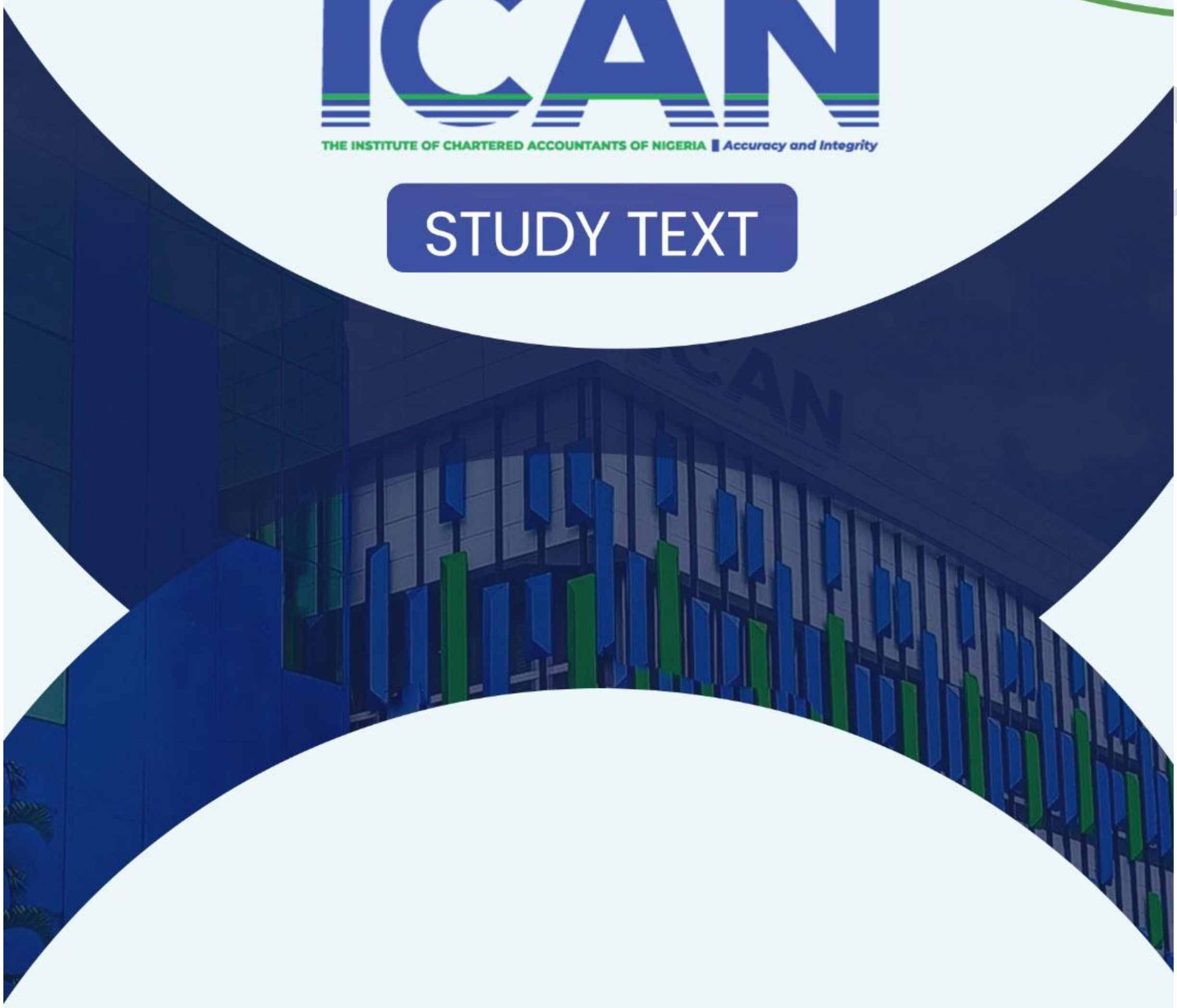
The selling price for each product is higher than the variable cost of purchasing each product externally; therefore, profit will be maximised by making the products in-house or purchasing them externally, up to the full amount of the annual sales demand.

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
	3,500		
Outsourced			
Z		1,000	110,000
X		6,000	708,000
Total variable cost			1,478,000

STUDY TEXT



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