# PERFORMANCE MANAGEMENT (PM)

## STUDY TEXT

THE INSTITUTE OF
CHARTERED ACCOUNTANTS
OF NIGERIA

PERFORMANCE MANAGEMENT (PM)

Published by:
The Institute of Chartered Accountants of Nigeria
PC 16, Idowu Taylor Street
Victoria Island, Lagos, Nigeria
Email: info.ican@ican.org.ng
www.ican-ngr.org

ISBN 978-978-57010-0-5 (A NEW ONE IS REQUIRED)

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August 2025

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# Foreword

## FORWORD

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 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 and Assurance 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**

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# A

# ACKNOWLEDGEMENT

## 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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Skills Level

PerformanceManagement

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**Skills level**

**Performance management**

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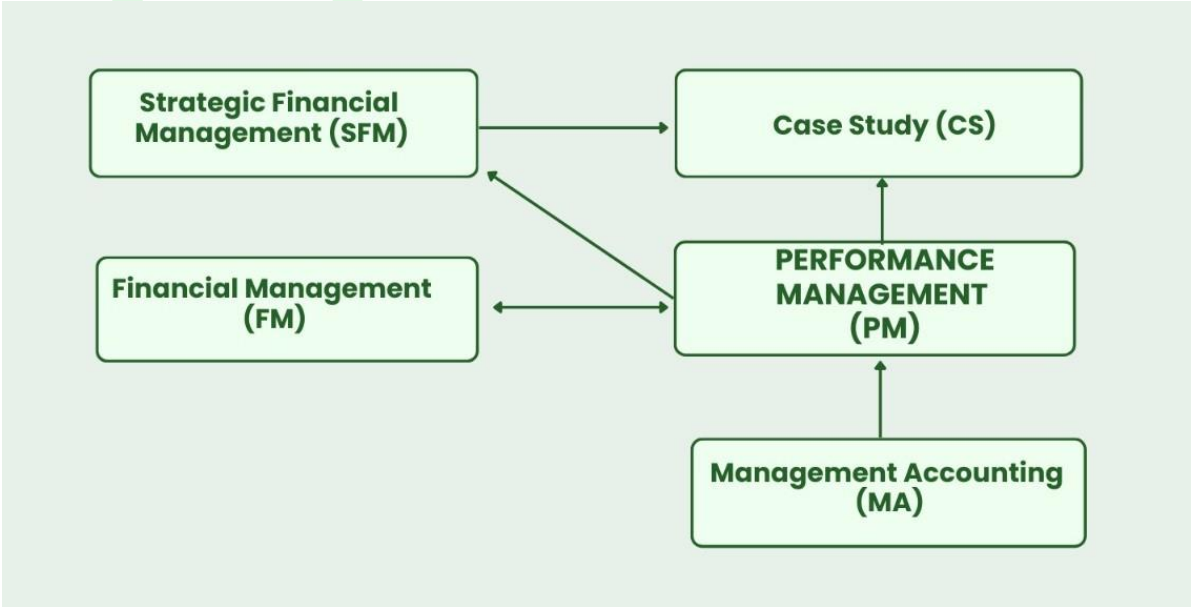
# SYLLABUS

## SYLLABUS

| AIMS |
| --- |
| To develop candidates' knowledge and skills in the application of management accounting techniques to prepare data, information and apply appropriate technology to support management decision making on setting metrics and targets, planning and budgeting, cost management, quality control, performance measurement and comparative analysis. |

***Linkage with other related 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:

- Identify and discuss requirements in management information systems (MIS) and developments in technology essential for organisations to manage and measure performance;
- Explain and apply cost accounting techniques;
- Select and apply appropriate decision-making techniques to setting metrics and targets, and facilitate business decisions and promote efficient and effective use of scarce business resources taking into consideration inherent risks and uncertainty in such businesses and their control;
- Identify and apply appropriate budgeting techniques and methods for planning and control;
- Use standard costing systems to measure and control business performance and recommend remedial actions;
- Evaluate the performance of an organisation, products and business segments, products and services against metrics and targets;
- Assess organisational performance from both financial and non-financial perspectives, considering the problems associated with the control of divisions within an organisation and the importance of allowing for external considerations;
- Advise clients and senior management on strategic business performance evaluation and recognising vulnerability to corporate failure;
- Apply appropriate technology and techniques to support management decision making, including product costing, variance analysis, inventory management, budgeting and forecasting, and value chain analysis; and
- Advise clients and top management of business organisation on emerging issues in performance management.

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## Specification grid

| | Content and competencies – Overview | |
|---|---|---|
| | **Grid** | **Weight %** |
| A | Management information systems and data analytics | 10 |
| B | Advanced costing techniques | 15 |
| C | Decision making techniques | 25 |
| D | Budgeting and control | 20 |
| E | Performance measurement, control and Management systems | 15 |
| F | Performance evaluation and corporate failure | 10 |
| G | Emerging issues in performance management | 5 |
| | TOTAL | 100 |

## DETAILED CONTENTS

### A. MANAGEMENT INFORMATION SYSTEMS AND DATA ANALYTICS 10%

**1. Management information systems**

(a) Explain the role of information systems in organisations.
(b) Discuss the costs and benefits of information systems.
(c) Explain the uses of the internet, intranet, wireless technology and networks.
(d) Identify the accounting information requirements and describe the different types of information system used for strategic planning, management and operational control and decision making.
(e) Define and discuss the main characteristics of transaction processing systems (TPS); management information systems (MIS); executive information systems (EIS); enterprise resource planning systems (ERPS) and customer relationship management systems (CRMS).
(f) Identify and discuss the social and ethical issues that may impact on an organisation's strategy formulation and assess the role of the management accountant in data collection for measurement and reporting of social and environmental factors, to demonstrate a wider view in performance reporting.

**2. Application of big data and data analytics**

(a) Discuss and apply the principles of big data in management information and decision making.
(b) Discuss the purpose and application of the big data pyramid.
(c) Discuss the uses and benefits of big data, data mining and data analytics.
(d) Discuss the challenges and risks associated with application of big data and data analytics in an organisation.

### B. ADVANCED COSTING TECHNIQUES 15%

**1. Activity based costing (ABC**

(a) Discuss ABC and its uses as a costing technique.
(b) Identify the suitable cost drivers under ABC.
(c) Calculate the cost per driver and per unit, using ABC.
(d) Compare ABC and the traditional method of overhead absorption.

2. **Target costing**

(a) Discuss the principles of target costing and its uses as a costing technique.
(b) Evaluate the target cost in manufacturing and service industries.
(c) Discuss the challenges of applying target costing in service industries.
(d) Advise on how a target cost gap can be managed.

3. **Life cycle costing**

| DETAILED CONTENTS | |
|---|---|
| (a) Discuss the principles of life cycle costing and its uses as a costing technique.<br>(b) Identify and discuss the various stages in the lifecycle of a product and the associated cost involved.<br>(c) Evaluate the lifecycle cost or profit in manufacturing and service industries.<br>(d) Explain the benefits of lifecycle costing. | |
| 4. **Throughput accounting** | |
| (a) Discuss the principles of throughput accounting and its uses as a costing technique.<br>(b) Assess and apply the theory of constraints [TOC].<br>(c) Evaluate and draw conclusions from the throughput accounting ratio (TAR).<br>(d) Advise on ways in which the TAR could be improved.<br>(e) Discuss the application of throughput accounting in multi-product decision making. | |
| 5. **Accounting for environmental and sustainability factors** | |
| (a) Discuss the concept of environmental accounting and sustainability in business.<br>(b) Discuss the issues involved in managing environmental costs.<br>(c) Evaluate the different methods of accounting for environmental costs.<br>(d) Discuss the challenges faced in accounting for environmental and sustainability factors.<br>(e) Assess the principal roles of the management accountant in supporting the business to develop sustainability practices and sustainability reporting. | |
| **C. DECISION MAKING TECHNIQUES** | **25%** |
| **1. Relevant cost analysis** | |
| (a) Explain the concept of relevant cost and revenue.<br>(b) Identify and calculate relevant costs for specific decision situations from given data.<br>(c) Explain and apply the concept of opportunity costs. | |
| **2. Cost volume profit analysis (CVP)** | |
| (a) Explain the concept of CVP analysis.<br>(b) Calculate and interpret the break-even point and margin of safety.<br>(c) Calculate the contribution to sales ratio in single and multi-product situations, and demonstrate an understanding of its uses.<br>(d) Calculate target profit and revenue in single and multi-product situations and demonstrate an understanding of its uses.<br>(e) Interpret break-even charts and profit-volume charts and interpret the information contained within each, including multi-product situations.<br>(f) Discuss the limitations of CVP analysis for planning and decision-making. | |
| **3. Limiting factors** | |
| (a) Identify limiting factors in a scarce resource situation and select appropriate technique for allocation of the scarce resource(s). | |

## DETAILED CONTENTS

(b) Determine the optimal production plan where an organisation is restricted by a single limiting factor, within the context of make-or-buy decisions.

(c) Formulate and solve multiple scarce resource problems using, both linear programming, graphs and simultaneous equations as appropriate (excluding simplex and sensitivity to changes in objective functions).

(d) Explain and calculate shadow prices (dual prices) and discuss their applications for decision making and performance management.

(e) Calculate slack and explain the implications of the existence of slack for decision-making and performance management.

### 4. Pricing decisions

(a) Discuss the factors that influence the pricing of a product or service.

(b) Calculate and explain the price elasticity of demand.

(c) Derive and apply a straight-line demand equation and also an equation for the total cost function (including volume based discounts).

(d) Calculate the optimum selling price and quantity for a product, equating marginal cost and marginal revenue.

(e) Evaluate a decision to increase production and sales levels, considering incremental costs, incremental revenues and other factors.

(f) Determine prices and output levels for profit maximisation, using the demand-based approach to pricing (both tabular and algebraic methods).

(g) Discuss different pricing strategies, including:

- (i) All forms of cost-plus;
- (ii) Skimming;
- (iii) Penetration;
- (iv) Complementary products;
- (v) Product-line;
- (vi) Volume discounting;
- (vii) Discrimination; and
- (viii) Relevant cost.

(h) Calculate a price from a given strategy using cost-plus and relevant cost.

### 5. Make-or-buy and other short-term decisions

(a) Explain the issues surrounding make-or-buy and outsourcing decisions.

(b) Calculate and compare "make" costs with "buy-in" costs.

(c) Compare in-house costs and outsource costs of completing tasks and consider other issues surrounding this decision.

(d) Apply relevant costing principles in situations involving shut down, one-off contracts and further processing of joint products.

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### 6. Dealing with risk and uncertainty in decision making

(a) Identify and evaluate research techniques to reduce uncertainty e.g., focus groups, market research.

(b) Explain the use and application of simulation, expected values and sensitivity to decision making.

(c) Explain the use and application of the following techniques: maximax, maximin, and minimax regret to decision making, including the production of profit tables.

(d) Interpret a decision tree and use it to solve a multi-stage decision problem.

(e) Explain and calculate the value of perfect and imperfect information.

## *D. BUDGETING AND CONTROL* *20%*

### 1. Budgetary systems and types of budget

(a) Select and explain appropriate budgetary system for an organisation, including fixed, flexible, top-down, bottom-up, rolling, zero-based, activity-based, incremental and feed-forward control.

(b) Discuss the usefulness and problems associated with different budget types (including fixed, flexible, zero-based, activity based, incremental, rolling, top-down and bottom-up).

(c) Prepare fixed budget, flexed budget, rolling budget and activity-based budget including functional and master budgets.

(d) Explain the beyond budgeting model, including the benefits and problems that may be faced if it is adopted in an organisation.

(e) Explain the benefits and difficulties of the participation of employees in the budgeting process and negotiation of targets.

(f) Discuss ethical and sustainability considerations when setting budgets.

### 2. Analytical techniques in budgeting and forecasting

(a) Analyse fixed and variable cost elements from total cost data, using high/low method.

(b) Explain and apply analysis techniques including correlation, regression and time series.

(c) Estimate the learning rate and learning effect.

(d) Apply the learning curve model to a budgetary problem, including calculations on steady states.

(e) Discuss the benefits and limitations of correlation, regression and time series techniques, and also the reservations with the learning curve model.

### 3. Standard costing

(a) Explain the use of standard costs.

(b) Outline the methods used to derive standard costs and discuss the different types of standard cost.

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|---|---|
| | (c) Calculate basic variances such as<br>(i) Material price and usage variances<br>(ii) Labour rate, efficiency and idle time variances<br>(iii) Labour mix and yield variances |
| **4.** | **Material mix and yield variance** |
| | (a) Calculate, identify the cause of, and explain material mix and yield variances.<br>(b) Explain the wider issues involved in changing material mix e.g., cost, quality and performance measurement issues.<br>(c) Identify and explain the relationship of the material usage variance with the material mix and yield variances. |
| **5.** | **Sales mix and quantity variances** |
| | (a) Explain, calculate and identify the causes of sales mix and quantity variances.<br>(b) Identify and explain the relationship of the sales volume variances with the sales mix and quantity variances. |
| **6.** | **Planning and operational variances** |
| | (a) Discuss the concept of planning and operational variances.<br>(b) Prepare a revised budget.<br>(c) Identify and explain those factors that could lead to revision of an original budget.<br>(d) Explain, calculate and identify the causes of planning and operational variances, for:<br>(i) Sales, including market size and market share;<br>(ii) Materials; and<br>(iii) Labour, including the effect of the learning curve. |
| **7.** | **Performance analysis** |
| | (a) Discuss the effects of variances on staff motivation and actions.<br>(b) Describe the dysfunctional nature of some variances in the environment of JIT and TQM.<br>(c) Discuss the behavioural problems resulting from using standard costs in rapidly changing environments. |
| **E.** | **PERFORMANCE MEASUREMENT, CONTROL AND MANAGEMENT SYSTEM 15%** |
| **1.** | **Performance analysis for profit oriented organisations** |
| | (a) Select and calculate suitable financial performance measures for a business from a given data and information.<br>(b) Evaluate the result of calculated financial performance measures based on business objectives and advise management on appropriate actions.<br>(c) Select and calculate suitable non-financial performance measures for a business from a given data and information. |

| DETAILED CONTENTS | |
|---|---|
| | (d) Evaluate the results of calculated non-financial performance measures, based on business objectives and advise management on appropriate actions.<br>(e) Explain the causes and problems associated with short-termism and financial manipulation of results and suggest methods to encourage a long term view.<br>(f) Discuss sustainability considerations in performance measurement of a business.<br>(g) Select and explain stakeholder-based measures of performance that may be used to evaluate environmental, social and governance (ESG) performance of a business.<br>(h) Explain and interpret the balanced scorecard. |
| **2.** | **Performance analysis in not-for-profit organisations** |
| | (a) Discuss the problems of using non-quantifiable objectives in performance management.<br>(b) Explain how performance may be measured in not-for-profit organisations.<br>(c) Discuss the problems of having multiple objectives.<br>(d) Demonstrate value for money (VFM) as a public sector objective. |
| **3.** | **Divisional Performance and Transfer Pricing** |
| | (a) Discuss the various methods of setting transfer price and evaluate the suitability of each method.<br>(b) Determine the optimal transfer price, using appropriate models.<br>(c) Explain the benefits and limitations of transfer pricing methods.<br>(d) Demonstrate and explain the impact of taxation and repatriation of funds on international transfer pricing.<br>(e) Select and explain suitable divisional measures for a given business using return on investment (ROI), residual income (RI) and economic value added (EVA) approaches. Evaluate the results and advise management. |
| **4.** | **Analyse and evaluate business objectives and strategies using value chain analysis.** |
| **5.** | **Analyse and evaluate suitable performance measures for profitability, liquidity and solvency.** |
| **F.** | **PERFORMANCE EVALUATION AND CORPORATE FAILURE 10%** |
| 1. | **Strategic performance issues in complex business structures** |
| | (a) Evaluate the problems encountered in planning, controlling and measuring performance level, including, productivity, quality, profitability and service levels in complex business structure.<br>**(b)** Assess the impact of the use of business models, including business alliances, complex supply chain structure, joint ventures, etc on performance management. |
| 2. | **Alternative views of performance measurement and management** |

| DETAILED CONTENTS | |
|---|---|
| | (a) Assess and evaluate the effectiveness of the performance pyramid in linking strategy, operations, and performance.<br>(b) Assess and evaluate the use of balanced scorecard approach in improving the range and linkage between performance measures.<br>(c) Evaluate and advise on the value-based management approaches to performance management. |
| 3. | **Predicting and preventing corporate failure** |
| | (a) Assess how long-term survival brings about the necessity of considering lifecycle issues.<br>(b) Calculate and advise on the potential likelihood of corporate failure utilising qualitative and quantitative performance measures and models, including Z-score and Argenti.<br>(c) Identify the advantages and disadvantages of each of quantitative and qualitative corporate failure prediction models.<br>(d) Identify and advise on performance management strategies that may be adopted to prevent corporate failure.<br>(e) Evaluate the operational changes in organisational performance management system required to implement performance improvement strategies. |
| ***G.*** | ***EMERGING ISSUES IN PERFORMANCE MANAGEMENT 5%*** |
| 1. | **Current developments in management accounting** |
| | (a) Identify and evaluate the various ways in which new techniques are made available to management accounting practitioners.<br>(b) Evaluate the use of benchmarking in public sector performance (league tables) and its effect on operational and strategic management and client behaviour.<br>(c) Identify the challenges of setting targets in public sector organisations. |
| 2. | **Current issues and trends in performance management** |
| | (a) Assess the changing role of the management accountant in modern business environment.<br>(b) Evaluate contemporary issues in performance management. |

**Skills level**
**Performance Management**




# MANAGEMENT INFORMATION SYSTEMS

## Chapter content

1.0 Learning objective
1.1 Learning outcomes
1.2 MIS and role of information systems in organizations.
1.3 Costs and benefits of information systems
1.4 Use of internets, intranets, wireless technology and networks.
1.5 Accounting information requirements and types of Accounting information used for Strategic, tactical and operational planning, control and decision making.
1.6 Characteristics of various types of accounting information.
1.7 Social and Ethical issues that impact on organization's strategy formulation.
1.8 Chapter review

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# 1 Management Information Systems

## 1.0 Learning objective

This chapter introduces candidates to the concept of management information system (MIS) and its use in planning and performance management.

## 1.1 Learning outcomes

On successful completion of this chapter, readers should be able to:

(a) understand the concept of management information system and the importance in performance management;

(b) understand the types and roles of accounting systems;

(c) understand the strategic planning process;

(d) explain the different informational needs for strategic, tactical and operational management;

(e) explain the difference between strategic, tactical and operational planning and control;

(f) explain the importance of corporate objectives and the link to performance management; and

(g) understand the potential conflict that may arise between strategic objectives and short- term decisions.

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## 1.2 Management Information System and Role of Information Systems in Organisations

Performance management incorporates activities that aim to ensure goals are consistently met in an effective and efficient manner. In order to achieve this, management require reliable information systems to support them in:

(a) making appropriate decisions; and
(b) reviewing the results of those decisions as a basis for future decisions and performance management.

In this chapter we re-visit the fundamentals of information systems that you initially encountered in the Management accounting paper as the basis for considering information systems in the context of performance management.

A Management Information System (MIS) is an information system used for decision-making, coordination, control, analysis, and visualization of information within an organisation, focusing on how people, processes, and technology interact. Thus the primary goal of an MIS is to provide managers with the information they need to make informed decisions and achieve organisational goals.

Information is processed data. Data can be defined as facts that have not been assembled into a meaningful structure. Data is processed into a structured form that has some meaning: this is called 'information'. Most management information can be likened to business information.

Businesses use information in several ways.

(a) Information is used to perform routine transactions, such as order processing and invoicing.

(b) Information is used to make decisions.

(c) Information is also developed into knowledge that can be used to improve the business.

Managers could not make decisions without information. However, information can vary in quality, and as a general rule managers will make better decisions when they have better-quality information.

### 1.2.1 Sources of information:

Introduction

Performance measurement systems, both for planning and for monitoring actual performance, rely on the provision of relevant, reliable and timely information.

Information comes from both inside and outside the organisation.

Traditionally, management accounting systems have been an information system providing financial information to managers from sources within the

organisation. In large organisations, management accounting information might be extracted from a cost accounting system, which records and analyses cost.

With the development of IT systems, management information systems have become more sophisticated, using large databases to hold data, from external sources as well as internal sources. Both financial and non-financial data are held and analysed. The analysis of data has also become more sophisticated, particularly through the use of spreadsheets and other models for planning and cost analysis (for example, activity based costing).

Information from internal sources

A control system such as a management accounting system must obtain data from within the organisation (from internal sources) for the purposes of planning and control. The system should be designed so that it captures and measures all the data required for providing management with the information they need.
**Potential internal sources include:**

(a) the financial accounting records;

(b) human resource records maintained in support of the payroll system;

(c) production information;

(d) sales information; and

(e) staff (through minutes of meetings etc.)

**1.2.2 The essential qualities of good information are as follows**:

(a) Relevance: Information should be relevant to the needs of management. Information must help management to make decisions. Information that is not relevant to a decision is of no value. An important factor in the design of information systems should be the purpose of the information – in what decisions should be made, and what information will be needed to make those decisions?

(b) Reliability: Information should be reliable. This means that the data should be sufficiently accurate for its purpose. It should also be complete.

(c) Timeliness: Information should be available in a timely manner. In other words, it should be available for when it is needed by management.

(d) Economy: The cost of providing the information should not exceed the benefits that it provides. The key factor that limits the potential size of many information systems is that the cost of obtaining additional information is not justified by the additional benefits that the information will provide.

**1.2.3 Other qualities of good information include:**

(a) Completeness: Information should have all the variables that will be needed for the intended decision.
(b) Accuracy**:** Information should be correct and precise for the intended purpose.
(c) Clarity**:** Information must be clear to the user(s).
(d) Consistency**:** Information must agree at all times with established norms and

frameworks.

(e) Comprehension**:** Information should be presented in a way that the user/ reader can easily comprehend it.

(f) Comparability**:** This is the degree to which accounting information and policies are consistently applied from one period to another in line with standards.

(g) Verifiability**:** Verifiability is the extent to which information is reproducible given the same data and assumptions.

In designing a performance measurement system, and deciding what information is required from internal sources, these desirable qualities of good information should influence the design of the system.

Traditionally, management accounting systems obtain internal data from the cost accounting system and costing records. In many organisations, IT systems now integrate costing data with other operational data. This means that data is available to the management accounting system from non-accounting sources.

### 1.2.3 Example: Information

An information system might be required to provide information about the profitability of different types of customer.

The starting point for the design of this information system is the **purpose** of the information. Why is information about customer profitability needed? The answer might be that the company wants to know which of its customers contribute the most profits, and whether some customers are unprofitable. If some customers are unprofitable, the company will presumably consider ways of improving profitability (for example, by increasing prices charged to those customers) or will decide to stop selling to those customers.

The next consideration is: What data is needed to measure customer profitability? The answer might be that customers should first be divided into different categories, and each category of customer should have certain unique characteristics. Having established categories of customer, information is needed about costs that are directly attributable to each category of customers.

| Information area | Examples of information needed |
|---|---|
| **Customers** | What are the needs and expectations of customers in the market?<br>Are these needs and expectations changing?<br>What is the potential for our products or services to meet these needs, or to meet them better? |
| **Competitors** | Who are they?<br>What are they doing?<br>Can we copy some of their ideas?<br>How large are they, and what is their market share? How profitable are they? |

| | |
|---|---|
| | What is their pricing policy? |
| *Legal environment* | What are the regulations and laws that must be complied with |
| *Suppliers services?* | What suppliers are there for key products or services?<br>What is the quality of their products or services? What is the potential of new suppliers?<br>What is the financial viability of each supplier? |
| *Political/ environmental issues* | Are there any relevant political developments or developments relating to environmental regulation or environmental conditions? |
| *Economic/financial environment* | What is happening to interest rates? |
| | What is happening to exchange rates? |
| | What is happening in other financial markets? |
| | What is the predicted state of the economy? |

This might be information relating to gross profits from sales, minus the directly attributable selling and distribution costs (and any directly attributable administration costs and financing costs).

Having established what information is required, the next step is to decide how the information should be 'captured' and measured. In this example, a system is needed for measuring each category of customer, sales revenues, costs of sales and other directly attributable costs.

The information should be available for when management intend to review customer profitability. This might be every three months, six months or even annually.

### 1.2.4 Information from external sources

Managers need information about customers, competitors and other elements in their business environment. The management information system must be able to provide this in the form that managers need, and at the time that they need it.

External information is needed for strategic planning and control. However, it is also often needed for tactical and operational management decisions.

Examples of the external information needed by companies are set out in the table below

What are the regulations and laws that must be complied with

What suppliers are there for key products or services?

What is the quality of their products or services? What is the potential of new suppliers?

What is the financial viability of each supplier? possible sources of external information

Sources of external information, some accessible through the Internet, include:

(a) market research

(b) supplier price lists and brochures

(c) trade journals

(d) newspapers and other media

(e) government reports and statistics

(f) reports published by other organisations, such as trade bodies.

### 1.2.5 Limitations of external information

It is important to recognise the limitations of external information.

(a) It might not be accurate, and it might be difficult to assess how accurate it is.

(b) It might be incomplete.

(c) It might provide either too much or not enough detail.

(d) It might be difficult to obtain information in the form that is ideally required.

(e) It might not always be available when required.

(f) It might be difficult to find.

(g) It might be out of date.

(h) It might be misinterpreted.

### 1.2.6 Costs of information

Information must be captured and processed, if it is to be useful, and used effectively.

The costs of capturing and processing data should include the cost of the hardware and software used, time spent inputting, analysing and interpreting data (though this might be automated in some instances, for example data input using EPOS systems).

Modern computing equipment makes it very easy to amass huge amounts of data which can be processed into information, but this can bring its own problems:

(a) The information might not be useful, in which case, the cost of producing it is a waste.
(b) Important details might be omitted in large volumes of information.

Another important cost is the associated cost of poor decisions based on incomplete information or on a misinterpretation of that information. That could prove very costly indeed.

## 1.3 Costs and Benefits of information system:

Implementing an information system can bring about benefits like improved efficiency, enhanced decision-making, and increased collaboration. However, there are need to justify the costs of having the information system. The costs of an information system include:

(a) costs associated with security risks
(b) costs associated with implementation
(c) costs related to technology dependency

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These can be detailed thus:

### 1.3.1 Costs:

(a) **Security risks:** Information systems can be vulnerable to cyberattacks, data breaches, and other security threats, requiring significant investment in security measures.

(b) **Costly implementation:** Developing and implementing new information systems can be expensive to pay for hard wares, software and training and development of personnel.

(c) **Dependency on technology:** Reliance on information systems can create vulnerabilities, as disruptions to technology can lead to operational problems.

(d) **Job displacement:** Some roles may be replaced by technology, leading to job losses or the need for employees to acquire new skills.

(e) **Training costs:** Employees need to be trained to use new information systems, which can be a significant cost.

(f) **Maintenance costs:** Information systems require ongoing maintenance and upgrades, which can be an ongoing expense.

(g) **Data storage and processing costs:** Storing and processing large amounts of data can be expensive, requiring investment in hardware and software.

(h) **Opportunity costs:** Investing in one information system may mean foregoing the opportunity to invest in other areas of the business

### 1.3.2 The benefits associated with information system include:

(a) **Improved efficiency:** Information systems can automate tasks, streamline processes, and reduce manual effort, leading to increased productivity and efficiency.

(b) **Enhanced decision-making:** By providing timely and accurate data, information systems enable better decision-making at all levels of an organisation.

(c) **Increased collaboration:** Information systems can facilitate communication and collaboration among employees, customers, and partners, leading to better coordination and teamwork.

(d) **Cost reduction:** Automation and improved efficiency can lead to lower operational costs, while also reducing the need for physical resources.

(e) **Better customer service:** Information systems can enable organisations to better manage customer relationships, track orders, and provide personalized service.

(f) **Greater availability:** Information systems can make data and resources more accessible to users, regardless of location or time.

### 1.3.3 Methodologies of cost -benefit justification for information system include:

**Decision analysis method**
The decision analysis approach is useful for evaluating information systems designed to support routine decision making especially in situations of uncertainty.

**Cost displacement and avoidance method**
This is the most common, and most direct, approach to cost justifying information systems is by comparing their costs to the total of the current costs they will displace plus the projected. The cost displacement/avoidance methodology involves only estimates and projections of costs (and not productivities, sales, revenues or profits), costs they will avoid.

**Structural models**
Here the cost of managing the information and the benefit of such are compared in terms of profit achieved.

**Cost effectiveness analysis**
Cost effectiveness analysis (CEA) is used for choosing among similar information systems or system components. It does not explicitly address whether the benefits of any of the systems exceed their costs. It attempts to identify the best among several options, without formally determining whether that best option is truly desirable.

**Breakeven analysis**
Breakeven analysis is a parametric assessment of benefits, where the parameter values are selected to equate costs and benefits. The technique is used when costs are quantifiable but some key benefits are uncertain or intangible.

**Subjective analysis**
This approach asks the decision maker(s) to subjectively determine whether the prospective benefits of a system are worth the projected costs. Ordinarily, the subjective approach is used when the benefits are intangible, speculative or uncertain

**Time savings time salary method**
An increasingly popular methodology for estimating the value of end user information systems is to estimate the percent of workers' time the system will save, and then to multiply that percentage by the workers' loaded salaries or wages

**Work value method**.

The work value model was developed to overcome the shortcomings of the time savings times salary approach. It is motivated by the recognition that white collar workers routinely perform activities of different intrinsic value to the organisation, and by the recognition that one of the major benefits of information systems is their capacity to restructure work patterns.

Other methods of cost benefit analysis are:

(a) discounted cash flow analysis (net present value approach, internal rate of return approach);
(b) life cycle cost analysis;
(c) incremental cost analysis; and
(d) sensitivity analysis

### 1.3.4 Importance of information systems

IT systems can produce:

(a) custom data to help with a specific task or decision-making;
(b) custom format (eg list, chart, etc) which can be tailored to the user's need;
(c) real-time data, particularly useful where fast action is needed (eg mechanical fault); and
(d) archived data, particularly useful for reports, analysis and business planning.

### 1.3.5 Other advantages of information system

Technology systems can also benefit a business by enabling:

(a) operational efficiencies;
(b) cost reductions;
(c) supply of information to decision-makers;
(d) better customer service;
(e) continuous availability of the systems; and
(f) growth in communication capabilities and methods.

### 1.3.6 Importance of information systems

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### 1.3.7 Other advantages of information systems

Technology systems can also benefit a business by enabling:

(a) operational efficiencies

(b) cost reductions
(c) supply of information to decision-makers
(d) better customer service
(e) continuous availability of the systems
(f) growth in communication capabilities and methods
(g)

## 1.4 Uses of internet, intranet, wireless technology and network

**Internet**

The Internet is a vast, interconnected network of computers and devices globally, allowing users to access information and communicate. Thus, Internet is a global public network for communication and information sharing.

### 1.4.1 Uses of internet:

(a) information access: search for information, browse websites, and access online resources;
(b) communication: email, instant messaging, video calls, and social media;
(c) e-commerce: online shopping, banking, and financial transactions;
(d) entertainment: streaming, gaming, and accessing online content; and
(e) education: online learning, research, and accessing educational resources.

### 1.4.2 Intranet

An intranet is a private, internal network within an organisation, typically used for secure communication and resource sharing among employees. An intranet is thus a private, internal network used by an organisation.

### 1.4.3 Uses of intranet:

(a) Internal communication: Sharing company news, announcements, and updates.
(b) Resource sharing: Accessing company documents, databases, and applications.
(c) Collaboration: Working on projects, sharing files, and communicating within teams.
(d) Training: Providing access to training materials and resources.

### 1.4.4 Wireless Technology

Wireless technology allows devices to connect to networks and the internet without physical cables, using radio waves or other electromagnetic waves. Wireless technology enables network connections without physical cables, examples of wireless technology are Wi-Fi, Bluetooth, cellular networks (4G, 5G).

The uses of wireless technology are**:**

(a) Internet Access: Connecting to the internet via Wi-Fi hotspots or cellular networks.

(b) Device Connectivity: Connecting devices like smartphones, tablets, and computers to networks.
(c) Data Transfer: Sharing files and data wirelessly.

### 1.4.5 Network

A network is a group of interconnected devices that can communicate and share resources. It thus, facilitate communication and resource sharing between devices.

(a) **Types of network:**
   i. LAN (Local Area Network): A network within a small area, like a home or office.
   ii. WAN (Wide Area Network): A network that spans a large geographic area, like the internet.
   iii. MAN (Metropolitan Area Network): A network that covers a city or metropolitan area.

(b) **Uses of network:**

   i. It is used for Communication: Sharing information and communicating between devices.
   ii. It is used in Resource Sharing: Accessing shared printers, storage, and other resources.
   iii. It is used in Collaboration: Working together on projects and sharing files.

## 1.5 Accounting information requirements and types of accounting information system and impact on strategic management process:

### Types of information system

This section revises the various information systems you encountered in the Management Information paper. In addition, you will see examples of appropriate information technology and information systems support that would typically be associated with each type of system, and common information sources.

The systems are:
(a) transaction processing systems;
(b) management information systems;
(c) office automation systems;
(d) decision support systems;
(e) executive information systems;
(f) expert systems; and
(g) knowledge work systems.

### 1.5.1 Transaction processing systems (TPS)

Transaction processing systems (TPS) are systems for processing routine transactions, often in large volumes. They are used extensively in business and government and are an example of an operational information system.

Examples of TPS include:

(a) production and purchasing;
(b) production planning and control;
(c) inventory control;
(d) purchasing system;
(e) accounting system;
(f) general ledger;
(g) receivables/payables systems;
(h) payroll;
(i) sales;
(j) sales order system;
(k) delivery scheduling system;
(l) human resources;
(m) employee records; and
(n) training records

The advantages of transaction processing systems, compared with manual systems for processing transactions, are:

(a) the ability to handle much larger volumes of transactions;
(b) cost-effectiveness;
(c) much faster processing;
(d) fewer errors in processing; and
(e) efficiency in storing/filing data records.

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**Illustration: TPS – Inventory**

Inventory in a small business

(a) The inventory system in a small business may be run on a stand-alone computer residing in the stores warehouse. This would be manually updated by the stores clerk entering information from goods received and goods dispatched notes (GRNs and GDNs) having first checked that an order had actually been made for the goods.

(b) Duplicate GRNs and GDNs are handed to the accountant for entry into the general ledger which resides on a separate computer.

(c) The two systems are then reconciled monthly by the accountant. Inventory in a large business

(d) Compare the above to an integrated system used in a much larger organisation. This would likely involve a perpetual inventory system located on a centralised computer system connected to various client computers across a local area network within the organisation.

(e) When the inventory records are updated in the stores warehouse the inventory module automatically updates trade receivables, purchases and

### 1.5.2 Management information systems (MIS)

Management information systems (MIS) provide information to management, of a routine or non-routine nature, by analysing data and converting it into organised information.

MIS provide management information in regular or routine reports, which management can use for planning and controlling activities.

In many cases, management information is produced from systems that also process transactions. For example, sales reports can be produced from a sales order processing system, and financial reports can be produced from a general ledger system.

Some management information systems take data from other sources, and provide reports for management. Examples are:

(a) **Budgeting systems**, which are used to prepare budgets;
(b) **Budgetary control systems**, that compare actual results with a budget and report the differences as variances;
(c) Cost accounting and management accounting systems; and
(d) **Sales analysis** reporting systems.

Management information systems provide structured information, and can help managers to make fairly routine or standard decisions. They are not well-suited for assisting managers with more complex decisions.

MIS may also rely mainly on data obtained internally, from within the organisation, rather than on external data obtained from outside sources.

**Illustration: MIS**

MIS in a small organization

(a) The management information system may be little more than a collection of spreadsheets that are manually updated by the accountant whenever they have time.

(b) Information would be extracted from the general ledger using standard queries from a standard 'off the shelf' accounting package and then manually entered into the spreadsheets.

(c) Given the high manual element there is a greater risk of errors in the subsequent MIS shared with management.

MIS in a large organization

(a) In a large organisation the MIS may have been programmed by a dedicated IT team, or at least involve a much more complex accounting package.

(b) A dedicated accountant (or team of accountants) would have written some queries that extract standard reports on a monthly basis for timely reporting to management.

(c) The system would integrate both financial accounting and management accounting to help ensure accuracy and consistency.

### 1.5.3 Office automation systems (OAS)

Office automation systems, as the name suggests, are systems that automate office processes. They include:

(a) word processing systems;
(b) database systems for desk-top pcs;
(c) electronic filing systems;
(d) systems with e-mail facilities and a link to the internet; and

(e) groupware systems.

**Illustration: word processing**

Word processing systems are typically simple, localised operational programmes that reside on an individual employee's PC or laptop computer.

The underlying data files might be saved:
(a) locally on the same physical device;
(b) locally in a peripheral storage unit – e.g. USB flash stick;
(c) online in the 'cloud' (needs an internet connection); and
(d) on a central computer accessed via LAN link.

Data might be entered into a word processing system in a number of ways:
(a) manually;
(b) automatically through an optical character reader; and
(c) from another file.

### 1.5.3 Decision support systems (DSS)

Decision support systems (DSS) are systems that provide support for managers in making decisions for unstructured or semi-structured problems. (In comparison, MIS can help managers with reaching decisions for structured problems.)

A DSS consists of data analysis models, and may have access to a database to extract data for analysis. It should provide the user with information about a number of different alternatives or different possible outcomes.

Models in a DSS will therefore provide statistical analysis or the facility for scenario planning. For example:

A DSS may include a forecasting model that allows the user to prepare forecasts from available data, and to consider possible variations in the forecast using sensitivity analysis or statistical analysis

A DSS may provide a planning model that allows the user to prepare draft plans and then carry out sensitivity analysis on the data. (A spreadsheet model is a form of DSS.)

**Illustration: DSS**

It can be argued that a DSS would be classified as a tactical or strategic system depending on whether it is used to support middle-management in making a short-medium term tactical decision (e.g. switching from holding inventory to a just-in-time system) or senior management making a long-term strategic decision (e.g. whether to close a particular branch).

Decision support systems are common in operational research. A good example might be simulating the baggage handling system at an airport. The system is used to simulate different phasing of baggage handling procedures to establish the best operational setup.

DSS are normally features of larger organisations. They would blend a combination of information from the general ledger plus extra externally sourced information relevant to the specific decision being addressed.

### 1.5.3 Executive information systems (EIS)

Executive information systems (EIS) are information systems for senior executives. They have access to data from sources both inside and outside the organisation. The system has the ability to analyse the data in a variety of ways, so that senior executives can obtain selected information on demand, analysed at a suitable level of detail. EIS are also called executive support systems (ESS).

A key feature of an EIS is that it provides information to executives in summarised form, for example information about performance in relation to critical success factors and key performance indicators, but which also allows the user to 'drill down' to extract more detailed information.

Although information can be presented to executives in the form of tables, or even narrative, EIS incorporate the facility to present information in a more user- friendly form, for example in the form of graphs, bar charts or pie charts.

### 1.5.3 Expert systems (ES)

Expert systems are a type of artificial intelligence system. The purpose of an expert system is to provide expert information to the system user.

An expert system covers a specific area of expertise. It allows a user to interrogate the system to obtain information, advice or possible solutions to a problem. Examples of expert systems are legal advice systems, investment advice systems, medical diagnosis systems and tax advice systems.

An expert system has several components:

(a) A knowledge base, that holds all the facts and rules relating to the area of expertise
(b) A knowledge acquisition program, through which the knowledge base is kept up-to-date
(c) An 'inference engine', which is the software that responds to inputs from the user, and draws on the knowledge base and applies reasoning to provide a response
(d) An explanation program that provides an explanation of the reasoning that has been used by the system to reach its conclusion and produce its advice.

Expert systems can be used by experts to reinforce their opinion or give them suggestions. For example:

(a) professional lawyers can use a legal expert system to obtain information about relevant legislation or court decisions;
(b) similarly, doctors can use a medical expert system to obtain a diagnosis, or several possible diagnoses, of a patient's medial symptoms; and
(c) an investment analyst can use a financial investment expert system to find suitable investments to recommend to a client.

**Illustration: Expert systems**

An expert system used to help diagnose patients in a public hospital is likely to be developed by a dedicated IT development team. The programme and database will be maintained in a central server which is then accessed through client terminals by individual doctors. More data is entered into the database as new cases evolve.

### 1.5.4 Knowledge work systems (KWS)

Knowledge work systems are systems that are used to create new knowledge

**Illustration: KWS**

A team of designers and architects operate a virtual company as they live in different cities across the world. The company has a knowledge work system which is located on a database in a central computer in Lagos.

Whenever the individual architects discover new materials or working practices they enter details into the KWS so that the new knowledge is accessible across the world to fellow employees in the same organisation.

The system issues 'alerts' based on new entries in the system. Employees set their alert preferences to ensure they only receive relevant knowledge updates.

or integrate new knowledge into an organisation. They include CAD systems and virtual reality systems

The effect of information technology on performance manageme

### 1.5.5 IT systems for providers of services

The service industry is made up of organisations that deliver services to consumers. The individuals who make up this industry are hired to perform tasks.

Most performance management techniques were developed for manufacturing organisations but might often be useful for service companies.

Both types of organisation turn inputs into outputs:

(a) A manufacturing company uses labour and other inputs to transform raw materials and components into finished products which it sells.
(b) A service company does not produce/sell products but provides a service.

Both types of company need to determine the costs of output for planning (e.g. activity levels) decision making (e.g. pricing) and control.

There are a number of performance management techniques which have been developed to link the cost of inputs to the costs of production. These can be used in the service industries also.

For example an accountancy firm provides a variety of services. The costs of the firm can be assigned to cost drivers (e.g. an hour of each staff types' time) and the cost of each consultancy contract found by multiplying time spent by hourly costs. This is based on ABC principles which identify cost drivers and job costing which assigns costs to individual jobs.

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### 1.5.6 IT systems and service providers

IT systems can improve the quality of service in a number of different ways.

The service provider has instant access to the customer's files or to other key information. Instant access means that a customer's requests can be dealt with immediately. This makes it possible, for example, to sell and renew insurance policies by telephone.

For companies that provide services (rather than manufacturing goods), IT systems can make substantial improvements in the quality of service provision. A key feature of many services is the contact between a representative of the company (the service provider) and the customer. This may be face-to-face contact, or contact by telephone or even e-mail or text message.

The Internet often makes it possible for customers to compare the products or services of different suppliers, and to make an informed choice about which supplier to buy from. It may therefore be important for companies to provide extensive information to customers on their web site, to help them make their purchase decisions.

Some services can be provided through IT systems. In some cases, the customer is given the opportunity to take control over his own service provision. For example, customers can book seats on air flights and at theatres using the Internet and the service provider's web site or download media items (music and film) through the Internet. Immediate service provision, made possible by IT systems, is likely to increase customer satisfaction with the service.

### 1.5.7 IT systems and performance management

Performance management systems are information systems, and the development of information technology(IT) continues to have a significant impact on performance management and on:

(a) Collecting data

(b) Storing data and information: (Note: data is unprocessed, whereas information is data that has been processed into something that has meaning or purpose)

The ability to process data into valuable information

(a) Access to information

(b) Communication of information.

### 1.5.8 Instant access to performance management data

Another significant feature of modern IT systems is instant access to information. Information might be held on a central database, and accessible to all authorised personnel through a network connection.

Instant access means that managers do not have to wait for information to come to them, for example in routine reports. They can search for and obtain the information they want at any time. Furthermore this can be done from any location that has an internet connection.

### 1.5.9 Remote input

In traditional performance management systems, data was input to the computer system by specialist staff. There was often a high rate of input errors, and data validation checks were included in the software to reduce the error rate. In many systems, the process of collecting data and input to a computer system was fairly slow.

Modern IT systems often provide for **automatic input of data by non-finance operating staff**, often with minimal risk of errors. One example is the automatic input of sales data and inventory data at check-out points in stores and supermarkets, using bar codes and automatic bar code readers. Information is available about sales and reductions in inventory at the exact moment that the items are being sold.

### 1.5.10 Instant access to external sources of data

IT systems also provide for access to external sources of data and information. External data can be obtained from the Internet, either:

(a) Free of charge, for example, from the web sites of government departments and public news agencies, or

(b) Through subscription (payments to an external information provider).

A wide range of complex data analysis can be performed with computer software. Many managers can use models for planning and forecasting, including the application of sensitivity analysis to plans and forecast

### 1.5.11 IT systems and competitive advantage

In a highly competitive market, service providers are continually looking for ways to manage their costs and increase productivity.

IT systems may be able to give one business a **strategic advantage (competitive advantage)** over its rivals. The efficiency of IT systems can improve the quality of administration, production and service to customers – and so provide better value for customers, for example by reducing costs or providing a faster service.

Even if an IT system does not provide a competitive advantage, however, a business may need to have efficient systems to avoid being at a competitive disadvantage. A business needs to invest in IT to keep up with what rivals are doing.

Significantly, IT systems can create a competitive advantage by providing management with better information. In this respect, a well-designed performance management system will provide a competitive advantage.

Management should keep their IT systems under continual review, and:

(a) be aware of new developments in its systems and new opportunities for exploiting it

(b) review existing systems to ensure that they are of a high quality and are operating effectively and efficiently

(c) monitor the use of it systems by competitors, and be prepared to respond to any initiatives in it that competitors introduce.

### 1.5.12 E-business and its implications for performance management

The objective of e-business is to increase the competitiveness and efficiency of an entity by using electronic information exchanges to improve processes. E- business does not simply involve automating existing processes. Processes should be radically redesigned by e-business methods so that they become more efficient and create added value. E-business opportunities can alter the strategic position of an entity and provide different strategic choices.

(a) E-business can change the nature of the market place in which goods and services are bought and sold. For example, it encourages the globalisation of markets and the buying and selling of items in the internet.

(b) E-business also changes the nature of the relationships with suppliers and customers.

E-business significantly extends the volume and scope of information accessible to organisations for performance management purposes.

1.5.14 Critical Success Factor

Definition of critical success factors (CSFs)

**Definition: Critical success factors**

Critical success factors (CSFs) are 'factors so critical to success that if the objectives associated with those factors are not achieved, the organisation will fail, possibly catastrophically'.

They have also been defined as 'the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the

### 1.5.15 CSF methodology

CSFs have been associated with business strategy and strategic planning for many years. It is a 'top-down' approach that begins with the main long-term strategic objective of the organisation.

From this overall strategic objective, five or six 'higher level' goals or objectives are decided. These are objectives that will have to be met in order to achieve the overall objective for the organisation.

Having identified five or six higher level objectives, the analysis is taken down to the next level of detail. For each higher level objective, a small number of critical supporting objectives are identified. These are objectives that will have to be met in order to meet the higher-level objective.

This approach to identifying success factors can be taken down to the lowest level of management and planning. However, all the factors that are identified as 'critical' will have to be met. Failure to achieve any of them will threaten the ability of the organisation to achieve its

**Example: CSF**

A government might decide that the main objective of its education policy should be to provide every pupil in state-run schools with the best-possible IT facilities to support their studies.

Having established this as the main objective of policy, the following two high- level CSFs might be identified:

(a) CSF1: To provide high-quality software to schools.

(b) CSF2: To increase the availability of IT facilities in schools

### 1.5.16 Measuring achievement: key performance indicators (KPIs)

In strategic planning, CSFs are associated with key performance indicators (KPIs).

(a) For each CSF, there must be a way of measuring whether the required objective or target has been met.

(b) This measure of performance (a key performance indicator) can be used to set planning targets, and to monitor actual performance by comparing actual results with the target.

CSFs and KPIs may be decided by planning teams of managers, who discuss different possible CSFs and KPIs, and reach agreement on which success factors are critical (and if appropriate, ranking them in order of priority).

**Example: KPI**

The main objective of a commercial company may be to maximise the wealth of its shareholders. A CSF of a commercial company might therefore be 'to achieve a minimum volume of annual sales to earn a sufficient return on investment'.

A suitable key performance indicator might be the annual sales volume, or possibly a target share of the market. Having identified what the KPI should be, strategic targets should be set for the CSF and actual achievements should be compared with the target.

### 1.5.17 The impact of internet technologies on KPIs

The volume and scope of information now readily accessible to organisations is simply immense. The potential to benefit from performance management with access to such vast information sources is also significantly improved. There are two components to this:

(a) Increased access to market data;

(b) The ability to measure the impact that e-business has on an organisation.

Some examples of KPIs relating to e-business could include:

| Example | KPI |
|---|---|
| Supply chain | reduction in average lead time following implementation of EDIs (electronic data interchange) |
| Product | proportion of customers selecting electronic invoicing rather than paper invoicing |
| Price | impact of price change on sales volume |
| Place | profitability by supply channel |
| Promotion | profitability by promotion method |
| Physical evidence | proportion of customers who book and pay in advance via the website rather than call the reservations manager |
| People | customer satisfaction survey results collated by email |
| Process | average number of 'website hits' per sale |
| CRM | net profitability by client (using activity-based costing) |

CSFs and IS/IT strategy

The idea of identifying CSFs as a basis for developing IS/IT strategy was popularised initially in the late 1970's.

There are two separate issues to consider:

(a) Critical success factors for IS/IT strategy, and the IS/IT systems needed to achieve CSF targets, and

(b) The extent to which IS/IT systems can support the use of CSFs by an organisation.

Existing IS/IT systems may have to be modified, or new systems may have to be developed, to enable an organisation to achieve the critical factors necessary for success. The process of identifying CSFs and KPIs for information systems is similar to the process described above for business strategy in general.

Some examples of high-level IS/IT-related CSFs are shown below.

| Entity type | CSF | KPI |
|---|---|---|
| **Bank** | Money transmission systems must always be in operation. Immediate back-up systems must always be available in case of breakdown or damage. | KPIs can be set in term of numbers of back-up computers and the existence of an emergency back-up network. |
| **Retail company** | We must have a web site with an e-commerce facility. | Target date for the introduction of an operational e-commerce facility. |
| **Manufacturing Company** | Customer orders must be dealt with quickly: lead times must be no longer than those of our main competitor. | Target 'lead time' for handling customer orders, to be achieved by the introduction of an upgraded sales order IT system. |

At a lower level in the hierarchy of objective setting, some success factors for IS/IT might also be as follows:

| Entity type | CSF | KPI |
|---|---|---|
| *Company with automated telephone call handling system for customers* | Customer calls must be dealt with quickly; otherwise we will lose business. | - an average time for a customer to be in the call- handling system<br>- a maximum target percentage of customers who terminate the call without having been given service. |
| **Company with database for staff dealing with telephone queries from customers** | The system must be in operation whenever customers call, so that their queries can be dealt with. | KPI might be a target for a maximum percentage 'downtime', when the system is not functioning due to computer failure. |

An examination question may require you to identify critical success factors for an organisation, and to suggest how modifications to existing IS/IT systems, or new IS/IT projects, may help the organisation to achieve these CSFs.

### 1.5.18 Sources of CSFs for information systems

There are four general sources from which CSFs originate.

(a) The **industry** in which the entity operates. There may be something about the industry that creates a factor critical to success. Banks, for example, must have IS/IT systems in order to provide their services.

(b) The **company itself** and its situation within the industry. For example, an insurance company may specialise in selling insurance policies on-line. The efficiency of it IS/IT system will be more critical to its success than for rival insurance companies that rely much less on on-line sales.

(c) The **environment**. Examples of environmental factors may be changing consumer tastes and trends, the state of the economy, and political factors. The effectiveness of an IS/IT system may be critical, for example, to enable an organisation to meet legislative requirements or regulations.

(d) **Temporary factors that may give cause for concern**, such as high levels of errors, cancelled orders, customer complaints, inaccurate inventory records and so on. An organisation needs to be aware that new critical factors may emerge, and if they do, it is important to recognise them quickly before the problem gets too big. Sources of warnings about a new crisis may be:

   i. Customers (changes in the level of satisfaction or dissatisfaction)

   ii. Complaints handled by customer services department

   iii. Major competitors (and new initiatives that they may take to gain competitive advantage)

   iv. Accounting reports (and changes in profitability and cash flows).

Using IS/IT to monitor CSFs and the achievement of targets

It has already been shown that targets should be set for each CSF, and actual performance should be monitored by comparison with the target. IS/IT systems can support the use of CSFs by an organisation because they can be used to monitor performance, and measure performance indicators.

Senior management could make use of an executive information system (EIS) to monitor performance and CSFs at a high level. An EIS can be designed that allows senior executives to monitor actual performance in relation to selected CSFs, so that the executive is always in a position to obtain up-to-the-minute information.

However, IS/IT systems can be used to monitor and measure key performance at all management levels within an organisation – at a strategic level, at a tactical level and at an operational level.

| | Strategic | Tactical | Operational |
|---|---|---|---|
| *Examples of CSFs* | Expand the business to | Be competitive on prices. | Speedy delivery to customers. |

| | | | |
|---|---|---|---|
| | become a global company. | Create loyal customers. | Keep customers satisfied. |
| | Increase market share. | Acquire and retain skilled staff. | Keep costs under control. |
| | Increase profitability | | Maintain quality standards. |
| *Examples of KPIs* | Target rate for annual growth in business in foreign markets. | Selling prices not to be higher than for any rival product. | Deliver to customers within 48 hours of order. |
| | Target share of the market. | Targets for repeat orders or frequency of repeat orders. | Target maximum level for items returned. |
| | Target annual growth in profits. | Targets for recruitment and training. | Target maximum rate of complaints. |
| | | | Efficiency targets. |
| | | | Targets for maximum error rates. |
| *IS/IT system support* | Executive information systems. | Systems for collecting and analysing market data. | Order processing system. |
| | Systems to collect and analyse market size and company sales. | Sales order system information. | Customer service system. |
| | Financial information systems. | HR system information. | Accounting system. |
| | | | Production control system. |

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## Implementing Performance management systems

Performance management develops and deepens student's capability to provide information and decision support to management in operational and strategic contexts with a focus on linking costing, management accounting and quantitative methods to critical success factors and operational strategic objectives whether financial, operational or with a social purpose. Students will be expected to be capable of analysing financial and non-financial data and information to support management decisions.

Organisations face a number of challenges when implementing new information systems. This chapter provides the context for various implementation considerations and explains how change can be managed effectively.

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

(a) describe the impact of it on employer/employee relations;
(b) discuss the general problems associated with implementing new systems;
(c) understand what drives the success or failure of information systems;
(d) explain the nature of common user resistance to new information systems and change;
(e) describe Lewin's 'three stage' change process;
(f) discuss tactics for managing successful change;
(g) state key project monitoring and control tasks; and
(h) briefly explain the role of the project manager in managing the team

### Accessibility

A key factor in the design of a performance management system is the way in which information is to be made available and accessible to the intended users.

Individuals with performance management responsibilities must have information to do their work. IT systems make it possible, in principle, to provide individuals with enormous amounts of data and information. There could be a risk that an information system makes so much information available to users that there is 'information overload'. Individuals may receive so much information that they do not necessarily know what are the most important and relevant items, and so they do not make the best use of the information they are given.

Performance management systems should be designed in a way that makes information accessible in a convenient and helpful way. Users should have ready access to the information they use the most often. They may in addition need access to other information occasionally.

Important factors to consider in the design of a performance management system are:

(a) What information is needed by individuals using the system?
(b) Why is the information needed or useful? What will the user do with it?
(c) How often is it needed?
(d) Where will the information be obtained from? In other words, how should the source data be captured?
(e) How should the information user be able to access the information?

For essential and important items of information, it should be the responsibility of the system designers to make sure that individuals are provided with the information.

(a) Information or data that is essential to carrying out a task must be provided to the user in a convenient way. For example, individuals who use an IT system for operational variance control must be able to access the data they need to drill down into individual variances. Gaining access to this information should be made as easy and convenient as possible for the user.

(b) Similarly, information that individuals will use often should also be made easily accessible.

When the information requirements of individuals are less predictable, or less frequent, a system might make the information accessible to users, but then leave the responsibility with the user for finding it when it is needed.

For example, intranets have made it possible to provide enormous amounts of data to employees within an organisation. However, there is so much information available that it might become the responsibility of the recipient to make sure that

he gets the information that he wants, rather than the responsibility of the provider of information to make sure that it reaches individuals who might need it.

Supporting the tasks of the manager

Introduction

According to 'traditional' theory of organisation and management, the tasks of management are to:

(a) Set targets and make plans for achieving those targets
(b) Communicate
(c) Organise activities
(d) Co-ordinate activities
(e) Provide leadership or direction
(f) Motivate others
(g) Monitor performance
(h) Take control measures to improve performance.

Performance management

The new IS/IT performance management systems will be used by managers to manage the performance of the organisation, and individuals and work units within it.

The requirements for the new performance management system include:

(a) Clear objectives, expressed perhaps as critical success factors
(b) Targets for each objective, expressed perhaps as key performance indicators
(c) Using these key performance measures to measure actual performance
(d) Providing managers with a comparison of actual performance with the target, or a comparison of target performance with current forecasts.

IS/IT systems can be designed to provide managers with the key performance measures that they should monitor. For example, executive information systems can be designed so as to provide senior managers with:

(a) Readily-available information about current performance or historical performance in selected key areas, and

(b) A facility to 'drill down' to analyse aspects of performance in more detail, if required.

Information and management decisions

Decisions are taken continually in business. Routine decisions may be taken by any employee as a part of normal procedures. However, a specific role of management is to make decisions. For this, managers need information.

Managers use information:
(a) to make plans and reach planning decisions;
(b) to measure performance, and take control action on the basis of comparing actual or expected performance with a target;
(c) to make 'one-off' or non-routine decisions;
(d) to communicate decisions to other people; and
(e) to co-ordinate activities with other people.

Information for different management levels:

Information should be provided to managers to help them to make decisions. The nature of the information required varies according to the level of management and the type of decision. Within organisations, there are management information systems that provide this information. A major element of the overall management information system should be the management accounting system.
A management accounting system should provide information for strategic management, tactical management and operational management.
The requirements of management for information vary with the level of management. This concept is set out simply in the diagram below.

Levels of management and information requirements




Performance management

**Strategic management information**

Strategic management information is information that helps strategic managers to:

(a) make long-term plans;
(b) assess whether long-term planning targets will be met; and
(c) review existing strategies and make changes or improvements.

Strategic management needs strategic information. The characteristics of strategic information may be summarised as follows:

(a) it is often information about the organisation as a whole, or a large part of it.
(b) it is often in summary form, without too much detail.
(c) it is generally relevant to the longer-term.
(d) it is often forward-looking.
(e) the data that is analysed to provide the information comes from both internal and external sources (from sources inside and outside the organisation).
(f) it is often prepared on an 'ad hoc' basis, rather than in the form of regular and routine reports.
(g) it may contain information of a qualitative nature as well as quantified information.
(h) 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

Tactical information is information reported to middle managers in a large organisation, or for the purpose of annual planning and budgetary control.

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:

(a) It is often information about individual departments and operations.
(b) It is often in summary form, but at a greater level of detail than strategic information.
(c) It is generally relevant to the short-term and medium-term.
(d) 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.
(e) The data that is analysed to provide the information comes from both internal and external sources (from sources inside and outside the organisation), but most of the information comes from internal sources.
(f) It is often prepared on a routine and regular basis (for example, monthly or weekly performance reports).
(g) It consists mainly of quantified information.
(h) 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.

Control reports might typically be prepared every month, comparing actual results with the budget or target, and much of the information comes from internal sources. Examples of tactical information might be:

(a) variance reports in a budgetary control system;

(b) reports on resource efficiency, such as the productivity of employees;
(c) sales reports: reports on sales by product or by customer; and
(d) reports on capacity usage.

Operational information

Operational information is needed to enable supervisors and front line (operational) managers to organise and monitor operations, and to make on-the- spot decisions whenever operational problems arise. Operational information 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:

(a) It is normally information about specific transactions, or specific jobs, tasks, daily work loads, individuals or work groups. (It is 'task-specific'.)
(b) It may be summarised at a work group or section level, but is in a more detailed form than tactical information.
(c) It is generally relevant to the very short-term.
(d) It may be forward-looking (for example, daily plans) but it is often concerned with transactions, procedures and performance measurement at a daily level.
(e) The data that is analysed to provide the information comes almost exclusively from both internal sources (from sources inside the organisation).
(f) It consists mainly of quantified information. Most of this information is 'factual' and is not concerned with uncertainty.

Operational information is provided regularly, or is available online when required. It is concerned with operational details, such as:

(a) the number of employees in the department absent from work
(b) wastage rates in production
(c) whether the scheduled work load for the day has been completed
(d) delays and hold-ups in work flow, and the reasons for the delay
(e) whether a customer's order will be completed on time.

In many respects, strategic information, tactical information and operational information are all concerned with the same things – business plans and actual performance. They are provided in different amounts of detail and with differing frequency. However, with the development of IT systems and internal and external databases, it is possible for all levels of information to be available to managers online and on demand.

**Example: Levels of information**

An accountancy tuition company has a strategic target of increasing its annual sales.

What strategic, tactical and operational decisions might be taken towards achieving this target?

Here is a suggested answer.

(a) At a strategic level management may decide it is necessary to increase sales by 20%. It will then need to study the company and its business environment and decide how this might be done – for example by developing the existing business, buying a competitor company, or diversifying into other forms of training, such as training lawyers or bankers.

(b) At a tactical level, a budget should be prepared for the next year, based on strategic decisions already taken. Middle management should consider a variety of plans for achieving targets, such as spending more money on advertising, recruiting more trainers and running more training programmes. Targets might be set for each type of course or each geographical training centre location.

(c) Operational management will make decisions about the courses and their administration, such as making special offers (free study materials) to attract more students, running additional courses when demand is strong, and making sure that all student fees are collected.

(a) To measure performance, and take control action on the basis of comparing actual or expected performance with a target
(b) To make 'one-off' or non-routine decisions
(c) To communicate decisions to other people
(d) To co-ordinate activities with other people.

Levels of management: strategic, tactical and operational

Management may be classified into three levels:

(a) Strategic management
(b) Tactical management
(c) 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 management

**Definition: Strategic management**

Strategic management is concerned with setting objectives for the organisation, and developing plans (strategies) to achieve those objectives.

The main objective of a business may be to maximise the wealth of the shareholders, or to achieve continuous growth in sustainable profits, or to be the world leader in a particular industry or market.

Having established the main objectives of the organisation, strategic management is also concerned with developing strategies to achieve the objectives. Strategic planning (and the control of strategy) is concerned with the general direction that

the organisation should take, in terms of the markets it operates in, the products or services it provides, and the resources it uses (money, equipment, people, and so on).

Strategic management should have a fairly long 'planning horizon'. The performance of an organisation in the short term is important, but strategic managers must also focus on the longer term, and the direction in which the organisation is going over the next few years.

Strategic management is the function of the senior managers in an organisation.

Tactical management

**Definition: Tactical management**
Tactical management has a shorter-term planning horizon than strategic management. It is concerned with:

(a) developing plans and making other decisions within the framework of strategic decisions that have been taken by senior managers

(b) monitoring actual performance to assess whether the planning targets will be achieved taking control action where necessary to improve performance.

If strategic planning has a planning horizon of up to, say, five to ten years (or longer), tactical management would have a planning horizon of up to about one year or so.

Tactical management is usually associated with budgets and budgetary control, and similar annual plans.

Tactical management is the function of the middle-ranking managers in an organisation. In organisations with a 'flat' management structure, however, tactical management decisions may be taken by either senior managers or other managers.

Operational management

**Definition: Operational management**

Operational management is concerned with the management of day-to-day operations. The planning horizon is short, and in many cases immediate decisions must often be taken about what should be done.

Operational management is often associated with supervision and front-line management. It includes scheduling of operations and monitoring output, such as daily efficiency levels.

There isn't a clear dividing line between tactical management and operational management, but essentially the differences are a matter of detail. Tactical management may be concerned with the performance of an entire department during a one-week period, whereas operational management may be concerned with the activities of individuals or small work groups on a daily basis

Tactical information

**Illustration: Strategic information for performance management**

The board of directors are concerned that the business is not sufficiently diversified which is suppressing the P/E ratio. This is despite having a healthy balance sheet and cash available to invest.

The executive information system (EIS) is used to benchmark the business's against three main competitors with metrics such as:

(a) P/E ratio
(b) Market share and growth
(c) Leverage (debt to equity ratio)
(d) Employee numbers

The system is also used to help identify two potential take-over targets and forecast what the combined business would look like, again using the above metrics.

The board makes a decision to proceed with a take-over and continues to use the EIS to monitor the impact on KPIs including the share price and P/E ratio.

Access to the EIS is restricted to a small number of users given the sensitivity around such confidential information. The directors use a 'dashboard' which provides highly summarised company-wide metrics and live market-data about competitors.

Tactical information is used to decide how the resources of the organisation

(c) There may be some degree

**Illustration: Tactical information for performance management**

A management information system is used to prepare monthly management accounts for divisional heads. The management accounting team prepare monthly accounts during a 4-day window immediately after each calendar month- end. This allows sufficient time for processing accruals, pre-payments and any other manual journals.

The management accounting system resides on the company's central mainframe. The system is accessed by authorised finance staff only via their desktop computers which are connected to the local area network.

The management accounting system reports underlying data directly from the financial accounting system.

Divisional heads use the monthly management accounts to review actual performance in their division versus budget and revise their annual forecast as each month of the accounting year progresses.

The key metrics they focus on include:

(a) Divisional return on investment
(b) Divisional return on capital employed
(c) Divisional gross and net profit margins
(d) Divisional headcount
(e) Divisional payroll expenses

Operational information

Operational information is needed to enable supervisors and front line managers to organise and monitor operations, and to make on-the-spot decisions whenever operational problems arise.

Operational information may also be needed by employees, to process e of their regular work.

**Illustration: Operational information for performance management**

Zoom limited manufactures low cost furniture. Margins are tight and hence high volume is required to achieve target profit.

The operations manager reviews the production plan at the start of each day that has been automatically generated from the organisation's integrated inventory and ordering system. The report highlights any potential inventory shortages which are then addressed by raising inventory requisition orders.

Zoom maintains a real-time perpetual inventory system which resides on the central mainframe. Data is kept up-to-date as inventory inwards and stores requisitions are recorded immediately by the inventory clerk.

## Strategic management process and management information system

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.

Performance management includes these three concepts:

Planning

Planning involves the following:

(a) setting the objectives for the organisation;
(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;
(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 performance reports or as special warnings or alerts when something unusual has occurred.

Decision making

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

Levels of strategic planning

Planning is a hierarchical activity, linking strategic planning at the top with detailed operational planning at the bottom. Strategic plans set a framework and guidelines within which more detailed plans, and shorter-term planning decisions, can be made.

R. N. Anthony (1965) dentified three levels of planning within an organisation:

(a) **Strategic planning**. This involves identifying the objectives of the entity, and plans for achieving those objectives, mostly over the longer term. Strategic plans include corporate strategic plans, business strategic plans and functional strategic plans.

(b) **Tactical planning**. These are shorter-term plans for achieving medium- term objectives. An example of tactical planning is the annual budget. Budgets and other tactical plans can be seen as steps towards the achievement of longer-term strategic objectives.

(c) **Operational planning**. This is a detailed planning of activities, often at a supervisory level or junior management level, for the achievement of short-term goals and targets. For example, a supervisor might divide the workload between several employees in order to complete all the work before the end of the day.

Definition of strategic planning and control

'Strategic planning and control' within an entity is the continuous process of:
(a) identifying the goals and objectives of the entity;
(b) planning strategies that will enable these goals and objectives to be achieved;
(c) setting targets for each strategic objective (performance targets);
(d) converting strategies into shorter-term operational plans;
(e) implementing the strategy;
(f) monitoring actual performance (performance measurement and review); and
(g) taking control measures where appropriate when actual performance is below the target.

Other aspects of strategic planning and control are:

(a) re-assessing plans and strategies when circumstances in the business environment change; and

(b) where necessary, changing strategies and plans.

Formal planning process

Companies might have a formal strategic planning process. Such a process:

(a) clarifies objectives;
(b) helps management to make strategic decisions. Strategic planning forces managers to think about the future: companies are unlikely to survive unless they plan ahead;
(c) establishes targets for achievement;
(d) co-ordinates objectives and targets throughout the organisation, from the mission statement and strategic objectives at the top of a hierarchy of objectives, down to operational targets;
(e) provides a system for checking progress towards the objectives.

However, planning must also be flexible. Plans and targets might need to change in response to changes in the business environment, for example, a new initiative by a rival company.

Changes in strategic plans

Strategic plans often cover a period of several years, typically five years or longer. They are prepared on the basis of the best information available at the time, using assumptions about the nature of the business environment – competitive conditions, market conditions, available technology, the economic, social and political climate, and so on.

However, the business environment can change very quickly, in unexpected ways. Changes can create new threats to a company, or they can create new business opportunities. Whenever changes occur, a company should be able to respond – by taking measures to deal with new threats, or to exploit new opportunities.

The response of a company to changes in its environment could mean having to develop new strategies and abandon old ones. When changes are made, the original strategic plan will no longer be entirely valid, although large parts of it might be unaffected.

Strategic planning in practice is therefore often a mixture of:

(a) formal planning; and
(b) developing new strategies and making new plans whenever significant changes occur in its business environment.

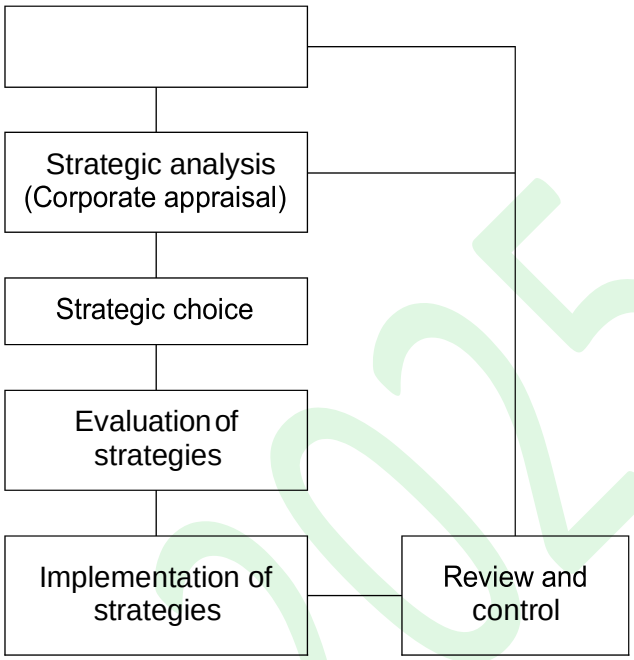
Responding to unexpected changes by doing something that is not in the formal plan is sometimes called ‘freewheeling opportunism’. It means making unplanned decisions, to take advantages of opportunities as they arise, or to deal with unexpected threats.

Strategic planning process

Different methods and approaches may be used to develop strategic plans but they share common features.

A basic approach to strategic planning is shown in the following diagram.

**Illustration: Strategic planning process**




Each stage will be explained in further detail later. For the moment, the text only provides an overview in order to provide a foundation for understanding key elements of performance management.

Objectives

The entity must develop clear objectives, such as, the maximisation of shareholders' wealth. These objectives should be consistent with the mission statement. Targets can be established for the achievement of objectives within the planning period.

Objectives should take into account the interest and power of stakeholders. Stakeholder mapping is a useful tool in this regard.

Strategic analysis

A strategic analysis comprises:

(a) an environmental analysis; and

(b) a position audit.

Environmental analysis involves an analysis of developments outside the organisation that are already affecting the organisation or could affect the organisation in the future. These are external factors that might affect the achievement of objectives and strategy selection.

A position audit is an internal analysis which identifies the strengths and weaknesses within the organisation – its products, existing customers,

management, employees, technical skills and 'know-how', its operational systems and procedures, its reputation for quality, the quality of its suppliers, its liquidity and cash flows, and so on.

The results of the environmental analysis and the position audit can be combined in a SWOT analysis. The SWOT analysis depicts the strengths and weaknesses of an organisation, and the opportunities and threats in its environment. This method of strategic analysis is often used by organisations as a starting point for strategic planning.

Strategic choice

Strategies should be developed to make full use of strengths within the entity and to reduce or remove significant weaknesses.

Strategies should be developed to:
(a) take advantage of opportunities;
(b) make full use of strengths;
(c) remove weaknesses; and
(d) take action to protect against threats.
These components of the strategic choice decisions will be covered later.

Evaluation of strategic options

Strategies should be evaluated to decide whether they might be appropriate.
Johnson and Scholes have suggested that strategies should be assessed for:
(a) suitability;
(b) feasibility; and
(c) acceptability.

Strategic implementation

The selected strategies should then be implemented.

The implementation of strategies should be monitored. Changes and adjustments should be made where these become necessary.

Areas of importance here are change management and project management. These are covered in more detail later.

**Review and control**

This is a key area. An entity will have management information systems in place to monitor the progress of the business. These are particularly important to the introduction of a new strategy where timing and achievement of progress points might be vital to its success. This is covered in more detail later.

Strategic Objectives

**Planning and corporate objectives**

The purpose of strategic planning and control is to help an entity to achieve its strategic objectives. It is normally assumed that the objective of a company is to provide a high return to its owners, the shareholders, consistent with the level of risk in the business.

Not-for-profit entities also have strategic objectives, which relate to the purpose for which they exist. These objectives are non-financial in nature.

Performance measurement is an integral part of a system of planning and control.

**Planning targets clarify the objectives of the organisation**. Corporate objectives are converted into planning targets. Similarly, the objectives of strategic plans are converted into planning targets. A target should be a clear statement of what an entity wants to achieve within a specified period of time. Planning targets are usually quantified, but may be expressed in qualitative terms.

**Measurements of performance** (target and actual) help to improve management's understanding of processes and systems.

Planning targets are set at strategic, tactical and operational management levels. Using quantitative measures of performance makes it easier to set targets for managers and the organisation as a whole.

In a well-designed performance management system, all planning targets are consistent with each other, at the strategic, tactical and operational levels.

When the business environment is changing, a performance measurement system should provide for the continual re-assessment of planning targets, so that targets can be altered as necessary to meet the changing circumstances.

Actual performance, at the strategic, tactical and operational levels should be measured and monitored. Comparing actual performance with targets provides useful control information. Differences between actual performance and targets can be analysed, to establish the causes. Where appropriate, action can be taken to improve performance by dealing with the causes of the poor performance.

Performance measures also make it possible to compare the performance of different organisations or different divisions within the same organisation.

Performance measurement systems promote accountability of the organisation to its stakeholders.

A performance management system may be linked to a system of rewarding individuals for the successful achievement of planning targets.

The need for performance measurement

Every managed organisation needs a system of performance measurement.

Managers need to understand what they should be trying to achieve. A sense of purpose and direction is provided by plans (strategies, budgets, operational plans and so on), and for each plan there should be objectives and targets. Setting targets for achievement (performance targets) is an essential part of planning.

Managers also need to know whether they are successful. The information they need is provided by comparing:

(a) their actual results or performance with the performance target; and
(b) the performance target with the current forecast of what performance will be.

Targets, forecasts and actual performance should be measured, in order to compare them. Ideally measures of performance should be quantified values

(financial or non-financial measures), because numerical measures of performance are easier to compare than non-quantified ('qualitative') measures.

The benefits of performance measurement systems

The advantages of having a formal system of performance measurement can be summarised as follows:

(a) A well-structured system of performance measurement clarifies the objectives of the organisation, and shows how departments, work groups and individuals within the organisation contribute to the achievement of those objectives.
(b) It establishes agreed measures of activity, based on key success factors.
(c) It helps to provide a better understanding of the processes within the organisation, and what each should be trying to achieve.
(d) It provides a system for comparing the performance of different organisations or departments.
(e) The system establishes performance targets for the organisation's managers, over a suitable time period for achievement.

Management accounting and performance measurement

Management accounting is an important element in performance measurement systems. Many performance targets are financial in nature, such as achieving targets for return on capital, profits and sales revenue and targets for keeping expenditure under control.

However, a performance measurement system uses a wide range of targets at the strategic, tactical and operational level. Many of these are non-financial targets, and not all targets are quantifiable.
Clearly, a comprehensive management accounting system should therefore provide information for setting targets and measuring actual performance at all levels. It should also provide non-financial information as well as financial information.

If a management accounting system cannot provide all this information to management, managers will have to rely on other information systems in addition to the management accounting system. An entity might then have several different information systems, which is probably inefficient and less effective than a fully coordinated management information system.

Levels of management

In 'traditionally-structured' large organisations, there is a hierarchy of managers, from senior management down to junior managers and supervisors. The responsibilities of managers vary according to their position in the management hierarchy.
Even in small organisations, the nature of management activities can be analysed into different levels.
A common approach to analysing levels of management and management decision-making process is to identify three levels:

(a) strategic management;
(b) tactical management; and
(c) operational management.

Strategic management

Strategic management is concerned with:

(a) deciding on the objectives and strategies for the organisation;
(b) making or approving long-term plans for the achievement of strategic targets;
(c) monitoring actual results, to check whether these are in line with strategic targets;
(d) where appropriate, taking control action to bring actual performance back into line with strategic targets; and
(e) reviewing and amending strategies.

A strategy is a plan for the achievement of a long-term objective. The main objective of a profit-making entity may be to maximise the wealth of its owners. Several strategies are selected for the achievement of this main objective, and each individual strategy might have its own specific objective.

Strategic planning is often concerned with developing products and markets and for long-term investment. For example, a company seeking to increase its profits by 10% a year for the next five years might select the following strategies:

(a) Marketing strategy: to expand into markets in other countries (with specific countries selected as planning targets for each year of the plan)
(b) Innovation strategy: to invest in research and development (with a target to launch, say, two new products on the market each year for the next five years)
(c) Investment strategy: to invest in new technology (with a target, say, of replacing all existing equipment with new technology within the next five years).

Tactical management

Tactical management is associated with the efficient and effective use of an organisation's resources, and the control over expenditure. In a large organisation, tactical managers are the 'middle managers'.

Tactical management is concerned with implementation and control of medium-term plans, within the guidelines of the organisation's strategic plans. For example, budgeting and budgetary control are largely tactical management responsibilities.

**Operational management**

Operational management is the management of day-to-day operating activities. It is usually associated with operational managers and supervisors.

At an operational level, managers need to make sure on a day-to-day basis that they have the resources they need and that those resources are being used efficiently. It includes scheduling of operations and monitoring output, such as daily efficiency levels.

There is no clear dividing line between tactical management and operational management, but essentially the differences are a matter of detail. Tactical management may be concerned with the performance of an entire department during a one-week period, whereas operational management may be concerned with the activities of individuals or small work groups on a daily basis.

Potential conflict between strategic plans and short-term decisions

Problems may occur in any organisation, especially large organisations with a large number of managers, when 'local' operational managers take decisions that are inconsistent with long-term strategic objectives.

There are several reasons why this might happen.

(a) 'Local' managers might be rewarded for achieving short-term planning targets, such as keeping actual expenditure within the budget limit. However, although there is a short-term benefit, there might be longer-term damage. For example, a local manager might decide to cut the training budget for his staff in order to reduce costs, but in the long-term the future success of the company might depend on having well-trained and skilled employees.

(b) 'Local' managers might fail to buy into the plan because they believe it to be unfair.

(c) 'Local' managers might be unaware of the strategic plans and objectives, due to poor communication within the entity.

In any system of performance management, especially in systems where managers are rewarded for achieving planning targets, it is important to make sure that the short-term planning targets are consistent with longer-term strategic objectives.

## 1.6 Characteristic of accounting information and accounting information system:

Qualities of good information

The quality of the performance management information system depends on the quality of the information that it provides. Good information has several characteristics.

### 1.6.1 Relevance (and volume)

Information has no value unless it has a purpose and is useful. Information must therefore be relevant for its intended purpose.

Some information systems process large amounts of data to provide large volumes of information, but not all of it is useful. There may be more information than a user can actually make sense of. Sometimes, the information generated by an information system might not be entirely relevant, and might not tell the user everything that he or she needs to know.

Information systems may be designed to help the user to find relevant information easily and quickly, for example by searching an expert system (ES) or an executive information system (EIS).

### 1.6.2 Reliability

Information must be reliable. Reliable information must be:

(a) Accurate enough for its intended purpose and

(b) Complete enough for its intended purpose.

Sometimes, this means that information must be 100% accurate and 100% complete. However there are many occasions, particularly with strategic information used by senior management, that information is based on estimates and forecasts, or information is incomplete due to a lack of data.

There are also occasions when the users of information systems have to apply their judgement and reach a decision on the basis of information available. Expert systems are an excellent example of this. An expert system for medicine, for example, might suggest several alternative courses of treatment for a patient, and an expert system for law might indicate several different and opposing legal arguments.

**Timely**

Information must be available in time for its recipient to make use of it. Information will be used for a purpose. Presumably, there is an 'ideal time' for using the information.

Managers might want items of information quickly, so that they can make an immediate decision. Many information systems, such as expert systems and executive information systems, offer immediate responses to input queries.

Speed of access to data (and the speed of a system in responding to queries) is often regarded as a desirable feature of an information system.

### 1.6.3 User confidence

Users must have confidence in their systems and the information that they provide. Information must therefore be realistic.
At the moment, information systems for business have not been designed that are capable of removing the need for management judgement in making decisions. However, information does not need to be 100% accurate for users to have confidence in it. The user of information needs to know how reliable the information may be, and (as suggested above) that the information will not be completely wrong.
The value of information must be more than its cost

Information should not cost more to obtain than the value it provides.

(a) Some information systems may provide information at a level of detail (or accuracy) that is not required, when it would be cheaper to provide less detailed (or less accurate) information to meet the user's requirements.

(b) Some information systems may provide additional information that is not used at all.

(c) An information system may provide information that is used, but the benefits from using the information are less than the cost of obtaining it.

### 1.6.4 Ensuring reliability and accuracy of information

When a performance management system is designed, one of the issues facing the system designer is how to ensure that the quality of the information will be good enough to meet the requirements of the users. In particular, information

must be reliable and users must have confidence in the information that the system provides.

The reliability of an information system depends on **three** main factors.

(a) The **completeness** of the information. Information should be obtained from the appropriate sources, and it needs to be sufficiently complete. A user cannot rely on information when significant items of data have not been taken into consideration.

(b) The **Timeliness** of the information. For some information systems, information needs to be up-to-date. For example, an on-line theatre booking system or airline travel booking system must ensure that the data about seat availability is always completely up-to-date for users of the system.

(c) **Accuracy**. The information needs to be accurate enough for its purpose. The accuracy of information in a computer system can be improved, if required, by trying to reduce the amount of errors in the input data.

(d) **Data validation** checks can be written into the system software. These carry out checks on input data and reject (refuse to accept) items for processing where there is a logical error in the input.

(e) **Input documents** can be designed to contain as much pre-printed material as possible, to reduce the number of errors in preparing the documents. Similarly, when data is input by keyboard and mouse, data screens can be designed to include as much pre-set data as possible, to reduce the risk of keying errors by the computer operator.

### 1.6.5 Accessibility of information

Business information in performance management systems should also be readily-accessible. The user of information should be able to find it when he or she needs to use it.

With developments in information technology and information systems, it is now common to think of 'accessible' information as information that can be obtained immediately, on demand. In particular, databases can make large amounts of information immediately available, especially when they are accessible through a computer network.

Even 'old' transaction data can be made accessible through storage on an electronic medium.

Security of information

Although information should be accessible to authorized users, it should also be kept secure, particularly from access by unauthorized users.

Methods of keeping data secure might include:

(a) **Physical security**. Access to computer centers may be restricted security measures such as identity cards and entry cards.

(b) **Software security** to prevent (or detect) unauthorized access, using passwords, encrypted data, firewalls, and so on.

(c) **Anti-virus software**, to prevent the corruption or destruction of data and software by hackers.

(d) The use of **back-up files**, to ensure that data is duplicated or can be re-created. Back-up files ensure that the data will not be lost if the main copy of a file is physically lost or destroyed, or becomes unreadable.

> **Example:**
>
> An information system might be required to provide information about the profitability of different types of customer.

The starting point for the design of this information system is the **purpose** of the information. Why is information about customer profitability needed? The answer might be that the company wants to know which of its customers contribute the most profits, and whether some customers are unprofitable. If some customers are unprofitable, the company will presumably consider ways of improving profitability (for example, by increasing prices charged to those customers) or will decide to stop selling to those customers.

The next consideration is: What data are needed to measure customer profitability? The answer might be that customers should first be divided into different categories, and each category of customer should have certain unique characteristics. Having established categories of customer, information is needed about costs that are directly attributable to each category of customers. This might be information relating to gross profits from sales, minus the directly attributable selling and distribution costs (and any directly attributable administration costs and financing costs).

Having established what information is required, the next step is to decide how the information should be 'captured' and measured. In this example, a system is needed for measuring each category of customer, sales revenues, costs of sales and other directly attributable costs.

The information should be available for when management intend to review customer profitability. This might be every three months, six months or even annually.

Organising a system for providing external information

If managers are to be provided with external information by a management information system (MIS), the system must be designed so that it is capable of providing it:

(a) There has to be a system of data capture. How should information be obtained from the environment and filed within the MIS? How should the data be held within the MIS?

(b) How should the information be provided to managers? Should it be e- mailed to them? Or should managers be expected to search for the information in the MIS when they need it?

(c) Should the external information be processed into a usable form for managers when it is captured, or should it be supplied to managers as 'raw unprocessed data'?

(d) The external information should be divided into strategic information and operational information. Which managers should be provided with the strategic information, and which ones need the operational information?

### 1.6.6 Quality of planning and control

The information provided by the performance management system can improve the quality of planning and control. For example, decision support systems can be used for forecasting and preparing plans. Sensitivity analysis and scenario testing are made much easier with computer models, and these improve planning by testing the assumptions that have been used in preparing the plans and testing the robustness of the plans.

However, there is some risk that performance management systems can be used to plan in excessive detail, or to apply excessive control. Management may use performance management systems to demand regular and detailed reports from employees, to the point where employees spend too much time on reporting and too little time on value-adding activities.

### 1.6.7 Impact of IT on Employer/Employee Relations

IT systems and organisation structure

IT-based performance management systems can affect the relationship between employees and management, and between employees and the organisation they work for.

IT-based performance management systems make information more easily accessible. As a result of improved communication and more convenient methods of communication, it is often possible for managers to organise and control the activities of a larger number of subordinates. In other words' the 'span of control' within an organisation may become much wider.

Communication systems, particularly e-mail, allow any individual to contact anyone else. It is possible for a junior employee to send an e-mail direct to the CEO, without the message having to pass through a number of intermediate managers.

In some organisations, there has been some reduction in management hierarchies. Organisations can operate efficiently with a 'flatter' structure (fewer levels of management).

(a) Although a function of management is to provide information and communication, a large part of this activity can be 'automated'.
(b) Since employees are able to access information themselves, for example from an intranet database, it is often possible to delegate more responsibility to operating staff, thereby reducing the need for junior management or supervisory staff.

1.6.8 The effect of home working on an organisation

IT has made it much easier for individuals to work from home. For an organisation, the benefits of home-working include:

a) A reduction in the need for office accommodation, and so a saving in costs
b) Providing more attractive working conditions for individuals who would prefer to work from home instead of commuting into work: for example, home-working may attract individuals wishing to work from home because of family commitments
c) Limited disruption to work in the event of a major transport strike.

There are also disadvantages with home working:

(a) Management. It may be more difficult to exercise management control over individuals who work in a distant location (from home) rather than in direct contact in an office. For example, it can be difficult to co-ordinate the activities of several different home-workers.
(b) Employees are likely to feel more distant and isolated, and might need strong self-motivation to work effectively.
(c) When employees work from home, it is very difficult to make them feel a member of a work team.

1.6.9 Implications of groupware for team-building

The same 'social problem' may arise when groupware is used to help individuals to work together as an electronic team. Groupware allows individuals to function as a 'team' without having to be in close physical proximity to each other. For example, groupware may allow team members to 'meet' and 'discuss' problems electronically, when they are geographically far apart. **This affects working relationships**, because teams linked electronically are unlikely to 'bond' as effectively as a team whose members all work in the same office.

### 1.6.10 E-mail and work practices

E-mail has had a profound effect on the way that individuals work with each other.

E-mail, the Internet and mobile telephone technology have all created a culture in which individuals expect immediate access to information and immediate responses to queries. Communication has become much faster, and in many cases, this means that tasks are accomplished more quickly, and organisations operate more efficiently.

### 1.6.11 Disadvantages of e-mail

Although e-mail improves communication, and so can improve the efficiency and effectiveness of a business, there are some potential disadvantages that need to be controlled.

(a) E-mail users may receive large amounts of junk mail ('spam' mail), although this can be reduced by anti-spam software.
(b) E-mails may expose a user's computer system to viruses.
(c) There can be a security problem, when information is sent to someone by e-mail without checking whether the person is authorised to receive it.
(d) Employees may get involved in 'chatting' to other individuals by e-mail, for example by exchanging gossip or jokes. Friendly exchanges of this sort can become time-consuming.
(e) Many users tend to respond immediately to e-mail messages, when their time would be better spent concentrating on more urgent issues in hand. Individuals sending e-mails often expect an immediate response, and are (unjustifiably) annoyed if they do not get a quick reply.
(f) There is a tendency for users to send e-mail messages without properly checking what they are sending. Messages may contain many typing errors and other mistakes, and the sender may forget to attach documents or may attach the wrong documents.

Some of the disadvantages of e-mail are 'technical' problems, but many are linked to employee behaviour – for example, importing viruses, excessive use of e-mail for chatting, inefficient use of time and prioritising of work.
Using e-mail within an organisation therefore has implications for control over e-mail use, and the ways in which this control should be applied. This affects management/employee relationships.

### 1.6.12 De-skilling of operatives

As a result of IT, some labour skills have been lost, or replaced by other skills. The automation of many operations removes or reduces the need for individuals to acquire specialist skills.

De-skilling has occurred in many aspects of work. For example, many engineering skills have been automated. Computers can be used to check for faults in an item of equipment (for example, a car) instead of relying on the skills of individual engineers.

Computer systems are also used to automate procedures, such as handling telephone calls from customers. Telephone operatives may be required to follow the procedures set out on a computer screen when dealing with a customer query or complaint, instead of using their initiative.
Consequences of de-skilling may be:

(a) For the employer, a saving in employment costs (because employees do not have to be as highly-skilled) and lower training costs

(b) For the employee, a loss of interest in the work and pride in performance.

Socio-technical system design

Socio-technical system design is an approach to the design of IT systems that recognises social factors in the operation of the system as well as technical factors. The most efficient IT systems are those that satisfy the needs of the system users for social interaction in the work that they do, as well as performing their 'technical functions'.

Technical aspects

The technical aspects of system design are concerned with identifying the operational requirements for the system, and designing a system to meet those requirements.

Social aspects

The social aspects of system design are concerned with identifying the social needs that a system satisfies for employees that use it. Social needs (or personal needs) include:

(a) The desire to be a part of a team with other employees, and to communicate with them regularly

(b) The desire to communicate with other people outside the organisation

(c) The need to feel that the work requires some skill

(d) The need for variety in the work

(e) The need for some authority and responsibility.

A risk with computers is that they isolate individuals, even when working together. Employees may spend too much of their time looking at screens, and not enough time in conversation with others.

However, opportunities for socio-technical system design may well improve over time. Wireless broadband creates the opportunity for individuals to move around with their computer, whilst remaining connected to the Internet. This may provide opportunities for individuals to work together more using their portable or laptop computers. Visual communication methods may be used to create a better sense of familiarity with distant work colleagues.

When 'social features' cannot be built into an IT system, social interaction for employees, and/or a sense of belonging to a team may be provided in other ways. For example, if employees are required to work at computer screens for much of the time, a 'break-out area' may be provided, where they are encouraged to take time out and relax for a while.

An appropriate socio-technical design for an IT system will vary according to the nature of the system. The key point, however, is that IS/IT system design should not ignore the 'human aspect' of how the system will operate and the effect that it will have on its users. A failure to consider the human aspect will probably result in user resistance to the new system and low enthusiasm for the work – and the end result will be an inefficient or ineffective system.

## Problem Areas: Organisational Impact Analysis

### Problem areas when implementing an IS

Whe an information system is designed, developed and implemented, several problem areas must be managed carefully.

(a) The new system should contribute to the economic, financial or operational performance of the organisation. However, when a new system is developed, a 'balance' or compromise must often be made between:
   i. a system that meets the user's requirements exactly, and the 'quality' of the system design
   ii. keeping costs within acceptable limits, and
   iii. implementing the system within an acceptable time scale.

It is generally impossible to develop and implement a system of the highest quality within a short time scale and for a low cost.

(b) The new system is likely to have an impact on organisational and social matters, and in doing so, may arouse strong resistance and hostility form the intended users of the system.

Research has shown that organisational and social issues are significant factors causing new information systems to fail. Even when management have shown an awareness of these problems, their actions are often 'too little, too late'.

A new IS system is 'likely to have a significant impact upon an organisation's culture, structure and working practices'.

Since organisational issues can be a major problem area, it would make sense to consider them carefully at an early stage in an IS project, and try to deal with the problems that are identified

Organisational impact analysis

'Organisational impact analysis' is, as its name suggests, the analysis of the likely impact of a new system on an organisation, including cultural, structural and political issues and the effect on working practices. It should be carried out at an early stage of a system development, and should not be left until it is too late to take suitable measures to deal with problems.

Organisational impact analysis should be carried out together with an analysis of the contribution that the new system will make to the organisation, in terms of economic benefit or the achievement of strategic goals.

The following issues should all be considered at an early stage in the project development, up to the implementation of the new system, as well as in a post-implementation review.

Contribution of the system to the economic and strategic goals of the organisation

(a) There should be a regular analysis of the projected benefits from a new system, to assess whether the system is still expected to meet theorganisation's needs within an acceptable time scale and for an acceptable cost.

(b) The proposed system should conform to the current IS/IT strategy of the organisation. (If it does not, the project should be abandoned, or IS/It strategy should be reviewed and changed.)

(c) Resources should be allocated to an IS project, so that priority is given to the most important parts of the project. This can be achieved using the **spiral model** approach to system development, which is explained later.

(d) Management should be aware of the need to think about **business process re-engineering (BPR)** in conjunction with developing a major new system.

(e) A new system should be designed to support planned future changes in the organisation, and so may need to be flexible in order to allow for these future changes when they occur. Management should not focus on current requirements and ignore planned changes in the future.

human-related issues

Human-related issues should be considered.

(a) Training. Management should assess whether a suitable and sufficient training programme has been planned for all users of the system.

(b) It may be necessary to consider health and safety aspects of using the new system, or ergonomic factors. For example, there may be risks from a new system to the eye sight of users (from working at computer screens), or other aspects of their health. There may be a need for specially-designed chairs for computer users, or a need for regular health check-ups.

(c) The motivation and needs of system users should be considered. There should be an assessment of how the motivation and needs of the system users will be satisfied (if at all) by the implementation of the new system.

(d) There should be an assessment of the working styles and the IT skills of the individuals who will be the system users, to decide the implications these may

have for system design or training needs.

(e) Job re-design. There should also be an assessment at an early stage in the system design of whether the new system will change the job specifications of individuals and the relative importance of their work.

All these human-related issues could lead to strong resistance to the new syste

**System implementation**

Another aspect of organisational impact analysis should be the period of transition from the old system to the new system, when the new system is eventually implemented. Again, this analysis should begin at an early stage in the project development.

(a) Management should carry out an assessment of how the planned timing of the new system implementation will interact with any other planned changes in the organisation that will be expected at about the same time.

(b) There should also be an assessment of the likely disruption to the organisation that implementing the new system will cause, and how long this disruption might last.

Organisation structure, culture and power

There should be an assessment of how the new system will have an impact on:

(a) The structure of the organisation (for example, will the management hierarchy become 'flatter', will there be more centralisation or decentralisation of authority, or will there be job losses or transfers of staff to other work?)
(b) The culture of the organisation (defined as 'the set of important assumptions, often un-stated, which members of an organisation share in common')
(c) The balance of power within the organisation. Information (and knowledge) gives power to the individuals who control it. An information system may alter the balance of power. If this can be foreseen, management can anticipate the political implications of introducing the new system.

Organisational impact analysis is needed because it helps management to identify the potential problems that anew system might create, and do something to resolve the problems before it is too late for effective measures.

Success and failure of information systems

**Measuring the success of a new information system**

The aim of management should be to ensure as much as possible that each new information system is a success. The factors that determine success for a new IS are as follows:

(a) **Achieving the objectives of the system**. Did the system achieve its objectives? The system objectives should have been identified clearly when the decision to develop the project was made. Actual achievements should be compared with these objectives.

(b) **Financial benefits**. A new system may achieve financial benefits, for example from savings in operational costs or from profits resulting from higher sales.

The actual financial benefits should be compared with the benefits that were expected when the decision to develop the project was made.

(c) **User satisfaction**. The success of a new system may be measured in terms of user satisfaction. Is the system helping users with their work? Do users have good things to say about the system?

(d) **Level of usage**. The success of a system can also be measured by the amount that it is used. High levels of usage suggest that the system is successful – and user satisfaction is high.

(e) **System availability**. Some new systems have problems with large amounts of down-time, when the system is not operating due to a hardware or software fault. If a requirement of the system is that it should be operational for as much time as possible, the success (or failure) of a system might be measured by the amount of down-time that it experiences.

(f) **Difficulty using the system**. The success of a system may be assessed according to whether it is user-friendly. A system cannot be a complete success if users have difficulty operating it. The number of calls to the help desk, and the nature of those calls, may therefore be a useful way of monitoring the success – or failure – of a system.

Success of IT development projects

The success factors listed above are the factors that determine the relative success or failure of a new system after it has been implemented. Another factor in the success of a system is the project development – in other words, the work carried out to design and develop the system prior to implementation.
Key factors for success of a system development project include:
Aims:

The project should be clearly defined.

Organisation:

(a) The project should have sufficient resources.
(b) Control mechanisms should be in place and used.
(c) The project must have the support of top management.
(d) Communication channels should be adequate.
(e) There should be capability for feedback, and comparing actual progress with the budget or target.
(f) IT contractors should be responsive to their clients.

People:

(a) The project manager should be competent
(b) The project team should be competent.

Reasons why IT Projects fail:

The nature of project failure

Failure is the opposite of success. The factors that determine whether a system is a success also determine whether it is a failure. Success and failure are both relative measures – there are differing degrees of success or failure. Some systems are more successful than others. Some are much bigger failures than others.

A new system may be described as a failure when any of the following outcomes occurs:

i. The development project is abandoned before the development work is completed, or before the system is implemented.

ii. The project costs much more to develop than expected (and/or costs much more to operate than expected).

iii. The new system is implemented, but meets strong user resistance, and the system is not used as much as expected.

iv. The system is implemented but fails to meet all the user's requirements.

v. The system functions inefficiently.

vi. The development project is completed much later than planned.

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**Example: new system failure**

A brief example of a system failure is a computerised command and control service introduced by the London Ambulance Service some years ago. The new system failed badly, and ambulances sometimes took very long times to reach the scene of an accident. The system cost a large amount of public money, and was claimed to have cost a number of patients their lives.

**PEST factors contributing to system failure**

The failure of an IT project may also be explained in terms of PEST factors (political, economic, sociological and technological factors).
A study by Bray (1993) identified PEST factors as reasons for the failure of the system.

Political factors. The government had published targets for achieving goals in the health service, in the form of a 'Patients' Charter'. In order to meet the targets in the Charter, deadlines for completion of the LAS project were far too short.

Economic factors. Sixteen companies tendered for the contract to develop the new IT system. The contract was given to the software company that submitted the lowest bid, even though it has a limited track record in developing IT systems.
Sociological factors. Ambulance staff were not given enough training in how the new system operated.

Technological factors. The system did not work as well as it should have done. The system operated slowly, and some telephone calls were lost.

Risks of failure: during development and during implementation

Projects can fail during the design and development work. The causes of failure during system development are mainly related to the issues of meeting user requirements (quality), cost and time scale.

Projects can also fail when they are implemented. Although poor design may be a factor, failure may also be caused by strong user hostility or indifference to the system, and **resistance to change**. Resistance to change is considered in more detail later.

Risks in a new system development

Three key factors affect the risk for a system development project.

**(a)** **Size of the project**. As a general rule, the risk of failure is greater for development projects that are:
   i. large, in terms of the amount of people and other resources required to complete it
   ii. complex
   iii. expected to take a long time to complete
   iv. costly (there is a large budget for the project).

With a large project, there are more things that can go wrong. There are more activities to plan, monitor and control. The individuals involved in the project may

not co-operate properly and so fail to work as an effective team. When a large project fails, the cost is usually high.

In contrast, small projects usually involve only a small number of people and a small budget. Even if they go wrong, the consequences are not as great.

**(b)** **Structure of the project**. The risk of failure is relatively low if the project has a clear structure. A clear structure depends on having clear user requirements, so that the project can be planned and scheduled with reasonable confidence that the objectives of the system are properly understood. The progress of the project can then be monitored, using project management software and techniques such as critical path analysis and budgetary control.

In contrast, there is a high risk of project failure if the requirements of the user are not properly understood when the project begins, and the user changes the requirements as the project is being developed.
Boehm's **spiral model** of project development (described later) was conceived as a way of reducing the risk in badly structured projects, where user requirements are not properly understood when the development work begins.

**(c)** **Experience with the technology**. The project development risk is much lower when the project involves technology that the project team knows well. Experience with using a technology brings a better understanding of its capabilities.

In contrast, when a new system involves new technology that the IT team is dealing with for the first time, the technology will be new and unfamiliar.

The risk of failure is higher because technical problems may arise for which the IT team cannot find an answer.

Managing the risks of project failure: external integration, internal integration, formal planning and formal control

A combination of external integration, internal integration, formal planning and formal control can be used to manage the risks in a development project. The choice of risk control methods should depend on the perceived size of the risk in the project.

(a) **External integration**: external integration refers to measures that are used to improve the relationship and communication between the project development team and the system user (the 'customer' for the system).

(b) **Internal integration**: internal integration refers to measures taken by the project managers to make sure that the project team have the skills required and work as a cohesive unit.

(c) **Formal planning and formal control**: these are well-established 'tools' or methods for the planning and control of system development projects.

The following table presents some examples of each of these.

| External integration | Internal integration | Formal planning and formal control tools |
|---|---|---|
| Regular communications with the user. | Appointing a project manager with relevant skills and experience of the technology. | Critical path charts and critical path progress control. |
| User representation in the project team. | Appointing team members with suitable skills and experience.<br>Outsourcing work where the team does not have the skills required. | Gantt charts for planning and control.<br>Budgetary control systems.<br>Use of project management software. |
| Formal procedures for the user to review and approve the system specifications. | Building a cohesive project team.<br>Regular team meetings.<br>Participation of team members in decisions affecting the design and development. | |
| User involvement in testing. | | |
| External integration methods can reduce risk when user requirements are not properly understood | Internal integration methods are most appropriate when there is a risk because the IT team may lack sufficient experience with the technology. | |

User resistance to new information systems and change

Reasons for user resistance

Users are often resistant to new information systems. They are reluctant to use a new system and criticise it strongly. When users are opposed to a new system, they are likely to want it to fail.

It was stated earlier that organisational and social issues are a major factor in the failure of IS/IT systems, and some of the reasons for user resistance were considered within the context of organisational impact analysis.
There are three general theories about the nature of user resistance. These are:
(a) People-oriented theory
(b) System-oriented theory
(c) Interaction theory.
People-oriented theory

This theory concentrates on resistance to a new system because it is seen by individuals or groups of individuals as a threat to something that matters to them, such as their way of working or their social relationships at work.

For example, resistance to a new system may arise from the fact that the system will call for more shift working and 'unsociable' hours of work. A system that allows users to work from home may be resisted by individuals who enjoy going to work because of the people they work with and the camaraderie. Managers may resist a new system for teleconferencing because they prefer the 'old way' of travelling to meet people face-to-face.
System-oriented theory

This theory concentrates on resistance to a new system because of dissatisfaction with the system design. The user interface with the system may be difficult to understand and use or the users may have difficulty making the system work.

The user interface may be badly designed, so that the screens are not user friendly, and users may not get suitable on-screen prompts to tell them what to do next.

The system may also be badly-designed and does not fully meet user requirements. Clearly, if this happens users will criticise the system and will not want to use it.

**Interaction theory**

This theory concentrates on the interaction between the system and its users, and the implications for the role of users in their organisation. It is based on the view that even if the system is well-designed, it could meet resistance from users who are concerned for the effect of the new system on their status or importance at work.

A new system may be seen as a threat to a person's job – for example, a new robotics system may threaten the jobs of production workers, and new transaction processing systems may threaten the jobs of office workers.

A new system may be seen as a threat to the status or importance of someone in their job. Skills that individuals used before the system was introduced may be replaced by automated processing – for example, an expert system may take away

some of the ‘status’ of the experts who use it.

A new system may result in changes to bonus pay arrangements, and users of the system may be worried that their bonus payments will fall as a result of introducing the new system.

Interaction theory is based on the view that even if the system is well-designed, it could meet resistance from users who are concerned for the effect of the new system on their status or importance at work.

Recording and processing methods

Recording data

There are many different ways of ‘capturing’ data, and recording it in an information system. Methods of recording data will depend on circumstances, and also on the nature of the data required. For example:

(a) Records of labour time spent on particular tasks or jobs might be recorded on time sheets or job sheets.

(b) Records of materials used might be recorded in materials requisition notes.

(c) Data about customer satisfaction might be captured as records of customer complaints. Alternatively, data might be obtained from market research surveys.

The system of recording data should be made as convenient as possible for the individuals responsible for input of the data to the information system. Where possible, the information system should be designed to minimise the risk of errors.

Data should also be recorded in a form that will allow it to be processed. As a simple example, suppose that records of labour costs should provide for an analysis of these costs into production costs, administration costs and sales and distribution costs. The data about labour costs will have to be recorded in a way that will enable the costs to be divided into their different categories.

Processing methods

Performance measurement systems should be designed so that data can be processed in a way that meets the requirements of management. There are various ways of processing data, and IT systems enable managers to obtain large amounts of information for different purposes.

(a) Data might be needed for planning or forecasting. Spreadsheet models and other forecasting models are now commonplace.

(b) Accountancy software packages, including management accounting packages or modules, can be used to process accounting data.

(c) E-mail allows managers to communicate information quickly between each other.

(d) Widespread availability of Wi-Fi connection enables easy connection to the internet when travelling.

(e) Network technology now allows workers in any location to connect to a firm’s system.

Unified corporate databases combine data from different systems (e.g. purchasing and inventory issues). This can improve control over budgeting, forecasting and planning; reporting etc.

Data warehouses

A data warehouse is a database used for reporting and analysis. The data stored in the warehouse is uploaded from the operational systems. The data may pass through an operational data store for additional operations before it is used in the data warehouse for reporting.

The term “data warehouse” implies a storage function but they do much more than this. The typical data warehouse includes a staging layer that stores raw data, an integration layer where the data is integrated and analysed and moved into a series of hierarchal groups, and an access layer from which users retrieve data.

RFID tagging

Radio-frequency identification (RFID) is the use of a wireless, non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purposes of automatic identification and tracking.

The tag contains electronically stored information which can be read from up to several metres away.

Decreased cost and increased reliability has led to the widespread use of this technology in many applications including:

(a) Tracking of goods during shipment – UPS customers are able to track dispatches on line

(b) Inventory control – RFID systems provide accurate knowledge of current inventory. Walmart were able to reduce inventory levels by 30% on some lines.

(c) Production control – RFID tags attached to cars in process of manufacture can track degree of completion.

(d) Supply chain management - In the fashion industry an RFID label is attached to the garment at production so that it can be traced throughout the supply chain and removed at the point of sale (POS).

(e) Tracking of livestock.

(f) Access into secured areas.

(g) Travel documents – the technology is used in E-passports.

Information systems and access to data

Management accounting systems are information systems, and the development of information technology (IT) continues to have a significant impact on management accounting and on:

(a) collecting data;

(b) storing data and information: (Note: data is unprocessed, whereas information is data that has been processed into something that has meaning or purpose);

(c) the ability to process data into valuable information;

(d) access to information; and

(e) communication of information.

Instant access to management accounting data

Another significant feature of modern IT systems is instant access to information. Information might be held on a central database, and accessible to all authorised personnel through a network connection.

Instant access means that managers do not have to wait for information to come to them, for example in routine reports. They can search for and obtain the information they want at any time. Furthermore, this can be done from any location that has an internet connection.

Remote input

In traditional management accounting systems, data was input to the computer system by specialist staff. There was often a high rate of input errors, and data validation checks were included in the software to reduce the error rate. In many systems, the process of collecting data and input to a computer system was fairly slow.

Modern IT systems often provide for automatic input of data by non-finance operating staff, often with minimal risk of errors. One example is the automatic input of sales data and inventory data at check-out points in stores and supermarkets, using bar codes and automatic bar code readers. Information is available about sales and reductions in inventory at the exact moment that the items are being sold.

Instant access to external sources of data

IT sytems also provide for access to external sources of data and information. External data can be obtained from the Internet, either:

(a) free of charge, for example, from the websites of government departments and public news agencies, or

(b) through subscription (payments to an external information provider).

A wide range of complex data analysis can be performed with computer software. Many managers can use models for planning and forecasting, including the application of sensitivity analysis to plans and forecasts.

Difficulties associated with recording and processing qualitative data

Companies should identify their critical success factors and then put in place a series of key performance indicators (KPIs), the achievement of which will result in the company meeting its corporate objectives. The performance measures identified as KPIs might be both quantitative (including financial performance measures) and qualitative.

The use of qualitative performance measures brings certain problems that are not found when using quantitative performance measures.

Qualitative data is subjective and open to judgement. For example, a requirement to achieve a high level of customer satisfaction is an admirable goal but a company needs to decide on how customer satisfaction might be measured in order to identify the success or otherwise of measures taken to improve it.

One approach is to try to express the qualitative measure in a quantitative way (sometimes described as a "quantitative surrogate").

For example a hotel company might invite guests to complete a short survey after their stay asking them to attach a score to a number of different aspects of their say.

**Example:**
A **hotel** might ask guests to complete the following questionnaire so as to obtain a measure of the perceived quality of their restaurant.
Please circle a number in each row to indicate how satisfied you were with the following aspects of the hotel restaurant.

| | Dissatisfied | Somewhat dissatisfied | Neither satisfied or satisfied | Somewhat satisfied | Dissatisfied |
|---|---|---|---|---|---|
| Range of food available | 1 | 2 | 3 | 4 | 5 |
| Quality of food | 1 | 2 | 3 | 4 | 5 |
| Price of the food | 1 | 2 | 3 | 4 | 5 |
| Speed of service | 1 | 2 | 3 | 4 | 5 |
| Cleanliness | 1 | 2 | 3 | 4 | 5 |
| Overall satisfaction | 1 | 2 | 3 | 4 | 5 |

Hotels often send emails to customers after their visit asking them to complete a short survey on the hotel's website. Information in this way can be scored and collated automatically.

**Possible problems with the use of quantitative surrogates**

There are problems with the use of quantitative surrogates. These include the following:

(a) People may not respond

(b) The people who do respond will often be biased towards those with a specific point that they wish to make. For example, a guest who has had a particularly bad experience is much more likely to respond that a guest who found everything to be OK.

(c) Many responders will not circle the extreme scores as a matter of practice.

These problems relate to a business to customer environment. In a business to business environment the supplier is more likely to receive a response from their customers, though the response might be biased downwards if customer is attempting to use the score as a bargaining chip for future price reductions.

Other problems

If qualitative performance can be recorded and processed the results must be communicated to the managers who are responsible for that aspect of performance. It is not always easy to identify the responsible manager. Care must be taken to

identify the person responsible correctly. This is particularly important where a manager's reward is based on a qualitative performance measure.

For example, a cleaning manager might lose a bonus if a hotel receives a low score for cleanliness of the rooms on one day out of the month. However, this might have been due to a power cut which prevented effective cleaning. This is a simple example to illustrate that effective performance measurement of individuals must be:

(a) based on fair targets;

(b) based on areas of performance that can be controlled by that individual; and

(c) fairly administered.

This is particularly important when remuneration is linked to performance as a failure to achieve a target due to a perceived injustice and the consequential adverse impact on remuneration can be very demotivating.

## 1.7 Social and ethical issues that impact on organisational strategy formulation:

Social and ethical issues have significant impact on organisational strategy formulation and implementation. Therefore, corporate social responsibility, stakeholder interests, and long-term sustainability must be taken into consideration when formulating and implementing corporate strategic objectives, so as to have a more sustainable business model.

The following is a detailed breakdown of these issues:

### Corporate Social Responsibility (CSR)

CSR refers to a business's responsibility towards society and the environment, encompassing ethical practices, environmental sustainability, and social well-being.

### Integrating CSR into strategy formulation

Integrating CSR principles into strategy formulation can lead to a more sustainable and ethical business model, enhancing reputation and attracting socially conscious stakeholders. Examples of CSR issues include Implementing fair labor practices, reducing environmental impacts, and supporting local communities.

### Stakeholder Interests

A Stakeholder is any individual, group, or organisation that can affect or be affected by a company's actions or decisions. They have vested interest in the success or failure of the business or organisation. Stakeholders include employees, customers, investors, suppliers, government and the broader community.

### Impact on Strategy

Strategies should consider the needs and expectations of all stakeholders, ensuring fairness and transparency in decision-making, such as ensuring fair wages and safe working conditions for employees, providing accurate information to customers, respecting the rights of suppliers, etc.

### Ethical Considerations

Ethical issues arise when decisions or actions conflict with ethical standards, such as honesty, fairness, integrity, and respect for the law.

Ethical considerations should be integrated into all aspects of strategy formulation, from identifying opportunities to evaluating potential risks**,** for example avoiding conflicts of interest, ensuring transparency in financial reporting and respecting intellectual property.

**Sustainability**

Sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable strategies focus on long-term value creation, balancing short-term profitability with long-term environmental and social responsibility. Sustainability issues includes Reduction of carbon emissions, promotion of resource efficiency, and investment in renewable energy.

**Corporate Governance**

Corporate governance refers to the system of rules, practices, and processes by which a company is directed and controlled. Strong corporate governance ensures accountability, transparency, and ethical decision-making, which are crucial for long-term success. Components of good corporate governance includes having an independent board of directors, implementing robust internal controls, and promoting ethical leadership.

## 1.8 Chapter Review

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

(a) explain the concept of Management information System (MIS);

(b) explain costs and benefits of information systems;

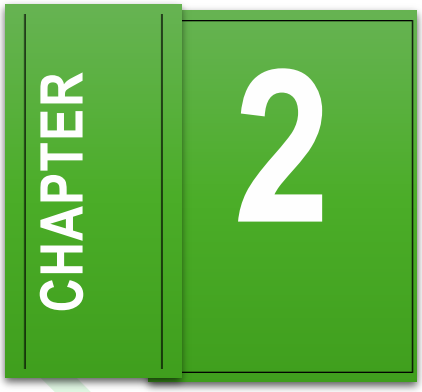
(c) explain uses of internet, intranet, and wireless technology;

(d) explain accounting information requirements and types of accounting information; and

(e) explain social and ethical issues that impact on organisational strategies.

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**Skills level**
**Performance management**




# Big Data Application and Analysis

## Chapter Content


2 Big Data Application and Analysis

2.0 Learning objective

2.1 Learning outcomes

2.2 Meaning of big data

2.3 Application of principles of big data in management information and decision making.

2.4 Purposes and application of big data pyramid

2.5 Discuss the uses and benefits of big data, data mining and data analytics

2.6 Discuss the challenges and risks associated with application of big data and data analytics in an organisation

2.7 Chapter review


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## 2. Big Data Application and Analysis

### 2.0 Learning objective

This chapter provides readers with knowledge of big data, its applications and uses in decision making.

### 2.1 Learning outcomes

On successful completion of this chapter, readers should be able to:

(a) understand the concept of big data and various techniques of mining such data in order to covert them to useable information;
(b) understand the strategic planning process;
(c) define the purposes and application of big data pyramid;
(d) understand the uses and benefits of big data, data mining and data analytics; and
(e) appreciate the challenges and risks associated with application of big data and data analytics in an organisation

### 2.2 Introduction to 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 is often grows exponentially overtime.

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 insight 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

#### 2.2.1 The four (4) characteristics of big data are:

**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.

### 2.2.2 Advantages of Big Data

**Better decision-making**

(a) Analysing massive datasets leads to insights that guide strategic choices.
(b) Predictive analytics helps forecast trends, customer behaviour, and potential risks.
(c) Real-time data empowers organisations to respond quickly to changing conditions.

**Personalisation**

(a) Enables tailored recommendations—think Netflix, Amazon, and Spotify.
(b) Enhances customer experience by customising offers, products, and services.
(c) In marketing, big data helps target the right audience more accurately.

**Operational efficiency**

(a) Streamlines processes by identifying bottlenecks and inefficiencies.
(b) Improves supply chain management through data-driven forecasting.
(c) Automation of tasks becomes more effective with the right data inputs.

**Cost reduction**

(a) Helps businesses cut waste and optimise resources.
(b) Data-driven maintenance (in industries like manufacturing) predicts equipment failure, reducing downtime.
(c) Improves budgeting by forecasting expenses more precisely.

**Innovation and product development**

(a) Reveals market gaps and customer needs for new product ideas.
(b) Enables rapid prototyping and iterative improvements using user feedback.
(c) Combines structured and unstructured data for richer insights.

**Transformative Impact in Sectors**

(a) In healthcare: improves diagnosis, tracks disease outbreaks, and personalizes treatment.
(b) In finance: enhances fraud detection, credit scoring, and investment strategy.
(c) In public services: boosts urban planning, disaster response, and citizen engagemen

**Disadvantages of Big Data**

High cost and complexity

(a) Infrastructure for storing and processing big data (e.g., cloud services, servers, analytics platforms) can be expensive.
(b) Requires specialised talent, data scientists, engineers, analysts who are often costly and in short supply.
(c) Integration with existing systems is technically demanding.

**Privacy concerns**

(a) Collecting large volumes of personal data can infringe on individual privacy.
(b) Data misuse, breaches, or surveillance can lead to public distrust.
(c) Regulatory challenges arise in keeping data collection lawful and ethical (e.g. GDPR in the EU).

**Security risks**

(a) Big data systems are attractive targets for cyberattacks.
(b) Storing and processing data across distributed systems increases vulnerability.
(c) If sensitive data is leaked, it can cause massive reputational and financial damage.

**Data quality issues**

(a) The sheer volume makes it hard to ensure accuracy, consistency, and reliability.
(b) “Garbage in, garbage out”: poor data leads to flawed insights and decisions.
(c) Unstructured data from diverse sources (text, video, social media) is hard to clean and process.

**Information overload**

(a) Too much data can overwhelm decision-makers, leading to analysis paralysis.
(b) It is easy to get lost in noise instead of focusing on actionable insights.

**Ethical challenges**

(a) Big data can inadvertently reinforce biases if the data used to train algorithms is not representative.
(b) Profiling and algorithmic decision-making may unfairly impact marginalised groups.
(c) There’s often a lack of transparency around how data is used in automated systems

**Traditional Data**

Traditional data is the structured data that is easy to organise, store and consequently maintained by most organisations. Such data can easily be handled by simple data bases, computer and spreadsheet especially data relating to accounting, sales information and production results.

**Advantages of Traditional Data**

(a) Storage and management are easier with regular database systems.

(b) Great efficiency in data access and manipulation arises from having a structured data models.
(c) It is relatively inexpensive in storing and processing of data or datasets that are relatively small in size.

**Disadvantages of Traditional Data**

(a) This is only available in structured formats and can therefore, limit flexibility.
(b) This does not work well for unstructured data types such as text, images or videos.
(c) when the number of inputs becomes too large it is difficult to scale.

**Difference between big data and traditional data**

Data is processed information that management uses to make informed decisions. The volume, variety, velocity referred to as the 4Vs, and mode of handling data makes the difference between big data and traditional data. The understanding of the 4 Vs gives management the knowledge to understand the appropriate method of mining and analysis to be adopted.

**The following are the differences between Big data and Traditional data**

(a) **Volume**: Traditional data typically refers to small to medium-sized datasets that can be easily stored and analysed using traditional data processing technologies. In contrast, big data refers to extremely large datasets that cannot be easily managed or processed using traditional technologies.
(b) **Variety**: Traditional data is typically structured, meaning it is organised in a predefined manner such as tables, columns, and rows. Big data, on the other hand, can be structured, unstructured, or semi-structured, meaning it may contain text, images, videos, or other types of data.
(c) **Velocity:** Traditional data is usually static and updated on a periodic basis. In contrast, big data is constantly changing and updated in real-time or near real-time.
(d) **Complexity:** Traditional data is relatively simple to manage and analyse. Big data, on the other hand, is complex and requires specialised tools and techniques to manage, process, and analyse.
(e) **Value**: Traditional data typically has a lower potential value than big data because it is limited in scope and size. Big data, on the other hand, can provide valuable insights into customer behaviour, market trends, and other business-critical information.

**Similarities between Traditional Data and Big Data**

(a) **Data quality**: The quality of data is essential in both traditional and big data environments. Accurate and reliable data is necessary for making informed business decisions.
(b) **Data analysis**: Both traditional and big data require some form of analysis to derive insights and knowledge from the data. Traditional data analysis methods typically involve statistical techniques and visualisations, while big data analysis may require machine learning and other advanced techniques.
(c) **Data storage:** In both traditional and big data environments, data needs to be stored and managed effectively. Traditional data is typically stored in relational databases, while big data may require specialised technologies like cloud-based storage systems.

(d) **Data security**: Data security is a critical consideration in both traditional and big data environments. Protecting sensitive information from unauthorised access, theft, or misuse is essential in both contexts.

(e) **Business Value**: Both traditional and big data can provide significant value to organisations. Traditional data can provide insights into historical trends and patterns, while big data can uncover new opportunities and help organisations make more informed decisions.

## 2.3 Application of principles of big data in management information and decision making.

### Big Data Principles

Big data principles revolve around the "5 V's" – volume, velocity, variety, veracity, and value – and are applied across various industries for insights, predictions, and better decision-making.

The following are the key principles and applications:

(a) **Volume:** Refers to the sheer amount of data being generated and stored;

(b) **Velocity:** Describes the speed at which data is created, processed, and moved;

(c) **Variety:** Highlights the different formats and types of data, including structured, unstructured, and semi-structured data;

(d) **Veracity:** Focuses on the quality, accuracy, and trustworthiness of the data; and

(e) **Value:** Emphasises the insights and business outcomes derived from analysing big data.

### 2.3.1 Management of Big Data Principles

For effective management of big data, the following key principles are necessary:

**Data quality**

(a) **Accuracy:** Ensuring data is free from errors and inconsistencies.

(b) **Completeness:** Ensuring all necessary data is present and accounted for.

(c) **Consistency:** Maintaining uniformity across different data sources and formats.

(d) **Timeliness:** Ensuring data is up-to-date and relevant.

(e) **Data Profiling:** Continuously analysing data to identify patterns, errors, and inconsistencies.

(f) **Data Cleansing:** Implementing processes to identify and correct data quality issues.

**Data accessibility:**

(a) **Availability:** Ensuring data is readily accessible to authorised users when needed.

(b) **Data discovery:** Implementing mechanisms for users to easily find and access relevant data.

(c) **Data integration:** Combining data from various sources into a unified view.

(d) **Data sharing:** Establishing controlled data sharing mechanisms to facilitate collaboration.

**Data security**

(a) **Data protection:** Implementing measures to protect data from unauthorised access, use, disclosure, disruption, modification, and destruction.

(b) **Access control:** Restricting access to data based on roles and responsibilities.
(c) **Data encryption:** Protecting sensitive data through encryption techniques.
(d) **Data backup and recovery:** Implementing robust backup and disaster recovery plans.
**(e) Compliance:** Adhering to relevant data privacy regulations and industry standards.

**Ethical considerations**

(a) **Data privacy:** Protecting the privacy of individuals whose data is being collected and used.
(b) **Transparency:** Being open and honest about data collection, use, and sharing practices.
(c) **Fairness:** Ensuring that data is used in a way that does not discriminate against or disadvantage any group.
(d) **Accountability:** Establishing clear lines of responsibility for data management practices.
(e) **Consent:** Obtaining informed consent from individuals before collecting and using their data

### 2.2.3 Applications of Big Data

(a) **Business**

i. **Customer relationship management (CRM):** Understanding customer behaviour, preferences, and trends to personalise marketing and improve customer experience.
ii. **Supply chain optimisation:** Analysing data to improve efficiency, reduce costs, and optimise logistics.
iii. **Fraud detection:** Identifying and preventing fraudulent activities in financial transactions and other areas.
iv. **Risk management:** Assessing and mitigating potential risks in various areas, such as financial, operational, and regulatory.
v. **Predictive analytics:** Forecasting future trends and outcomes to make data-driven decisions.

(b) **Healthcare:**

i. **Disease prediction and prevention:** Identifying risk factors and predicting outbreaks to improve public health outcomes.
ii. **Personalised medicine:** Tailoring treatments and interventions based on individual patient data.
iii. **Drug discovery:** Accelerating the development of new drugs and therapies.
iv. **Medical image analysis:** Analysing medical images to detect diseases and improve diagnosis.

(c) **Finance:**

i. **Algorithmic trading:** Using algorithms to automate trading and make quick decisions based on market data.
ii. **Credit risk assessment:** Evaluating the creditworthiness of individuals and businesses.

iii. **Fraud detection:** Identifying and preventing fraudulent activities in financial transactions.

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(d) **Marketing:**

i. **Targeted advertising:** Delivering relevant ads to specific customer segments.
ii. **Product recommendations:** Suggesting products or services that customers are likely to be interested in.
iii. **Customer segmentation:** Grouping customers based on their characteristics and behaviours.

(e) **Transportation:**

i. **Traffic management:** Optimising traffic flow and reducing congestion.
ii. **Autonomous vehicles:** Developing self-driving cars and other autonomous transportation systems.
iii. **Smart cities:** Using data to improve urban planning and resource management.

(f) **Government and public administration:**

i. **Public health:** Monitoring disease outbreaks and tracking public health trends.
ii. **Crime prevention:** Analysing crime data to identify patterns and predict crime hotspots.
iii. **Resource management:** Optimising the use of public resources, such as water and energy.

### 2.2.4 Key considerations

**(a)** **Data quality:** Ensuring the accuracy, completeness, and consistency of data is crucial for reliable insights.
**(b)** **Data privacy and security:** Protecting sensitive data and ensuring compliance with privacy regulations is essential.
**(c)** **Data governance:** Establishing clear policies and procedures for managing data assets is important.
**(d)** **Scalability and performance:** Big data systems need to be able to handle large volumes of data and perform complex analyses efficiently.
**(e)** **Skills and expertise:** Organisations need to invest in training and hiring personnel with the necessary skills to manage and analyse big data

## 2.4 Purposes and application of big data pyramid

The Data Pyramid represents the relationships between data, information, knowledge and wisdom. Hence it is referred to as DIKW. The Data-Information-Knowledge-Wisdom (DIKW) pyramid illustrates the progression of raw data to valuable insights. It gives one a framework to discuss the level of meaning and utility within data. Each building block is a step towards a higher level - first comes data, then is information, next is knowledge and finally comes wisdom. Each step answers different questions about the initial data and adds value to it. The component of DIKW are detailed below:

Data (D):

Raw, unprocessed facts and figures without context, forming the foundation of the pyramid.

Information(I):

Organised, structured, and contextualized data, useful for answering basic questions like "who," "what," "where," and "when".

Knowledge (K):

The result of analysing and interpreting information to uncover patterns, trends, and relationships, providing an understanding of "how" and "why" certain phenomena occur.

Wisdom (W):

The ability to make well-informed decisions and take effective action based on an understanding of the underlying knowledge.

### 2.4.1 The Purposes of DIKW are detailed below:

(a) **Framework for Understanding:** The DIKW pyramid provides a structured way to discuss the levels of meaning and utility within data, helping to understand how data transforms into valuable insights.

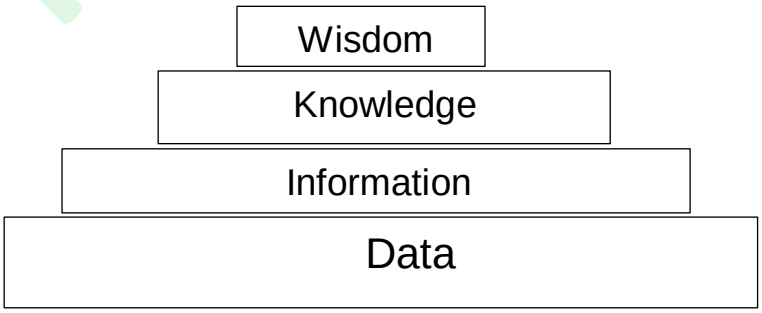
(b) **Data-Driven Decision-Making:** By understanding the progression from data to wisdom, organisations can leverage data more effectively to make informed decisions and take strategic actions.

(c) **Communication and Collaboration:** The pyramid can serve as a common language for discussing data, information, and knowledge within an organisation, facilitating better communication and collaboration among different teams.

**(d)** **Foundation for Analytics and Knowledge Management:** The DIKW pyramid serves as a foundation for analytics, business intelligence (BI), and knowledge management, helping to organize and leverage data for organisational success.

**(e)** **Career Development:** The pyramid can be used to frame conversations on skills and responsibilities, helping individuals understand how their technical skills and interests map to different roles and responsibilities within a data-driven organisation.

**The Pyramid diagram is shown below:**




Big Data Pyramid

**Components of a big data pyramid:**

Wisdom - Ability to make sound judgement and informed decision.
Knowledge – Understanding and insight brought from processed data
Information – Data that has been processed, organised , structured and given context
Data - Raw or unprocessed data or facts

## 2.5 Discuss the uses and benefits of big data, data mining and data analytics:

Uses of Big data

Only a small percentage of the huge amounts of data available is actually analysed. The importance of big data is not how much data there is but how it may be used. Analysis might lead to:

cost reductions;

new product development; and

smart decision making.

Big data – and the way organisations manage and derive insight from it – is changing the way the world uses business information

**Example:**

UPS is a very large logistics company.

It stores a large amount of data – much of which comes from sensors in its vehicles.

UPS launched an initiative called ORION (On-Road Integration Optimization and Navigation) which used on online map data to reconfigure a driver's pickups and drop-offs in real time.

The project cut 85.000.000 miles off routes leading to savings of 8.4 million gallons of fuel.

(UPS has estimated that saving one daily mile per driver saves the company $30 million).

### 2.5.1 Characteristics of Big Data

(a) **Volume:** The sheer size of the data, often measured in terabytes or petabytes

(b) **Variety:** The different types of data formats, including structured data (traditional databases), semi-structured data (like JSON or XML), and unstructured data (text, images, videos).

(c) **Velocity:** The speed at which data is generated and processed.

(d) **Veracity:** The quality and accuracy of the data.

(e) **Value:** The potential for extracting insights and making informed decisions from the data.

### 2.5.2 Benefits of Big Data

(a) Helps in improving decision-making through analysis of large data set

(b) By processing large data set , continuous customer interaction will lead to enhanced customer experiences

(c) Big data allows through personalize customer interactions, leads to increased customer satisfaction and loyalty.

(d) By processing complex and large data will facilitate the elimination of inefficient data therefore leading to increased efficiency and productivity

(e) By processing complex and large data will facilitate the elimination of inefficient data therefore leading to optimization of workflows, reduce costs, and improve overall productivity.

(f) By processing complex and large data will facilitate the elimination of inefficient operations thereby guaranteeing competitive advantage.

(g) By processing and analysing complex and large data will help identify potential risks and vulnerabilities thus availing opportunity for the management.

(h) Big data analytics can help enabling businesses to take proactive measures to mitigate them.

(i) Big data management will facilitate the use of analytic models that predict patterns and behavior **.**

### 2.5.3 Data Mining and Data Analytics

Data Mining:

Data mining is the process of sorting large and complex data in order to identify patterns , trends and relationships of data elements which could be structured or unstructured that can help solve business problems through data analysis enabling management to make informed decision.

Effective Data mining process relies on efficient data preparation, data gathering, data collection, mining and Analysis .

Types of Data Mining techniques:

(a) Large data can be mined using Association rule that are established or frequently used relationship trends.
(b) Large data can be processed and analysed by Classification using logistics regressions.
(c) Large data can be mined using Clustering parameters like k-means clustering, hierarchical clustering and Gaussian mixture models.
(d) Large data can be mined using parameters like linear Regression and multiple regression.
(e) Large data can be mined using parameters that focuses on Sequence and path analysis
(f) Neural networks such as algorithms that simulates the activity of the human brain, where data is processed using nodes.
(g) Decision trees can also be used in data mining resulting in Treelike structures are used to represent the potential decision outcomes.

**Data Analytics:**

Data analytics is the process of examining data to extract meaningful insights and draw conclusions, ultimately helping organisations make informed decisions and improve performance.

Data analytics eliminates guesswork from marketing, product development, content creation, and customer service. It allows companies to roll out targeted content and fine-

tune it by analysing real-time data. Data analytics also provides valuable insights into how marketing campaigns are performing

## 2.6 Challenges and risks associated with application of big data in organisations

The process of mining big data in organisations comes with the following challenges as well as associated risks.

### Challenges of application of big data in organisation

The challenges include:

**(a)** Poor data quality including accuracy, completeness and consistency can compromise the result expected from the processing.
**(b)** The vast nature of the data to be mined can be complex affecting processing speed and result.
**(c)** Data Privacy and Security is also a problem. Most data of this nature are secured and not open to public tampering or copying.
**(d)** Scalability: Data mining algorithms must be scalable handle large data.
**(e)** Iterpretability: Usage of complex models makes it difficult to be interpreted.
**(f)** Ethical issues: Data mining raises serious ethical issues when is been collected and used.

### 2.6.1 Risks associated with big data mining

The major risks associated with big data mining include:

**(a)** Privacy and data protection risks
**(b)** Risk associated with unorganised data
**(c)** Risk associated with costs of managing mining of big data.
**(d)** Risk associated with storage and retention of big data.
**(e)** Risk of employing incompetent processing and analysing procedures.
**(f)** Risks associated with Mining of poor quality data

## 2.7 Chapter Review

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

(a) Concept of Big data and the usefulness
(b) The Purposes of Big data
(c) Mining of big data and the associated problems and risks
(d) Benefits of Big Data

Question

What are the key challenges and opportunities in managing and analyzing big data, and how can organizations effectively leverage big data analytics for better decision-making and business outcomes?

Question

What are the methods for storing and accessing big data? What are the benefits of big data? What are some techniques for analyzing large amounts of data? What are the differences between big data and traditional data?

PART B

ADVANCED COSTING TECHNIQUES

1. **Activity based costing (ABC)**
2. **Target Costing**
3. **Life Cycle Costing**
4. **Throughput Accounting**
5. **Accounting for environmental and sustainability factors**
6. **Other advanced costing techniques**

**Skills level**
**Performance management**




# ACTIVITY BASED COSTING

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| 3.0 | Learning Objective |
| 3.1 | Learning outcomes |
| 3.2 | Discuss Activity based costing (ABC) and Uses as costing techniques |
| 3.3 | Identify suitable cost drivers under ABC |
| 3.4 | Calculate cost per driver and cost per unit , using ABC |
| 3.5 | Compare ABC and the traditional Method of overhead absorption. |
| 3.6 | Advantages and disadvantages of ABC |
| 3.7 | Chapter Review |

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## 3.0 Learning objective

This chapter introduces candidate to the concept of Activity based costing techniques, computation of cost drivers and comparing the importance of ABC approach to traditional method.

## 3.1 Learning Outcome

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

(a) Understand the concept of Activity based costing, its uses and its importance
(b) Identify suitable cost drivers under ABC approach
(c) Be in a position to calculate cost per driver and cost per unit, using ABC
(d) Compare ABC and the traditional Method of overhead absorption.
(e) Analyse the advantages and disadvantages of ABC.

## 3.2 Discuss ABC and the uses as a costing technique

Activity-based costing (ABC) is a form of absorption costing that takes a different approach to the apportionment and absorption of production overhead costs.

Activity-based costing is based on the following ideas:

(a) In a modern manufacturing environment, a large proportion of total costs are overhead costs, and direct labour costs are relatively small.
(b) It is appropriate to trace these costs as accurately as possible to the products that create the cost because overhead costs are large.
(c) The traditional methods of absorbing production overhead costs on the basis of direct labour hours or machine hours have no rational justification as many production overhead costs are not directly related to the production work that is carried out. For example:
    (i) The costs of quality control and inspection depend on the quality standards and inspection methods that are used: these do not necessarily relate to the number of hours worked in production.
    (ii) The costs of processing and chasing customer orders through the factory relate more to the volume of customer orders rather than the hours worked on each job in production.
    (iii) Costs of managing the raw materials inventories (storage costs) relate more to the volume of materials handled rather than hours worked on the material in production.
    (iv) The costs of production relate more to the volume and complexity of customer orders or the number of batch production runs, rather than hours worked in production.

### 3.2.1 Uses of ABC costing techniques

Activity-based costing (ABC) helps businesses gain a more accurate understanding of their costs by assigning overhead costs to specific activities, which are then

allocated to products or services, leading to better pricing, profitability analysis, and resource allocation decisions.

Uses of Activity-Based Costing (ABC) are:

**Accurate Product Costing:**

ABC provides a more realistic view of product costs by allocating overhead expenses based on the activities required to produce them, rather than relying on traditional methods that often distort costs.

**Improved Pricing Decisions:**

ABC provides basis for clearer understanding of product costs with which businesses can make more informed pricing decisions that ensure profitability and competitiveness.

**Enhanced Profitability Analysis:**

ABC helps identify which products or services are most profitable and which are not, enabling businesses to focus on high-margin offerings and potentially eliminate or improve low-performing ones.

**Better Resource Allocation:**

The ABC techniques provides a good understanding of the costs associated with different activities, in which businesses can allocate resources more effectively, optimize processes and reduce unnecessary expenses.

**Process Improvement:**

ABC can help identify inefficiencies and bottlenecks in production or service processes, allowing businesses to implement improvements that reduce costs and improve efficiency.

**Strategic Decision-Making:**

ABC provides valuable insights for strategic decisions, such as product mix, outsourcing, and customer segmentation, enabling businesses to make more informed choices that align with their long-term goals.

**Cost Control:**

ABC helps businesses identify and control costs by pinpointing areas where expenses are high and opportunities for cost reduction exist.

**Budgeting:**

ABC can help businesses create more accurate budgets by providing a detailed breakdown of costs associated with different activities and products.

**Identifying Value-Adding and Non-Value-Adding Activities:**

ABC helps identify activities that contribute to the value of a product or service and those that do not, allowing businesses to focus on the most important activities.

**Adapting to Economic Changes:**

ABC helps businesses identify potential economic or regulatory hazards beforehand and then take useful action to mitigate them

## 3.3 Identify the suitable Cost drivers under ABC

Cost drivers

For each activity, there should be a cost driver. A cost driver is the factor that determines the cost of the activity. It is something that will cause the costs for an activity to increase as more of the activity is performed.

Overhead costs are therefore caused by activities, and the costs of activities are driven by factors other than production volume.

Each cost driver must be a factor that can be measured so that the number of units of the cost driver that have occurred during each period can be established.

Possible examples include:

| Activity | Possible cost driver | Information needed for ABC |
|---|---|---|
| Customer order Processing | Number of customer Orders | Number of orders for each product |
| Materials purchasing | Number of purchase orders | Number of orders for materials for each finished product |
| Quality control and inspection | Number of inspections | Number of inspections of output of each product |
| Production planning | Number of production runs or batches | Number of runs or batches of each product |
| Repairs and Maintenance | Number of machines, or machine hours operated | Number of machines or machine hours worked for each product |
| Selling | Number of sales orders | Number of orders for each product |
| Warehousing and dispatch | Number of deliveries Made | Number of deliveries for each product |

### 3.3.1 Cost pools

A cost pool is simply the overhead expenditure allocated and apportioned to an activity. Overhead costs are allocated (or allocated and apportioned) to each activity, and for each activity there is a 'cost pool'.

## 3.4 Calculate the cost per driver and per unit , using ABC

ABC absorbs overheads into the cost of products (or services) at a separate rate for each cost pool (each activity).

The total production cost for each product or service is therefore direct production costs plus absorbed overheads for each activity.

The cost absorbed under ABC might be very different to that absorbed using a traditional, volume-based approach

**Example: ABC vs traditional, volume based absorption**

A manufacturing company makes four products and incurs estimated material handling costs of ₦250,000 per month. (This is the cost pool for material handling cost).

The company produces 160,000 units per month and absorbs material handling cost on the number of units. This gives a material handling cost of ₦1.5625 (₦250,000 ÷ 160,000 units)

The material handling cost is absorbed as follows:

| Product | Units produced | Unit cost (₦) | Cost absorbed (₦) |
|---|---|---|---|
| W | 60,000 | ₦1.5625 | 93,750 |
| X | 33,000 | ₦1.5625 | 51,563 |
| Y | 40,000 | ₦1.5625 | 62,500 |
| Z | 27,000 | ₦1.5625 | 42,187 |
| | 160,000 | ₦1.5625 | 250,000 |

The company has instigated a project to see if ABC costing would be appropriate.

The project has identified that a large part of the material handling costs are incurred in receiving material orders and that the same effort goes into receiving orders regardless of the size of the order. Order sizes differ substantially.

The company has identified the following number of orders in respect of material for each type of product.

| Product | Number of orders |
|---|---|
| W | 15 |
| X | 22 |
| Y | 4 |
| Z | 9 |
| | 50 |

An ABC cost per order (hence cost per unit) can be estimated as follows:

If the cost driver for order handling is the number of orders handled, the budgeted order handling cost will be ₦5,000 per order (₦250,000/50).

Overhead costs will be charged to products as follows:

| Product | Number of orders | Cost per order | Apportioned cost | Units produced | Unit cost |
|---|---|---|---|---|---|
| W | 15 | ₦5,000 | 75,000 | 60,000 | 1.25 |
| X | 22 | ₦5,000 | 110,000 | 33,000 | 3.33 |
| Y | 4 | ₦5,000 | 20,000 | 40,000 | 0.50 |
| Z | 9 | ₦5,000 | 45,000 | 27,000 | 1.67 |
| | 50 | ₦5,000 | 250,000 | 160,000 | |

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The above example shows that the material handling overhead absorbed to each type of product is very different under the two approaches.

For example, only 33,000 units of product X are made (out of a total of 160,000 units). However, product X requires 22 orders out of a total of 60 and it is the number of orders that drive this cost.

The traditional approach recognised ₦51,563 as relating to product but ABC, using the number of orders as the driver results in ₦110,000 being absorbed by product X.

The above example shows the difference between traditional absorption and ABC using a single cost. In reality there would be more than one activity used as

a basis for absorption leading to a series of absorption rates (per activity).

Also note that one of the absorption methods might be a volume-based method. The point is that traditional absorption methods treat all costs as varying

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**Example: ABC**

A company makes three products, X, Y and Z using the same direct labour employees and the same machine for production.

Production details for the three products for a typical period are as follows:

according to a volume measure whereas ABC splits the total and treats each part of the total cost according to what drives it.

Direct labour costs ₦160 per hour.

Total production overheads are ₦1,309,000 and further analysis shows that the total production overheads can be divided as follows:

| | Labour hours per unit | Machine hours per unit | Material cost per unit (₦) | Number of units produced |
|---|---|---|---|---|
| Product X | 0.25 | 0.75 | 100 | 1,500 |
| Product Y | 0.75 | 0.50 | 60 | 2,500 |
| Product Z | 0.50 | 1.50 | 120 | 14,000 |

| | |
|---|---|
| Costs relating to machinery | N196,350 |
| Costs relating to inspection | 458,150 |
| Costs relating to set-ups | 392,700 |
| Costs relating to materials handling | 261,800 |
| Total production overhead | 1,309,000 |

**Example (continued): ABC**

The following total activity volumes are associated with each product for the period:

| | Number of inspections | Number of set-ups | Number movements of materials | Machine hours |
|---|---|---|---|---|
| Product X | 360 | 80 | 40 | 1,125 |
| Product Y | 80 | 120 | 80 | 1,250 |
| Product Z | 960 | 500 | 280 | 21,000 |
| | 1,400 | 700 | 400 | 23,375 |

Machine costs are absorbed on a machine hour basis.

The costs per unit for each product may be estimated as follows using ABC principles.

**Step 1: Cost per activity**

| Activity | Cost allocated (₦) | Cost driver | Activity per period | Overhead absorption rate |
|---|---|---|---|---|
| Inspection | 458,150 | Inspections | 1,400 | ₦327.25 per inspection |
| Set-ups | 392,700 | Set-ups | 700 | ₦561 per set-up |
| Materials handling | 261,800 | Movements | 400 | ₦654.50 per movement |
| Machinery operations | 196,350 | Machine hrs | 23,375 | ₦8.40 per machine hour |
| **Total** | 1,309,000 | | | |

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**Example (continued): ABC**

**Step 2: Allocate overheads to product types based on cost per activity and cost drivers**

| | X | Y | Z |
|---|---|---|---|
| Set-ups | | | |
| 80 set ups × ₦561 | 44,880 | | |
| 120 set ups × ₦561 | | 67,320 | |
| 500 set ups × ₦561 | | | 280,500 |
| Inspection | 117,810 | 26,180 | |
| 360 set ups × ₦327.25 | | | 314,160 |
| 80 set ups × ₦327.25 | 26,180 | | |
| 960 set ups × ₦327.25 | | 52,360 | |
| | | | 183,260 |
| Materials handling | | | |
| 1,125 movements hours □ ₦8.40 | 9,450 | | |
| 1,250 hours □ ₦8.40 | | 10,500 | |
| 21,000 hours □ ₦8.40 | | | 176,400 |
| Overhead costs per product | 198,320 | 156,360 | 954,320 |

**Example (continued): ABC**

**Step 3**

**Calculate overhead per unit (if required)**

| | | | |
|---|---|---|---|
| Overhead costs per product | | | |
| | **X** | **Y** | **Z** |
| (from step 2) | ₦198,320 | ₦156,360 | ₦954,320 |
| Number of units | 1,500 | 2,500 | 14,000 |
| Overhead cost per unit | ₦132.21 | ₦62.54 | ₦68.17 |

**Step 4: Calculate total production cost per unit (if required)**

| | | | |
|---|---|---|---|
| **Production cost per unit: ABC** | **X** | **Y** | **Z** |

| | | | | | |
|---|---|---|---|---|---|
| Direct materials | ₦ 100.00 | | ₦ 60.00 | | ₦ 120.00 |
| Direct labour | 40.00 | | 120.00 | | 80.00 |
| Production overhead (from step3) | 132.21 | | 62.54 | | 68.17 |
| | | | | | |
| Full production cost per unit | 272.21 | | 242.50 | | 268.17 |

Although ABC is a form of absorption costing, the effect of ABC could be to allocate overheads in a completely different way between products. Product costs and product profitability will therefore be very different with ABC compared with traditional absorption costing.

### 3.5 Compare ABC and the traditional method of overhead absorption

Activity-Based Costing (ABC)is a form of absorption costing in which allocates overhead costs to products based on the activities they consume, while traditional costing uses a single, volume-based cost driver like machine hours to allocate overhead.

The traditional method of allocating overhead costs involves spreading manufacturing overhead to products based on the volume of production resources consumed, such as direct labor hours or machine hours.
It is computed thus:

$$\text{Overhead absorption rate} = \frac{\text{Overhead}}{\text{Volume of production resources}}$$

ABC, however, provides a more accurate and detailed view of product costs, while traditional costing is simpler but less accurate.

This can further be detailed as shown in the table below:

| S/N | Basis of Differences | Traditional method of overhead Absorption | ABC Method of overhead Absorption |
|---|---|---|---|
| 1 | Cost driver | Uses single cost driver | Uses multiple cost drivers |
| 2 | Overhead Allocation | Allocation of overhead is based on the total single cost driver | Allocation of overhead based on multiple activities used. |
| 3 | Accuracy | Less accurate as it is just an average. | More accurate as it is based on the actual activities used. |
| 4 | Complexity | Less complex and simple to calculate | More complex to calculate |
| 5 | Focus | Focused on cost | Provide better |

| | | | |
|---|---|---|---|
| | | control and cost reduction | information for decision making in the areas of pricing and product mix. |
| 6 | Use | Used for external reporting and regulatory objectives. | Useful in internal reporting and performance analysis |

Activity-based costing could be suitable as a method of costing in the following circumstances:

(a) In a manufacturing environment, where absorption costing is required for inventory valuations.

(b) Where a large proportion of production costs are overhead costs, and direct labour costs are relatively small.

(c) Where products are complex.

(d) Where products are provided to customer specifications.

(e) Where order sizes differ substantially, and order handling and despatch activity costs are significant.

## 3.6 Advantages and disadvantages of ABC

### Advantages

(a) ABC provides useful information about the activities that drive overhead costs. Traditional absorption costing and marginal costing do not do this.

(b) ABC also provides information that could be relevant to long-term cost control and long-term product selection or product pricing.

(c) With ABC, overheads are charged to products on the basis of the activities that are required to provide the product: Each product should therefore be charged with a 'fair share' of overhead cost that represents the activities that go into making and selling it.

(d) It might be argued that full product costs obtained with ABC are more 'realistic', although it can also be argued that full product cost information is actually of little practical use or meaning for management.

(e) There is also an argument that in the long-run, all overhead costs are variable (even though they are fixed in the short-term). Measuring costs with ABC might therefore provide management with useful information for controlling activities and long-term costs.

### Disadvantages

(a) ABC systems are costly to design and use. The costs might not justify the benefits.

(b) The analysis of costs in an ABC system may be based on unreliable data and weak assumptions. In particular, ABC systems may be based on inappropriate

activities and cost pools, and incorrect assumptions about cost drivers.

(c) ABC provides an analysis of historical costs. Decision-making by management should be based on expectations of future cash flows.

(d) Within ABC systems, there is still a large amount of overhead cost apportionment. General overhead costs such as rental costs, insurance costs and heating and lighting costs may be apportioned between cost pools. This reduces the causal link between the cost driver and the activity cost.

(e) Many ABC systems are based on just a small number of cost pools and cost drivers. More complex systems are difficult to justify, on grounds of cost.

(f) Identifying the most suitable cost driver for a cost pool/activity is often difficult. Many activities and cost pools have more than one cost driver.

(g) Traditional cost accounting systems may be more appropriate for the purpose of inventory valuation and financial reporting.

**Criticisms of traditional overhead absorption costing**

Traditional absorption costing has many weaknesses, especially in a 'modern' manufacturing environment.

(a) Production overhead costs are often high relative to direct production costs. Therefore, a system of adding overhead costs to product costs by using time spent in production (direct labour hours or machine hours) is difficult to justify.

(b) A full cost of production has only restricted value for many types of management decision.

However, traditional absorption costing is still in use with some companies.

(a) It provides a rational method of charging overhead costs to production costs, so that a full cost of production can be calculated for closing inventories.

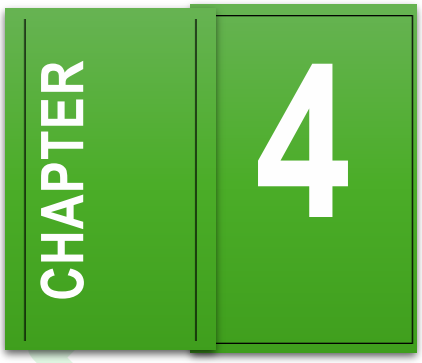
(b) bIt is also argued that absorption costing is useful for some pricing decisions. (Pricing is covered in a later paper).

A number of alternative costing methods have been developed with a view to replacing the traditional methods. One such method is activity-based costing.

## 3.7 Chapter Review

Before moving on to the next chapter, candidates are advised to ensure they understand the concept of Activity based costing (ABC), computation and their uses in performance Management.

**Skills level**
**Performance management**




# TARGET COSTING

## Chapter Content


4.0 Learning objective
4.1 Learning outcomes
4.2 Discuss the principles of target costing and its uses as a costing techniques.
4.3 Evaluate the target cost in a manufacturing and service industries.
4.4 Discuss the challenges of applying target costing in service industries.
4.5 Advise on how a target cost gap can be managed.
4.6 Comprehensive example


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# 4 Target costing

## 4.0 Learning objective

Performance management develops and deepens candidates' capability to provide information and decision support to management in operational and strategic contexts with a focus on linking costing, management accounting and quantitative methods to critical success factors and operational strategic objectives whether financial, operational or with a social purpose. Candidates are expected to be capable of analysing financial and non- financial data and information to support management decisions.

## 4.1 Learning outcomes

On successful completion of this chapter, readers should be able to:

(a) Understand the concept of Target costing, its uses and its importance

(b) Discuss the principles of target costing and its advantages as a costing techniques.

(c) Evaluate the target cost in a manufacturing and service industries.

(d) Discuss the challenges of applying target costing in service industries.

(e) Advise on how a target cost gap can be managed.

## 4.2 Discuss the Principles of target costing and its uses as a costing techniques

Target costing originated in Japan in the 1970s. It began with recognition that customers were demanding more diversity in products that they bought, and the life cycles of products were getting shorter. This meant that new products had to be designed more frequently to meet customer demands.

Companies then became aware that a large proportion of the costs of making a product are committed at the design stage, before the product goes into manufacture. The design stage was therefore critical for ensuring that new products could be manufactured at a cost that would enable the product to make a profit for the company.

Target costing is a method of strategic management of costs and profits. As its name suggests, target costing involves setting a target or objective for the maximum cost of a product or service, and then working out how to achieve this target.

It is used for business strategy in general and marketing strategy in particular, by companies that operate in a competitive market where new products are continually being introduced to the market. In order to compete successfully, companies need to be able to

(a) continually improve their existing products or design new ones

(b) sell their products at a competitive price; this might be the same price that competitors are charging or a lower price than competitors, and

(c) make a profit.

In order to make a profit, companies need to make the product at a cost below the expected sales price.

**Target costing and new product development**

Target costing is used mainly for new product development. This is because whenever a new product is designed and developed for a competitive market, a company needs to know what the maximum cost of the new product must be so that it will sell at a profit.

A company might decide the price that it would like to charge for a new product under development, in order to win a target share of the market. The company then decides on the level of profitability that it wants to achieve for the product, in order to make the required return on investment. Having identified a target price and a target profit, the company then establishes a target cost for the product.
This is the cost at which the product must be manufactured and sold in order to achieve the target profits and return at the strategic market price.

Keeping the costs of the product within the target level is then a major factor in controlling its design and development.

**Illustration: Target cost**

**New product design and development**

| | ₦ |
|---|---|
| Decide: The target sales price | X |
| Deduct: The target profit margin | (X) |
| Equals: The target cost (maximum cost in order to meet or exceed the target profit) | X |

The reason that target costing is used for new products, as suggested earlier, is that the opportunities for cutting costs to meet a target cost are much greater during the product design stage than after the product development has been completed and the production process has been set up.
Typically, when a new product is designed, the first consideration is to design a product that will meet the needs of customers better than rival products. However, this initial product design might result in a product with a cost that is too high, and which will therefore not be profitable.

The estimated cost of a product design can be compared with the target cost. If the expected cost is higher than the target cost, there is a cost 'gap'.

A cost gap must be closed by finding ways of making the product more cheaply without losing any of the features that should make it attractive to customers and give it 'value'. For example, it might be possible to simplify that product design or the production process without losing any important feature of the product. It might also be possible to re-design the product using a different and cheaper material, without loss of 'value'.

Having worked out how to reduce costs at the product design stage, management should try to ensure that the product is developed and the method of producing it is introduced according to plan, so that the target cost is achieved.

**Target costing** is thus a new pricing strategy, that involves setting a price for a product or service based on the costs associated with making it and the desired profit margin expected from the production of goods and services.

There are four core steps to the target costing process:

1. Research: The first step is to carry out a research on the target market and designing the product or services to meet the customer needs of the market.
2. The second step is to determine the Maximum Cost and Target Price expected of the product as well as the desired profit expectation. The target cost structure is s shown below:

   The Market Price = Target Price NXXX

   Less the Target Costs (All Costs) (XXX)

   Desired Profit XXX

3. The Third step is to determine the desired profit for the product,
4. Thereafter, every effort should be put in place by the design engineer to draw up features that will facilitate achievement of the Product maximum costs
5. Finally, the product costs will be monitored to facilitate needed adjustments to achieve the target profit.

### 4.2.1 The target costing method and Principles

The principles of target costing may therefore be summarised as follows.

(a) Price-led costing that is market driven pricing.

(b) Customer focused Principles that ensures the engagement of customers in order to deliver value.

(c) Product design focused that ensures effective manufacturing design with product innovation.

(d) Process design focused that emphasizes the on lean manufacturing with continuous improvement.

(e) Principles of cross functional team work that facilitates collaborative tendencies in decision making process.

(f) Principles of value chain adoption where integrated relationship from suppliers to consumers are emphasized.

(g) Life cycle costing principles are utilized to ensure sustainable practices.

(h) Price led costing that is supported by market driving pricing mechanism.

Target costing is based on the idea that when a new product is developed, a company will have a reasonable idea about:

(a) the price at which it will be able to sell the product, and

(b) the sales volumes that it will be able to achieve for the product over its expected life.

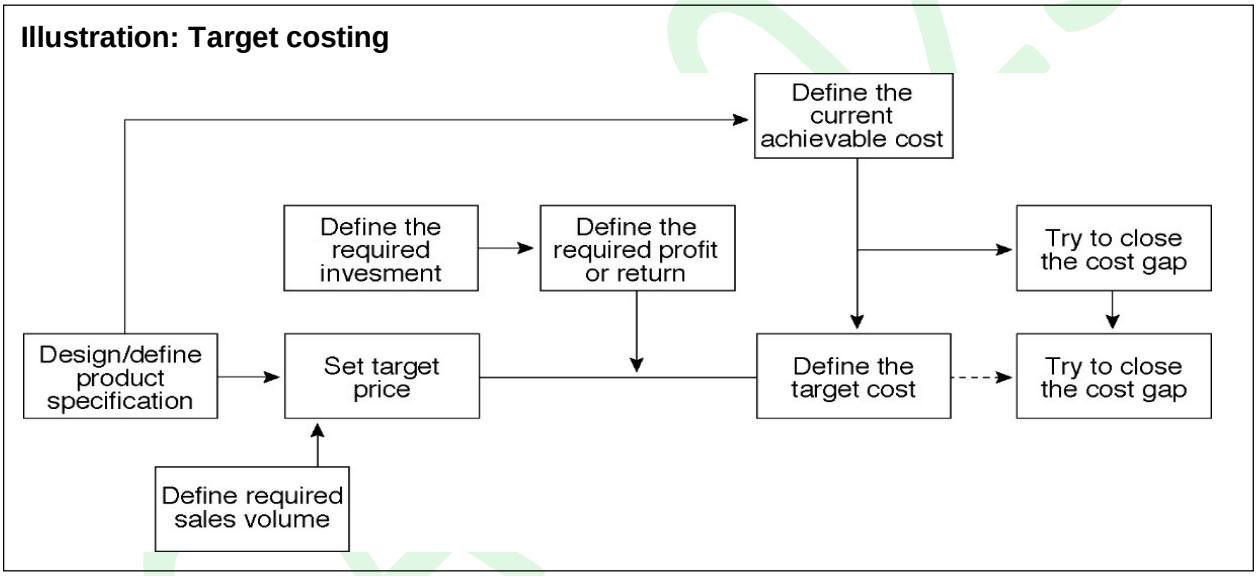
There may also be estimates of the capital investment required, and any incremental fixed costs (such as marketing costs or costs of additional salaried staff).
Taking estimates of sales volumes, capital investment requirements and incremental fixed costs over the life cycle of the product, it should be possible to calculate a target cost.

The target cost for the product might be the maximum cost for the product that will provide at least the minimum required return on investment.

However, an examination question might expect you to calculate the target cost from a target selling price and a target profit margin.

The elements in the target costing process are shown in the diagram below.

**Illustration: Target costing**




### Elements in the estimated cost and target cost

A problem with target costing is to make sure that the estimates of cost are realistic. It is difficult to measure the cost of a product that has not yet been created, and the cost must include items such as raw material wastage rates and direct labour idle time, if these might be expected to occur in practice.

## 4.2.2 Raw materials costs

The target cost should allow for expected wastage rates or loss in processing. The price of materials should also allow for any possible increases up to the time when the new product development has been completed. Estimating prices of materials can be difficult when prices are volatile – such as commodity prices, which can be subject to large increases and falls within relatively short periods of time

### 4.2.3 Direct labour

The target cost should allow for any expected idle time that will occur during the manufacture of the product. This might be the normal level of idle time in the company's manufacturing operations.

**Production overheads**

A target cost could be a target marginal cost. However, production overhead costs are often a large proportion of total manufacturing costs, and it is therefore more likely that the target cost will be a full cost, including production overheads. If activity-based costing is used, it might be possible to identify opportunities for limiting theamount of production overheads absorbed into the product cost by designing the product in a way that limits the use of activities that drive costs, for example by reducing the need for materials movements or quality inspection.

**Example : Target Costing**

A company has designed a new product. NP8. It currently estimates that in the current market, the product could be sold for ₦70 per unit. A gross profit margin of at least 30% on the selling price would be required, to cover administration and marketing overheads and to make an acceptable level of profit.

A cost estimation study has produced the following estimate of production cost for NP8

| *Cost item* | |
|---|---|
| *Direct material M1* | ₦9 per unit |
| *Direct material M2* | Each unit of product NP8 will require 0.50 hours of direct labour time. However it is expected that there will be unavoidable idle time equal to 5% of the total labour time paid for. Labour is paid ₦19 per hour |
| *Production Overhead* | It is expected that overheads wil lbe absorbed into product costs at the rate of ₦60 per direct labour hour, for each active hour worked. (Overheads are not absorbed into the cost of idle time.) |
| *Required calculate* | (a) the expected cost of Product NP8<br>(b) the target cost for NP8<br>(c) the size of the cost gap. |

| | | | |
|---|---|---|---|
| | Direct material M1 | | 9.0 |
| | Direct material M2: 3 metres □ 100/90 □ ₦1.80 | | 6.0 |
| | Direct labour: 0.5 hours □ 100/95 □ ₦19 | | 10.0 |
| | Production overheads: 0.5 hours □ ₦60 | | 30.0 |
| | Expected full cost per unit | | 55.0 |
| **b)** | **Target cost** | | |
| | Sales price | 70.0 | |

| | | | |
|---|---|---|---|
| | Minimum gross profit margin (30%) | 21.0 | |
| | Target cost | | 49.0 |
| **c)** | **Cost gap** | | 6.0 |

The company needs to identify ways of closing this cost gap.

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## 4.3 Evaluate the Target cost in manufacturing and service industries.

Target cost in a Manufacturing industry:

Target costing is a strategy that manufacturing companies can use to plan the prices of their new products before they manufacture them. This strategy allows companies to determine whether they can manufacture new products and reach their profit goals.

Target costing and services

Target costing can be used for services as well as products. Services vary widely in nature, and it is impossible to make general statements that apply to all types of services. However, features of some service industries that make them different from manufacturing are as follows:

Some service industries are labour-intensive, and direct materials costs are only a small part of total cost. Opportunities for achieving reductions in materials costs may therefore be small.

(a) Overhead costs in many services are very high. Effective target costing will therefore require a focus on how to reduce overhead costs.

(b) A service company might deliver a number of different services through the same delivery system, using the same employees and the same assets. Introducing new services or amendments to existing services therefore means adng to the work burden of employees and the diversity or complexity of the work they do.

A system of target costing therefore needs to focus on quality of service and value for the customer. Introducing a new service might involve a loss of value in the delivery of existing services to customers. For example, adding a new service to a telephone call centre could result in longer waiting times for callers.

New services might be introduced without proper consideration being given to whether the service is actually profitable. For example, a restaurant might add additional items to its menu, in the belief that the only additional cost is the cost of the food. In practice there would be implications for the purchasing and preparation of the food and possibly also for the delivery of food from the kitchen to the restaurant dining area. New items added to the menu might therefore make losses unless all aspects of cost are properly considered.

When a single delivery system is used for services, the cost of services will consist largely of allocated and apportioned overheads. For target costing to be successful, there must be a consistent and ‘fair’ method of attributing overhead costs to services (both existing services and new services).

Services might be provided by not-for-profit entities. For example, health services might be provided free of charge by the government. When services are provided free of charge, target costing can be used for new services. However, it is doubtful whether concepts of ‘target price’ and ‘target profit’ can be used by a not-for-profit entity. This raises questions about how to decide what the target cost should be.

## Comprehensive Example

Example: Target costing

A company wishes to introduce a new product to the market.

The company estimates the market for the product to be 50,000 units. The company uses target costing.

Current projected costs are as follows:

| | |
|---|---|
| Manufacturing | ₦000 |
| Bought in parts (100 components)<br>Direct labour (assembly of components) | 50,000 |
| 10 hours □ ₦500 per hour | 5,000 |
| Machine costs (750,000,000 ÷ 50,000) | 15,000 |
| Ordering and receiving<br>(500 orders □ 100 components □₦500 per order) ÷ 50,000 units | 500 |
| Quality assurance (10 hours □ ₦800 per hour) | 8,000 |
| Rework costs<br>10% (probability of failure) □ ₦10,000 (cost of rework) | 1,000 |
| Non-manufacturing costs | |
| Distribution | 10,000 |
| Warranty costs<br>10% (probability of recall) □ ₦15,000 (cost to correct) | 1,500 |
| | 91,000 |
| Target selling price (₦) | 100,000 |
| Target margin | 20% |
| Target profit (₦) | 20,000 |
| Target cost (₦) | 80,000 |

The company has undertaken market research which found that several proposed features of the new product were not valued by customers.

Redesign to remove the features leads to a reduction in the number of components down to 80 components and a direct material cost reduction of 12%.

The reduction in complexity has other impacts:

1. Assembly time will be reduced by 20%.
2. Quality assurance will only require 6 hours.
3. The probability of a failure at the inspection stage will fall to 5%.
4. The probability of an after-sales failure will also fall to 5%.
5. Cost of warranty corrections will fall by ₦2,000.
6. Reduced weight of the product will reduce shipping costs by ₦1,000 per unit.

**Example (continued): Target costing**

The revised projected costs are as follows:

| | Before | After |
|---|---|---|
| | ₦'000 | ₦'000 |
| Manufacturing cost | | |
| Bought in parts (100 components) | 50,000 | |
| Bought in parts (80 components with 12% reduction) | | 44,000 |
| Direct labour (assembly of components) | | |
| 10 hours × ₦500 per hour | 5,000 | |
| 8 hours × ₦500 per hour (10% reduction) | | 4,000 |
| Machine costs (750,000,000 ÷ 50,000) | 15,000 | 15,000 |
| Ordering and receiving | | |
| 500 orders □ 100 components □ ₦500 per order/50,000 units | 500 | |
| 500 orders □ 80 components □ ₦500 per order/50,000 units | | 400 |
| Quality assurance | | |
| 10 hours × ₦800 per hour | 8,000 | |
| 6 hours × ₦800 per hour | | 4,800 |
| Rework costs | | |
| 10% × ₦10,000 | 1,000 | |
| 5% × ₦10,000 | | 500 |
| Non–manufacturing costs | | |
| Distribution | 10,000 | 9,000 |
| Warranty costs | | |
| 10% × ₦15,000 | 1,500 | |
| 5% × ₦13,000 | | 650 |
| | 91,000 | 78,350 |

The target cost is achieved.

4.4 Discuss the challenges of applying target costing in services industries.

**The challenges of applying target costing in services industries include:**

(a) Cultural shift and resistance to change;

(b) Balancing cost reduction and value creation;

(c) Accuracy of market analysis and problems in cost estimation; and

(d) Interdepartmental coordination and complexity.

**4.4.1 Challenges of target costing in service oriented industries can be resolved these ways:**

**(a)** Training , orientation and workshop can be put in place to address short comings of resistance to change due to fear of job loss, uncertainty about personnel growth etc.

**(b)** Introducing clear lines of authority and departmenta●l functions to address lack of cross functional collaboration.

**(c)** Provision of effective data mining process and analysis to address issues of to address insufficient or large data problems.

**(d)** Motivation of staff to resolve the issues of un-realistics appraisal.

**(e)** Putting in place correct feedback mechanism to refocus the industry to customer focused.

**(f)** Effective Performance measurement to address ineffective measures.

4.5 Advise on how a Target cost gap can be managed.

A target cost gap is the difference between the estimated cost of a product and its target cost, which is derived by subtracting a desired profit margin from a competitive market price. Companies aim to close this gap through cost reduction strategies

Target costs are rarely achievable immediately and ways must be found to reduce costs and close the cost gap.

Target costing should involve a multi-disciplinary approach to resolving the problem of how to close the cost gap. The management accountant should be involved in measuring estimated costs. Ways of reducing costs might be in product design and engineering, manufacturing processes used, selling methods and raw materials purchasing. Ideas for reducing costs can therefore come from the sales, manufacturing, engineering or purchasing departments.

**Common methods of closing the target cost gap are:**

(a) To re-design products to make use of common processes and components that are already used in the manufacture of other products by the company.

(b) To discuss with key suppliers methods of reducing materials costs. Target costing involves the entire 'value chain' from original suppliers of raw materials to the customer for the end-product, and negotiations and collaborations with suppliers might be an appropriate method of finding important reductions in cost.

(c) To eliminate non value-added activities or non-value added features of the product design. Something is 'non-value added' if it fails to add anything of value for the customer. The cost of non-value added product features or activities can therefore be saved without any loss of value for the customer. Value analysis may be used to systematically examine all aspects of a product cost to provide the product at the required quality at the lowest possible cost.

(d) To train staff in more efficient techniques and working methods. Improvements in efficiency will reduce costs.

(e) To achieve economies of scale. Producing in larger quantities will reduce unit costs because fixed overhead costs will be spread over a larger quantity of products. However, production in larger quantities is of no benefit unless sales demand can be increased by the same amount.

### Advantages of target costing

There are several possible advantages from the use of target costing.

(a) It helps to improve the understanding within a company of product costs.

(b) It recognises that the most effective way of reducing costs is to plan and control costs from the product design stage onwards.

(c) It helps to create a focus on the final customer for the product or service, because the concept of 'value' is important: target costs should be achieve without loss of value for the customer.

(d) It is a multi-disciplinary approach, and considers the entire supply chain. It could therefore help to promote co-operation, both between departments within a company and also between a company and its suppliers and customers.

(e) Target costing can be used together with recognised methods for reducing Costs, such as value analysis, value engineering, just in time purchasing and production, Total Quality Management and continuous improvement.

### The implications of using target costing

The use of a target costing system has implications for pricing, cost control and performance measurement.

Target costing can be used with pricing policy for a company's products or services. A company might decide on a target selling price for either a new or an existing product, which it considers necessary in order to win market share or achieve a target volume of sales. Having identified the selling price that it wants for the product, the company can then work out a target cost.

Cost control and performance measurement has a different emphasis when target costing is used.

(a) Cost savings are actively sought and made continuously over the life of the product

(b) There is joint responsibility for achieving benchmark savings. If one department fails to deliver the cost savings expected, other departments may find ways to achieve the savings

(c) Staff are trained and empowered to find new ways to reduce costs while maintaining the required quality

Target costing is more likely to succeed in a company where a culture of 'continuous improvement' exists.

## 4.6 Chapter Review

Before moving on to the next chapter, candidates should ensure that they can:

(a) understand the concept of target costing,

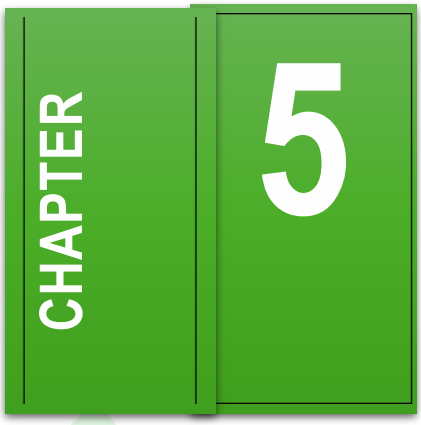
(b) the computation of target costing,

(c) advise on how target cost gap can be managed

(d) use target costing in performance Management.

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**Skills level**
**Performance management**




# LIFE CYCLE COSTING

## Chapter Contents

5.0 Learning objective
5.1 Learning outcomes
5.2 Discuss the principles of life cycle costing (LCC) and its uses as costing techniques.
5.3 Identify and discuss the various stages in the life cycle of a product and the associated cost involved.
5.4 Evaluate the life cycle cost or profit in manufacturing and service industries.
5.5 Explain the benefits of life cycle costing

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# 5 Life cycle costing

## 5.0 Learning Objectives

This chapter introduces life cycle costing , its principles and various stages in the life cycle of product and associated costs. It proffers basis of evaluation of life cycle costs in manufacturing and service industries.

## 5.1 Learning Outcomes

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

(a) Understand the concept of Life cycle costing (LCC), its uses and its importance

(b) Discuss the principles of life cycle costing (LCC) and its uses as costing techniques.

(c) Identify and discuss the various stages in the life cycle of a product and the associated cost involved.

(d) Evaluate the life cycle cost or profit in manufacturing and service industries.

(e) Explain the benefits of life cycle costing. Discuss

## 5.2 Discuss the Principles of Life cycle Costing and its uses as costing techniques:

**The nature of life cycle costing (LCC)**

Life cycle costing is sometimes called 'whole life costing' or 'whole life cycle costing'. It is a technique that attempts to identify the total cost associated with the ownership of an asset so that decisions can be made about asset acquisitions. It recognises that decisions made at the initial acquisition have the effect of locking in certain costs in the future.

The principles of LCC can be applied to both complex and to simple acquisitions.

As a simple example if a person buys a new printer that person is committed to buying toner cartridges that are compatible to the printer. Thus in choosing between two printers the initial cost of one might be less than the other but its toner cartridges might be more expensive. Life cycle cost analysis would allow a choice to be made based on the total life time costs.

A company will of course be concerned with cost when it buys a complex asset of some kind but it will also be concerned with reliability, servicing time, maintenance costs etc.

Life cycle costing can be applied to:

(a) Major asset acquisitions; and

(b) Introduction of new products to the market.

**Asset acquisitions**

The cost of ownership of an asset is incurred throughout its life and not just at

acquisition. A decision made at the purchase stage will determine future costs associated with an asset.

**Life cycle costs**

The costs of a product or asset over its life cycle could be divided into three categories:

### 5.2.1 Acquisition costs, set-up costs or market entry costs.

These are costs incurred initially to bring the product into production and to start selling it, or the costs incurred to complete the construction of a building or other major construction asset

### 5.2.2 Operational costs or running costs

throughout the life of the product or asset

### 5.2.3 End-of-life costs.

These are the costs incurred to withdraw a product from the market or to demolish the asset at the end of its life.

Acquisition costs or set-up costs are usually 'one-off' capital expenditures and other once-only costs, such as the costs of training staff and establishing systems of documentation and performance reporting. Similarly, end-of-life costs are 'one- off' items that occur just once.

Running costs or operational costs are regular and recurring annual costs throughout the life of the product or asset. However, these may vary over time: for example maintenance costs for an item of equipment, such as the maintenance costs of elevators in a building, are likely to increase over time as the asset gets older.

Although costs are incurred throughout the life of an asset, a large proportion of these costs are committed at a very early stage in the product's life cycle, when the decision to develop the new product or construct the new building is made.

**Example: Life cycle costing**

Transport company wishes to buy a new heavy goods vehicle which will be run for 100,000 miles and then sold.

It is considering two types.

The following information is relevant:

| | Lorry A | Lorry B |
|---|---|---|
| Initial cost | ₦10,000,000 | ₦15,000,000 |
| Cost per service | ₦500,000 | ₦400,000 |
| Service required every: | 10,000 miles | 25,000 |
| Miles Running costs per mile | ₦750 | ₦500 |
| Scrap value at end of life | ₦1,000,000 | ₦3,000,000 |

The life cycle cost of each lorry based on the above is as follows:

| | ₦ | ₦ |
|---|---|---|
| **Capital cost:** | | |
| Initial cost | 10,000,000 | 15,000,000 |
| Scrap value | (1,000,000) | (3,000,000) |
| | 9,000,000 | 12,000,000 |
| **Service costs** | | |
| Life time use (miles) | 100,000 | 100,000 |
| Service frequency | 10,000 | 25,000 |
| (miles) Number of miles | 750 | 500 |
| Cost per mile (₦) | 75,000,000 | 50,000,000 |
| Life cycle cost | 89,000,000 | 63,600,000 |

**Life cycle costing methodology**

A proper purchasing decision requires that the costs of all available options should be taken into account. This involves cost identification and estimation and discounting. (Discounting is a technique that takes into account the time value of money. That is to say it recognises that ₦1 today is worth more than ₦1 in the future).

**Life cycle costing and building construction**

Life cycle costing is relevant to the construction of buildings and other major items of construction. An international standard on life cycle costing for buildings was published in 2008.

When a building is planned, several different designs might be considered. Each design will have different construction features and therefore a different initial capital cost. Over the life of the building, annual running costs will vary according to the design that is selected. For example:

(a) Energy-efficient buildings will incur lower energy costs each year

(b) The choice of construction materials will affect the life of the building and the annual costs of repairs and maintenance

(c) The choice of design could affect the costs of demolition at the end of the life of the building.

When two or more different building designs are considered, the preferred design might be:

(a) the design that will achieve the lowest total cost over the life of the building, or

(b) the design that will provide the most value for money (or benefits less costs) over the life of the building.

## 5.3 Identify and discuss the various stages in the life cycles of a product and associated costs

Most products made in large quantities for selling to customers go through a life cycle which consists of several stages:

(a) product development stage

(b) product introduction to the market

(c) a period of growth in sales and market size

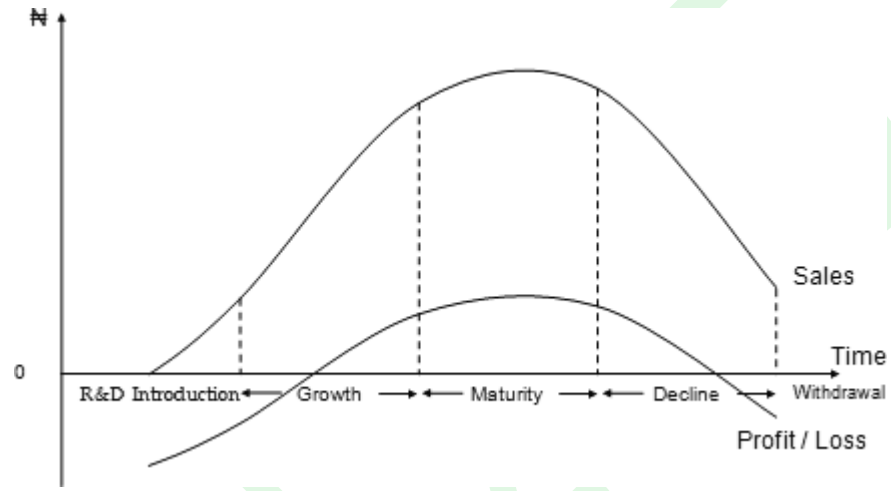
(d) a period of maturity

(e) a period of decline.

(f) withdrawal from the market.

The diagram below indicates typical characteristics of sales revenue and profit at each stage.

**Illustration: Product life cycle**




At each phase of a product's life cycle:

(a) selling prices will be altered;

(b) costs may differ;

(c) the amount invested (capital investment) may vary; and

(d) spending on advertising and other marketing activities may change.

LCC can be important in new product launches as a company will of course want to make a profit from the new product and the technique considers the total costs that must be recovered. These will include:

(a) research and development costs;

(b) training costs;

(c) machinery costs;

(d) production costs;

(e) distribution and selling costs;

(f) marketing costs;

(c) working capital costs;

(d) retirement and disposal costs.

**Decisions made at the development phase impact later costs**.

| Stage | Costs |
|---|---|
| Product development | R&D costs<br>Capital expenditure decisions |
| Introduction to the market | Operating costs<br>Marketing and advertising to raise product awareness (strong focus on market share)<br>Set up and expansion of distribution channels |
| Growth | Costs of increasing capacity<br>Maybe learning effect and economies of scale Increased costs of working capital |
| Maturity | Incur costs to maintain manufacturing capacity<br>Marketing and product enhancement costs to extend maturity |
| Decline | Close attention to costs needed as withdrawal decision might be expensive |
| Withdrawal | Asset decommissioning costs<br>Possible restructuring costs<br>Remaining warranties to be suppo |

**5.4 Evaluate the life cycle cost or profit in manufacturing and service industries:**
Life cycle costing (LCC) in manufacturing evaluates all costs associated with a product or process from its inception to disposal, enabling informed decision-making and long-term cost optimization.

Life cycle costing is the economic analysis process that assesses the total cost of acquisition, ownership, and disposal of a product over a period of time.
Thus, LCC tracks and accumulates the actual costs and revenue attributable to each product from inception to abandonment after the economic life of the product.

O Limited specialises in the manufacture of a hi-tech product, the company is considering developing a new product that will take one year to develop, while sales commence in the second year. The product will have two years life cycle before its replacement by another product. The following cost estimates are noted:

| | Year 1 | Year 2 | Year 3 |
|---|---|---|---|
| Units manufactured and sold | | 20,000 | 30,000 |
| Research and development costs | ₦80,000 | | |
| Product design costs | ₦300,000 | | |
| Marketing costs | ₦ 600,000 | ₦ 550,000 | ₦750,000 |
| Manufacturing costs: | | | |
| Variable costs per unit | | ₦ 30 | ₦ 35 |
| Fixed production costs | | ₦ 300,000 | ₦ 700,000 |

| | | | |
|---|---|---|---|
| Selling and distribution costs: | | | |
| Variable cost per unit | | ₦3 | ₦4 |
| Fixed selling and distribution cost | | ₦150,000 | ₦170,000 |
| Required: Calculate the life cycle cost per unit | | | |
| Solution: | | | |
| Life cycle cost per unit | | | |
| Initial costs: | | | |
| Research and development | ₦ 80,000 | | |
| Product design cost | ₦300,000 | | |
| Marketing costs | ₦1,900,000 | | |
| Variable Manufacturing costs: | | | |
| Year 1 | | | |
| Year 2 (N30 x 20,000) ₦600,000 | | | |
| Year 3 (N35 x 30,000) ₦1,050,000 | ₦1,650,000 | | |
| Fixed Manufacturing costs: | | | |
| Year 1 | | | |
| Year 2 ₦300,000 | | | |
| Year 3 ₦700,000 | ₦1,000,000 | | |
| Variable Selling and Distribution costs: | | | |
| Year 1 | | | |
| Year 2 (₦3 x 20,000) ₦60,000 | | | |
| Year 3 (₦4 x 30,000) ₦120,000 | ₦180,000 | | |
| Fixed selling and Distribution costs: | | | |
| Year 1 | | | |
| Year 2 ₦150,000 | | | |
| Year 3 ₦170,000 | ₦320,000 | | |
| Total cost for the life cycle of the Product | ₦5,430,000 | | |
| Life cycle cost per unit = ₦5,430,000/ 50,000 = ₦108.60. | | | |

## 5.5 Benefits of Life Cycle Costing (LCC)

Life cycle costing compares the revenues and costs of the product over its entire life. This has many benefits.

The potential profitability of products can be assessed before major development of the product is carried out and costs incurred. Non-profit-making products can be abandoned at an early stage before costs are committed.

Techniques can be used to reduce costs over the life of the product.

Pricing strategy can be determined before the product enters production. This may lead to better control of marketing and distribution costs.

Attention can be focused on reducing the research and development phase to get the product to market as quickly as possible. The longer the company can operate without competitors entering the market the more revenue can be earned and the sooner the product will reach the breakeven point.

By monitoring the actual performance of products against plans, lessons can be learnt to improve the performance of future products. It may also be possible to improve the estimating techniques used.

An understanding of the product life cycle can also assist management with

decisions about:

(a) Pricing;

(b) Performance management; and

(c) Decision-making.

**Pricing**. As a product moves from one stage in its life cycle to the next, a change in pricing strategy might be necessary to maintain market share. For example, prices might be reduced as a product enters its maturity phases (and annual sales volume stops rising).

In addition, an understanding of life cycle costs help with strategic decisions about price. Over the entire life of the product, sales prices should be sufficiently high to ensure that a profit is made after taking into account all costs incurred – start-up costs and end-of-life costs as well as annual operating costs.

**Performance management**. As a product moves from one stage of its life cycle to another, its financial performance will change. Management should understand that an improvement or decline in performance could be linked to changes in the life cycle and should therefore (to some extent at least) be expected.

**Decision-making**. In addition to helping management with decisions on pricing, an understanding of life cycle costing can also help with decisions about making new investments in the product (new capital expenditure) or withdrawing a product from the market.

## 5.6 Chapter Review

Before moving on to the next chapter, readers should ensure that they can:

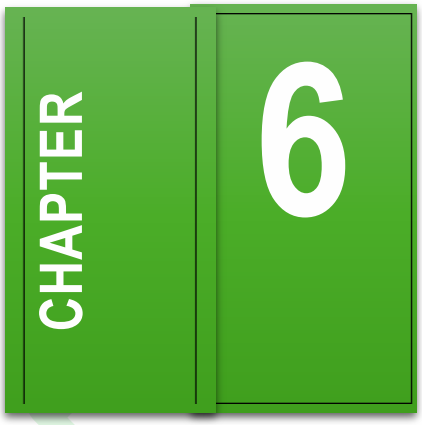
(a) explain the concept of Life Cycle Costing (LCC);

(b) explain the uses of Life Cycle Costing; and

(c) explain the importance of Life Cycle Costing as basis for decision making.

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**Skills level**
**Performance management**




# THROUGHPUT ACCOUNTING

## Chapter content


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6.0 Learning objective
6.1 Learning outcomes
6.2 Discuss the principles of throughput accounting and its uses as a costing techniques
6.3 Assess and apply the theory of constraints (TOC).
6.4 Evaluate and draw conclusions from the throughput accounting ratio (TAR).
6.5 Advise on ways in which the TAR could be improved.
6.6 Chapter Review


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# 6 Throughput accounting

## 6.0 Learning Objectives

The Chapter dwells on the concept of throughput accounting and its use in decision making.

## 6.1 Learning Outcome

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

(a) Understand the concept of Throughput Accounting, its uses and its importance

(b) Assess and apply the Theory of constraints (TOC).

(c) Evaluate and draw conclusions from the throughput accounting ratio (TAR).

(d) Advise on ways in which the TAR could be improved.

(e) Discuss the application of throughput accounting in multi-product decision making.

## 6.2 The nature of throughput accounting

Throughput accounting is not really a costing system, because with costing no costs are allocated to units of production, with the exception of materials costs.
With traditional costing systems, the main focus of attention is on costs and how to control or reduce costs.

With throughput accounting, the main focus of attention is on how to achieve the goals of the entity successfully. For profit-making companies, the goals of the entity are assumed to be the maximisation of profit.

Throughput accounting is also associated with the Theory of Constraints. This is a theory that states that an entity always has a constraint that sets a limit on the achievement of its goals. The task of management should therefore be to:

(a) identify what this effective constraint is;

(b) maximise the performance of the entity in achieving its goals, within the limits of this constraint; and

(c) look for ways of removing the constraint, so that performance can be improved still further.

Although they are different, throughput accounting has some close similarities with marginal costing and limiting factor analysis, which you should be familiar with from your earlier studies.

### 6.2.1 Throughput accounting is based on a number of assumptions.

(a) In traditional marginal costing, it is assumed that direct labour costs are a variable cost, but in practice this is not usually correct. Employees are paid a fixed weekly or monthly wage or salary, and labour costs are a fixed cost.

(b) The only variable cost is the purchase cost of materials and components

purchased from external suppliers.

(c) A business makes real profit by adding value. Value is added by selling goods or services to customers whose market value is more than the cost of the materials that go into making them. However, value is not added until the sale is actually made.

(d) Value added should be measured as the value of the sale minus the variable cost of sales, which is the cost of the materials.

### 6.2.2 Throughput, inventory and operating expenses

Throughput accounting is based on three concepts:

(a) throughput;

(b) inventory (investment); and

(c) operating expenses.

**Throughput**

Throughput can be defined as the rate at which an entity achieves its goals, measured in 'goal units'. In not-for-profit entities, the goal of the entity could be measured in terms of a non-financial goal. For profit-making entities, the goal is profit, and:

Contribution = Sales minus total variable costs

Throughput differs from contribution in traditional marginal costing because variable costs consist only of real variable costs, which are (mainly or entirely) materials costs.

It is therefore appropriate to define throughput as:

Throughput = Sales minus cost of raw materials and components

**Inventory (or investment)**

Inventory or investment is all the money that is tied up in a business, in inventories of raw materials, WIP and finished goods. The term 'investment' is normally preferred to 'inventory' because it includes the amount of capital tied up in making the product and selling it to customers. Investment therefore includes not only the amount invested in inventories but also investment in non-current assets.

Inventory is eventually converted into throughput, but until it is sold it is capital tied up earning nothing. When inventory is sold, throughput is created.

Throughput is not created until finished goods are sold. Creating finished goods for inventory is therefore damaging to the entity's goals, because it ties up finance in investment and investment finance has a cost.

**Operating expenses**

Operating expenses are all the expenditures incurred to produce the throughput. They consist of all costs that are not variable costs, and so include labour costs.

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### 6.2.3 Profit and throughput accounting

Profit in throughput accounting is measured as throughput minus operating expenses.

**Example: Profit and throughput accounting**

| | ₦ |
|---|---|
| Sales | 800,000 |
| Raw materials and components costs | 350,000 |
| Throughput | 450,000 |
| Operating expenses | 340,000 |
| Net profit | 110,000 |

### 6.2.4 The value of inventory in throughput accounting

Inventories do not have value, except the variable cost of the materials and components. Even for work-in-progress and inventories of finished goods, the only money invested is the purchase cost of the raw materials. No value is added until the inventory is sold.

In throughput accounting, all inventory is therefore valued at the cost of its raw materials and components, and nothing more.

It should not include any other costs, not even labour costs. No value is added by the production process, not even by labour, until the item is sold.

It is **impossible** to make extra profit simply by producing more output, unless the extra output is sold.

**Comparing throughput accounting with absorption costing and marginal costing**

The difference between throughput accounting and the traditional methods of accounting can be illustrated with an example.

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**Example: Comparing throughput accounting with absorption costing and marginal costing**

A company makes 1,000 units of a product during May and sells 800 units for

₦32,000. There was no inventory at the beginning of the month. Costs of production were:

| | |
|---|---|
| Raw materials | 6,000 |
| Direct labour | 8,000 |
| Fixed production overheads | 10,000 |
| Other non-production overheads | 5,000 |

**Required**

Calculate the profit for the period using:
(a) absorption costing
(b) marginal costing
(c) throughput accounting.
Assume for the purpose of absorption costing that budgeted and actual production overheads were the same, and there are no under- or over-absorbed overheads.

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**Example (continued): Comparing throughput accounting with absorption costing and marginal costing**

Profit for the month using each costing method is therefore as follows:

| | Absorption costing | Marginal costing | Throughput accounting |
|---|---|---|---|
| Sales | 32,000 | 32,000 | 32,000 |
| Production costs | | | |
| Raw materials | 6,000 | 6,000 | 6,000 |
| Direct labour | 8,000 | 8,000 | |
| Fixed overhead | 10,000 | | |
| Closing inventory | 24,000 | 14,000 | 6,000 |
| × 200/1,000 | (4,800) | (2,800) | (1,200) |
| Cost of sale | (19,200) | (11,200) | (4,800) |
| Gross profit | 12,800 | | |
| Contribution | | 20,800 | |
| Throughput contribution | | | 27,200 |
| Less operating expenses | | | |
| Other non-production overheads | 5,000 | 5,000 | 5,000 |
| Fixed overheads | | 10,000 | 10,000 |
| Labour costs | | | 8,000 |
| | (5,000) | (15,000) | (23,000) |
| Net profit | 7,800 | 5,800 | 4,200 |

The differences in profit are entirely due to the differences in inventory valuations.

Raw

## 6.2 Constraints and bottlenecks in the system

Throughput accounting is derived from the Theory of Constraints, which is based on the view that every system has a constraint. A constraint is anything that limits the output from the system.

(a) If a system had no constraint, its output would be either zero or the system would continue to produce more and more output without limit; and

(b) Therefore for any system whose output is not zero, there must be a constraint that stops it from producing more output than it does.

Constraints for a manufacturing company might be caused by any of the following:

(a) external factors, such as a limit to customer demand for the products that the company makes

(b) weaknesses in the system itself, such as shortages of key resources and capacity limitations

(c) weaknesses in the system's controls, such as weak management.

In a manufacturing system, constraints can be described as **bottlenecks** in the system. A bottleneck is simply a constraint that limits throughput. For example, a bottleneck might be a shortage of materials, or a shortage of machine time.

### 6.2.1 Dealing with constraints

The management of business operations should focus on dealing with the key constraints. The output of a system is restricted by its key constraint.

Management must identify what this is.

Action by management to improve operational efficiency is a waste of time and effort if it is applied to any area of operations that is not a constraint. For example, measures to improve labour efficiency are a waste of time if the key constraint is a shortage of machine capacity.

The key constraint limits throughput. As stated earlier, the nature of the key constraint might be:

(a) limitations on sales demand;

(b) inefficiency in production, with stoppages and hold-ups caused by wastage, scrapped items and machine downtime ;

(c) unreliability in the supplies of key raw materials, and a shortage of key materials;

(d) a shortage of a key production resource, such as skilled labour.

Goldratt, argued that:

(e) Management should identify the key constraint and consider ways of removing or easing the constraint, so that the system is able to produce more output.

(f) However, when one constraint is removed, another key constraint will take its place.

(g) The new key constraint must be identified, and management should now turn its attention to ways of removing or easing the new key constraint.

(h) By removing constraints one after another, the output capacity of the system will increase.

However, there will always be a key constraint.

### 6.2.2 The relevance of constraints to throughput accounting

Goldratt argued that if the aim of a business is to make money and profit, the most appropriate methods of doing this are to:

(a) increase throughput;

(b) reduce operating expenses; or

(c) reduce investment, for example by reducing inventory levels (since there is a cost to investment).

Goldratt also argued that the most effective of these three ways of increasing profit is to increase throughput.

Throughput can be increased by identifying the bottlenecks in the system, and taking action to remove them or ease them.

### 6.2.3 Performance measurement ratios in throughput accounting

There are several key performance measurements in throughput accounting. One of these is net profit, which is total throughput minus Operating expenses. An objective is to increase net profit. Performance can also be measured using ratios:

(a) Return on investment

(b) Throughput accounting productivity

(c) Throughput per unit of the bottleneck resource

(d) Operating expenses per unit of the bottleneck resource

(e) Throughput accounting ratio.

#### Return on investment

**Formula: Return on investment**

$$= \frac{\text{Net profit}}{\text{Investment}} \times 100$$

An objective should be to increase the return on investment, either by increasing net profit or reducing the size of the investment.

#### Throughput productivity

This is measured as:

**Formula: Throughput productivity**

$$= \frac{\text{Throughput}}{\text{Operating expenses}} \times 100$$

An objective should be to increase throughput productivity, either by increasing throughput or reducing operating expenses.

#### Throughput per unit of constraint

One of the advantages of throughput accounting is that it treats labour costs as a fixed cost. In many manufacturing companies, where the production process has been automated, direct labour costs are not a significant part of total production costs.

However traditional costing systems treat direct labour as a variable cost and assume that variable overheads vary with labour hours. In addition, fixed overheads

might be absorbed on a labour hour basis. It is often assumed that performance will be improved by improving labour efficiency.

Throughput accounting challenges this approach to costs and performance measurement. Labour is a fixed cost and relatively small compared to other costs. Improving labour efficiency will therefore do little to improve performance and increase profits.

Net profit will be improved much more effectively by identifying the constraint on activity and seeking to maximise throughput per unit of the constraint.

**Throughput accounting ratio**

The throughput accounting ratio is the ratio of [throughput in a period per unit of bottleneck resource] to [operating expenses per unit of bottleneck resource].

Units of a bottleneck resource are measured in hours (labour hours or machine hours). This means that the throughput accounting ratio can be stated as:

**Formula: Throughput accounting ratio**

$$= \frac{\text{Throughput per hour of bottleneck resource}}{\text{Operating expenses per hour of bottleneck resource}} \times 100$$

**Example: Throughput accounting ratio**

A business manufactures product Z, which has a selling price of ₦20. The materials costs are ₦8 per unit of Product Z. Total operating expenses each month are ₦120,000.

Machine capacity is the key constraint on production. There are only 600 machine hours available each month, and it takes three minutes of machine time to manufacture each unit of Product Z.

**Required**

(a) Calculate the throughput accounting ratio.

(b) How might this ratio be increased?

**Answer**

i. Throughput per unit = ₦(20 – 8) = ₦12
Throughput per machine hour = ₦12 x (60 minutes/3 minutes) = ₦240
Operating expenses per machine hour = ₦120,000/600 hours = ₦200
Throughput accounting ratio = ₦240/₦200 = 1.2

ii. To increase the throughput accounting ratio, it might be possible to:
Raise the selling price for product Z for each unit sold, to increase the throughput per unit.
Improve the efficiency of machine time used, and so manufacture product Z in less than three minutes.
Find ways of reducing total operating expenses, in order to reduce the operating

expenses per machine hour.

## 6.3 Evaluate and draw conclusions from the throughput accounting `ratio

(TAR)

The throughput accounting ratio is the ratio of [throughput in a period per unit of bottleneck resource] to [operating expenses per unit of bottleneck resource].
Throughput Accounting Ratio (TAR) helps businesses prioritize profit maximization by focusing on increasing throughput (sales revenue minus variable costs) and minimizing operating expenses and inventory. A TAR greater than 1 indicates a product is profitable that is throughput exceeds operating costs meaning the organisation should sustain operation, while a TAR less than 1 suggests a loss that is operating costs exceeds throughput, prompting a need for improvement.

### 6.3. 1 Benefits of Using TAR:

(a) **Prioritises profitability:** By focusing on throughput, businesses can make decisions that directly impact profitability.

(b) **Identifies bottlenecks:** Helps pinpoint areas where constraints are limiting throughput and profitability.

(c) **Improves decision-making:** Provides a framework for making informed decisions about product mix, pricing, and resource allocation

(d) **Identifies optimal product mix:** Businesses can use TAR to determine which products to prioritise based on their profitability potential.

(e) **Helps in determination of pricing strategies:** TAR can help determine if price increases or decreases are warranted to improve throughput.

(f) **Helps in resource allocation:** Businesses can use TPAR to allocate resources to activities that generate the most throughput.

### Limitations of Throughput Accounting:

(a) Throughput Accounting primarily focuses on short-term profitability and may not fully account for long-term strategic considerations.

(b) The assumption that all costs except direct materials are fixed may not always be accurate in the real world

## 6.4 Advise on ways in which the TAR could be improved

TAR can be improved through increase potentials for the numerator, which is to increase the throughput and decrease the components of the denominator, which is operating expenses. The numerator which is the throughput (sales - materials) while the denominator is the operating costs or expenses made up of labour costs, variable overheads, and fixed overheads.

Here is a more detailed breakdown:

(a) Increase Throughput can be achieved by increasing selling price, reduce material costs, improve productivity through better automation, optimisation of resources allocation and increase sales volume

(b) Reduce operating expenses by identifying and eliminating unnecessary expenses, achieve better contract, while streamlining operations.

## 6.5 Discuss the application of throughput accounting in multi-product decision making

In multi-product situation, throughput accounting focuses on maximising throughput (sales revenue minus direct material costs) and then prioritising products based on their throughput return per bottleneck resource hour (limiting factor or constraint) to optimise production and profitability.

The key applications include:

(a) identify the bottle neck;

(b) determine the throughput per unit of product;

(c) determine the throughput per bottleneck per hour;

(d) rank the product based on throughput return per bottleneck hour;

(e) compute the optimal production plan; and

(f) evaluate and improve the plan.

## 6.6 Chapter Review

Before moving on to the next chapter, readers should ensure that they can:

(a) explain the concept of the throughput accounting;

(b) explain the uses of throughput accounting; and

(c) explain the importance of throughput accounting as a basis for decision making.

**Illustration:**

P Ltd manufactures three Products A, B and C . The details of the products are shown below:

| | Product A | Product B | Product C |
|---|---|---|---|
| | ₦ | ₦ | ₦ |
| Sales Price | 400 | 300 | 250 |
| Material costs | 150 | 140 | 110 |
| Direct Labour Costs | 100 | 70 | 50 |
| Variable cost | 50 | 35 | 25 |
| Weekly sales demand | 4,000units | 4,500units | 5000 units |
| Machine hours per unit | 0.5hour | 0.3hour | 0.2hour |
| | | | |

Machine time is the identified bottle neck and Maximum capacity is 4000 machine hours. Operating costs including Direct labour cost, variable overhead costs and fixed cost of ₦1,670,000.

a. You are required to determine optimum production Plan.

b. Which product is more profitable using the throughput model.

Solution:

Step 1: Identify the bottle neck

The bottle neck is Machine hours of 4000 hours maximum

Step 2: Determine the throughput per unit of Product

| | Product A<br>₦ | Product B<br>₦ | Product C<br>₦ |
|---|---|---|---|
| Sales Price | 400 | 300 | 250 |
| Material costs | 150 | 140 | 110 |
| Throughput per unit | 250 | 160 | 140 |

Step 3 : Determine the throughput per bottleneck per hour

| | | | |
|---|---|---|---|
| Throughput per unit | 250 | 160 | 140 |
| Bottleneck hours per unit | 0.5 hours | 0.3 hours | 0.2 hours |
| Throughput per bottleneck hour | 500 | 533 | 700 |

Step 4: Rank the Product based on throughput return per bottleneck hour.

| | | | |
|---|---|---|---|
| Throughput per bottleneck hour | 500 | 533 | 700 |
| | 3rd | 2nd | 1st |

Step 5: Compute the optimal production plan through allocation of resources

| **Product** | **Units** | **Bottleneck hours /unit** | **Total Hours** | **Throughput per hour** | **Total throughput** |
|---|---|---|---|---|---|
| Product C | 5,000 | 0.2 | 1,000 | ₦700 | ₦700,000 |
| Product B | 4,500 | 0.3 | 1,350 | ₦533 | ₦719,550 |
| Sub-Total | | | 2,350 | | |
| Product C | 4,000 | 0.5 | 1,650 | ₦500 | ₦825,000 |
| Total | | | 4,000 | | ₦2,244,550 |
| Less Operating costs | | | | | ₦1,670,000 |
| Profit for the period | | | | | ₦574,550 |

b. Which Product is more profitable using the throughput model

Throughput Accounting ratio (TAR) = $\frac{\text{Throughput return per hour}}{\text{Operating cost per hour.}}$

Total operating cost = ₦1,670,000.

Total hours available = 4,000 hours

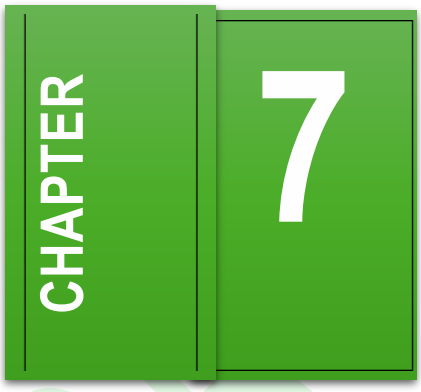
Operating cost per hour = ₦1,670,000/₦4000 = ₦417.50

| | A | B | C |
|---|---|---|---|
| Throughput per bottleneck hour | ₦500 | ₦533 | ₦700 |
| Operating cost per hour | ₦417,5 | ₦417,5 | ₦417.5 |
| Throughput accounting ratio | 1.197 | 1.276 | 1.676 |

All the products are profitable but Product C shows higher profitability since TAR is higher than others.

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**Skills level**
**Performance management**




# ACCOUNTING FOR ENVIRONMENTAL AND SUSTAINABILITY FACTORS

| | Content |
|---|---|
| 7.0 | Learning objective |
| 7.1 | Learning outcomes |
| 7.2 | The purpose of environmental management accounting |
| 7.3 | Issues in managing environmental costs. |
| 7.4 | Different methods of accounting for environmental costs |
| 7.5 | Challenges faced in accounting for environmental and sustainability factors |
| 7.6 | The principal roles of the management accountant in supporting the bbusiness to develop sustainability practices and sustainability reporting |
| 7.7 | Chapter Review |

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# 7 Accounting for environmental and sustainability factors

## 7.0 Learning objective

This chapter introduces the candidates to environmental and sustainability issues as well as its accounting implications and the roles of the management accountant.

## 7.1 Learning outcomes

At successful completion of this chapter, readers should be able to:

(a) discuss the concept of environmental accounting and sustainability in business;

(b) discuss uses and importance of environmental accounting and sustainability in business;

(c) evaluate issues involved in managing environmental costs;

(d) evaluate different methods of accounting for environmental costs;

(e) discuss challenges faced in accounting for environmental and sustainability factors; and

(f) assess the principal roles of the management accountant in supporting the business to develop sustainability practices and sustainability reporting

## 7.1 The purpose of environmental management accounting

For some companies, environmental issues are significant, in terms of both strategy and cost. Poor environmental behaviour can result in significant costs or losses, such as fines for excessive pollution, environmental taxes, loss of land values, the cost of law suits, and so on.

Environmental behaviour can affect the perception of customers, and their attitudes to a company and its products. Increasingly, consumers take environmental factors into consideration when they make their buying decisions.

Environmental management accounting can be used to provide information to management to help with the management of environmental issues. Traditional management accounting techniques can:

(a) under-estimate or even ignore the cost of poor environmental behaviour;

(b) over-estimate the costs of improving environmental practices; and

(c) under-estimate the benefits of improving environmental practices.

Environmental management accounting (EMA) provides managers with financial and non-financial information to support their environmental management decision-making. EMA complements other 'conventional' management accounting methods, and does not replace them.

The main applications of EMA are for:

(a) estimating annual environmental costs (for example, costs of waste control);
(b) budgeting;
(c) product pricing;
(d) investment appraisal (for example, estimating clean-up costs at the end of a project life and assessing the environmental costs of a project); and
(e) estimating savings from environmental projects.

**A framework for environmental management accounting**

Burritt et al (2001) suggested a framework for EMA based on providing information to management: from internal or external sources;

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Four of these elements of EMA are shown in the following table:

**Environmental management accounting (EMA)**

| | | **Monetary EMA** | | **Physical EMA** | |
|---|---|---|---|---|---|
| | | **Short-term focus** | **Long-term focus** | **Short-term focus** | **Long-term focus** |
| ■ *Historical orientation* | ■ **Routine reporting** | ■ Environmental cost accounting | ■ Analysis of environmentally-induced capital expenditures | ■ Material and energy flow accounting | ■ Accounting for environmental capital impacts |
| | ■ **Ad hoc (one-off) information** | ■ Historical assessment of environmental decisions | ■ Environmental life cycle costing, environmental target costing | ■ Historical assessment of short-term environmental impacts, e.g. of a site or product | ■ Post-investment assessment of environmental impacts of capital expenditures |
| ■ *Future orientation* | ■ **Routine reporting** | ■ Environmental operational budgets and capital budgets (monetary | ■ Environmental long-term financial planning | | ■ Environmental long-term physical planning |
| | ■ **Ad hoc (one-off) information** | ■ Relevant environmental costing (e.g. special orders) | ■ Environmental life cycle budgeting and target costing | ■ Assessment of environmental impacts | ■ Physical environmental investment appraisal. Specific project life cycle |

## 7.2 Issues in managing environmental costs. EMA techniques

Environmental management accounting techniques include:

(a) re-defining costs;

(b) environmental activity-based accounting; and

(c) environmental life cycle costing.

### 7.3.1 Re-defining costs

The US Environmental Protection Agency (1998) suggested terminology for environmental costing that distinguishes between:

(a) **conventional costs**: these are environmental costs of materials and energy that have environmental relevance and that can be 'captured' in costing systems;

(b) **potentially hidden costs**: these are environmental costs that might get lost within the general heading of 'overheads';

(c) **contingent costs**: these are costs that might be incurred at a future date, such as clean-up costs;

(d) **image and relationship costs**: these are costs associated with promoting an environmental image, such as the cost of producing environmental reports. There are also costs of behaving in an environmentally irresponsible way, such as the costs of lost sales as a result of causing a major environmental disaster.

In traditional management accounting systems, environmental costs (and benefits) are often hidden. EMA attempts to identify these costs and bring them to the attention of management.

### 7.3.2 Environmental activity-based accounting

Environmental activity based accounting is the application of environmental costs to activity based accounting. A distinction is made between:

Environmental-related costs: these are costs that are attributable to cost centres involved in environmental-related activities, such as an incinerator or a waste recycling plant;

Environmental-driven costs: these are overhead costs resulting from environment-related factors, such as higher costs of labour or depreciation.

The cost drivers for environment-related costs may be:

(a) The volume of emissions or waste;
(b) The toxicity of emissions or waste;
(c) Environmental impact added' (units multiplied by environmental impact per unit); or
(d) The volume of emissions or waste treated.

### 7.3.3 Environmental life cycle costing

Life cycle costing is a method of costing that looks at the costs of a product over its entire life cycle. Life cycle costing can help a company to establish how costs are likely to change as a product goes through the stages of its life (introduction, growth, maturity, decline and withdrawal from the market). This analysis of costs should include environmental costs.

**Illustration: Environmental life cycle costing**

Xerox provides a good example of the environmental aspect of life cycle costing. Xerox manufactures photocopiers, which it leases rather than sells. At the end of a lease period, the photocopiers are returned from the customer to Xerox.

At one time, photocopiers were delivered to customers in packaging that could not be re-used for sending the machines back at the end of the lease period.

Customers disposed of the old packaging and had to provide their own new packaging to return the machines to Xerox. Xerox then disposed of this packaging.

The company therefore incurred two costs: the cost of packaging to deliver machines and the cost of disposal of the packaging for returned machines.

By looking at the costs of photocopiers over their full life cycle, Xerox found that money could be saved by manufacturing standard re-usable packaging. The same packaging could be used to deliver and return machines, and could also be re- used.

At the same time, the company created benefits for the environment by reducing disposals of packaging materials.

### 7.3.4 Performance and sustainability

To succeed over the long term, a business must be sustainable. It needs to remain profitable, but to do this it also needs to consider the non-financial aspects of a sustainable business. Sustainability has been defined in terms of setting performance objectives for three areas or aspects of performance:

(a) economic performance/ financial performance

(b) performance relating to the environment

(c) social aspects of performance.

Economic, social and environmental performance are known as the 'three pillars of sustainability'. They are also known as the three Ps (a phrase coined by John Elkington in 1994):

**People** refers to fair and beneficial business practices for labour (employees), the community and region in which a corporation conducts its business, and the organisation's customers.

**Planet** (natural capital) refers to sustainable ('green') environmental practices so environmental indicators might include measurements relating to improving energy efficiency; minimising pollution; using renewable materials or sources of energy and

avoiding the use of non-renewable items; and minimising waste, for example by recycling materials;

**Profit** is the economic value created by the organisation after deducting the cost of all inputs, including the cost of the capital tied up. It is the real economic impact the organisation has on its economic environment.
Arguably, a business will not survive over the long term unless it gives due consideration to people and planet, as well as to profit.

Stakeholder-based measures of performance: social and environmental performance

**Stakeholder**

A person, group or organisation that has an interest in an organisation.

Anybody who can affect or is affected by an organisation, strategy or project

The primary stakeholders in a typical company are its owners, employees, customers and suppliers. However, increasing globalisation, greater environmental and social awareness, and more efficient communication, have resulted in a wider and deeper understanding of the impact that organisations have on society and on the environment. In consequence many organisations take a view of stakeholders that includes other groups in addition to these including the community at large.

There is an increasing understanding that although companies increase economic wealth through growth and the search for profit maximisation, society may well be getting poorer because of the damage that economic activity is having on the environment and society.

A successful business now must not only be financially secure but it must minimise its negative environmental impacts and must meet the expectations of society.
As companies have become increasingly aware of environmental issues, and have started to accept that economic growth might not be sustainable, they have become more interested in measuring sustainability and environmental impact.
Public companies report their financial performance in their published annual financial statements, but many companies also provide information about social and environmental goals and performance, in a strategic report or a sustainability report (or corporate social responsibility report).

### 7.3.5 Triple bottom line reporting

Performance relating to sustainability may be presented in a triple bottom line report. In traditional financial reporting the bottom line refers to either the profit or loss, which is presented at the very bottom line on in a statement of profit or loss.

**Example: Full cost of operation**

A company runs a gold mine at a profit.

The operation of the mine has caused significant pollution of the local water supply leading to death and illness among the local population and livestock.

The financial statements bottom line only shows the profit but not these other costs to society.

Environmentalists and economists have argued that the traditional bottom line does not include the full costs of the business.

The triple bottom line adds two more bottom lines. These are social and environmental (ecological) concerns. Triple bottom line (abbreviated as TBL or 3BL) incorporates the notion of sustainability into business decisions.

TBL is an accounting framework with three dimensions, social, environmental (or ecological) and economic (financial). Many organisations have adopted the TBL framework to evaluate their performance in a broader context.

### 7.3.6 Measures of social and environmental performance

Measures of profitability are similar for all for-profit businesses. However, measures of social and environmental performance may differ widely between companies, because of their size and the nature of their business operations.

One major global company using triple bottom line reporting reported its environmental performance in terms of:

(a) global energy use, measured in thousands of GWh (giga watt hours)

(b) global carbon dioxide emissions, measured in metric tonnes

(c) production of non-recycled waste, measured in metric tonnes

Emissions of other polluting cases can be converted into a 'carbon dioxide

equivalent', so that the total quantities of polluting emissions by a company can be expressed in a common measure – carbon dioxide. Total emissions of carbondioxide equivalents by a company are commonly known as the company's 'carbon footprint'.

The same global company reported, as social indicators:

(a) its donations to communities and sponsorships;
(b) diversity: the percentage of its employees who were female and the percentage who came from minority groups;
(c) the number of discrimination charges brought against the company during the year;
(d) employee satisfaction, based on a census of employee opinion; and
(e) the recordable injury rate per 1,000 employees.

Some companies publish targets for improvements in the social or environmental aspects of their operations. For example, some global packaging and bottling companies now have targets for the replacement of non-recyclable plastic materials with recyclable or biodegradable materials.

### 7.3.7 A system for social and environmental reporting

Traditional performance measures are directed primarily at the owners and those who act on their behalf (the management) with most companies using performance measurement systems that are extensions of their financial reporting systems.

Such traditional accounting systems do not provide information which could be used to explain the company's performance in terms of environmental and social impacts. Performance measurement systems must be designed to do this.

In order for a company to design a suitable performance reporting system it must do the following:

(a) identify its stakeholders;
(b) find out what aspects of the company's performance are important to each stakeholder group;

(c) design performance metrics to show the company's performance in each area of interest;
(d) set targets for each metric and communicate these to the stakeholder;
(e) design information systems that integrate data collection and information processing so that performance can be measured against these metrics; and
(f) introduce a transparent system of reporting to stakeholder groups.

Triple bottom line reporting is a framework that can be used to inform this process.

Environmental accounting plays a crucial role in both environmental conservation and financial decision-making for businesses. It helps organisations analyse how their operations, products, or services impact the environment and then share this information with others.

Environmental accounting involves determining environmental costs in a company's financial records. This helps companies share information on their financial performance with outsiders.

### 7.3.8 Importance of Environmental Accounting

Environmental accounting is like putting on eco-lenses when examining a nation's or company's finances. Instead of just tracking profits and expenses, it includes the environmental costs of production, resource consumption, and pollution—things that traditional accounting often ignores.

The importance of environmental accounting includes:

(a) **Reveals hidden costs**: Pollution, deforestation, and carbon emissions aren't typically reflected in financial statements. Environmental accounting brings these externalities into the spotlight.
(b) **Promotes sustainable decision-making**: When businesses see the full environmental cost of their operations, they're more likely to adopt greener practices.
(c) **Informs public policy**: Governments can craft smarter regulations and incentives by understanding the true environmental impacts of economic activity.
(d) **Encourages corporate responsibility**: Shareholders and consumers increasingly demand transparency. Environmental accounting helps companies report on their sustainability performance.
(e) **Supports long-term planning**: It provides data for forecasting and strategizing sustainable development, helping balance economic growth with environmental health.

## 7.4 Different methods of accounting for environmental costs

The various methods of accounting for environmental issues are classified under

**Environmental management accounting:** This method emphasizes managing resources and making internal decisions by identifying, analysing, and measuring the environmental costs and benefits of a company's operations.

**Sustainability Accounting: In sustainability accounting, the emphasis is the evaluation and disclosure of veritable information pertaining to a** company's social, environmental, and economic performance. This includes assessing indicators like energy usage, social impacts, and greenhouse gas emissions. The goal is to provide a comprehensive understanding of the organisation's sustainable development, encourage engagement with stakeholders, and identify areas for enhancement.

## 7.5 Challenges faced in accounting for environmental and sustainability factors

Some of the challenges faced in accounting for environmental costs include:

(a) environmental cost measurement are very unscientific;
(b) accounting mechanism for environmental costs have flaws;
(c) environmental accounting is only recognised through information disclosure;
(d) there is no legal provisions in our present laws to support environmental accounting; and
(e) most organisation due to lack of legal provisions fail to take serious attention to its accounting.

The following counter measures are put in place to strengthen environmental accounting:

(a) optimising the measurement of environment costs; and
**(b)** companies should formulate overall strategies that will guide it in environmental **accounting.**

## 7.6 The principal roles of the management accountant in supporting the business to develop sustainability practices and sustainability reporting

The importance of sustainability is beginning to change the way businesses think and react with several businesses using voluntary initiatives to integrate social, economic, and ecological issues into their organisations structure as a means of seeking a form of competitive advantage. These objectives are:

social progress which recognises the needs of everyone;

effective protection of the environment; and

prudent use of natural resources.

maintenance of high and stable levels of optimized operation to achieve economic growth and employment using physical capital which is economic assets such as buildings, machines and infrastructure that are the accountants usual concern; Social capital: which is people's skills and abilities as well as the institutions, relationships, and norms So as to shape the quality and quantity of a society's social interactions. Natural capital: natural resources, both commercial and non-commercial, and ecological services which provide the requirements for life, including food, water, energy, fibers, waste assimilation, climate stabilization, and other life-support services.

Other roles include:

Use organisational strategies, budgets and policies to set performance target;

Help in providing advisory role with known and available information; and

Take active part in decision making and strategy formulation.

Management accountant works assiduously using the various capital mix, physical capital,

human capital and social capital to ensure sustainable development for the organisation.

The two drivers that assist management accountant to achieve this role is cost savings and risk management.

Cost Saving: Through efficient resource management across various capital types, data on environmental and social expenditures is analysed to enhance overall environmental performance.

The second driver is risk management: Environmental risks are identified and managed.

## 7.7 Chapter review

Before moving on to the next chapter, readers should ensure that they can:

(a) discuss environmental and sustainability issues that affect the business environment;
(b) discuss the importance of environmental accounting in management reporting; and
(c) discuss the roles of the management accountant in ensuring that business organisations considers environmental, social and economic factors in decision making processes.

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**Skills level**
**Performance management**



# OTHER ADVANCED COSTING TECHNIQUES

## Chapter Content


8.0 Learning objective

8.1 Learning outcomes

8.2 Just in time (JIT) technique

8.3 Backflush accounting

8.4 Kaizen costing

8.5 Product profitability analysis

8.6 Segment profitability analysis

8.7 Chapter review


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## 8 Other Advanced Costing Techniques

## 8.0 Learning objective

This chapter introduces the readers to other aspects of advanced costing techniques, such as just in time (JIT), backflush accounting, Kaizen costing, segmental profit analysis and product profitability analysis.

## 8.1 Learning outcomes

On successful completion of this chapter, readers should be able to:

(a) discuss the concept of JIT, backflush accounting, kaizen costing techniques, profit analysis for products and segments;

(b) discuss the uses and importance of Backflush techniques, kaizen costing principles as well as profitability analysis; and

(c) assess the principal roles of the management accountant in using back flush techniques, kaizen costing approach supporting management decision making process.

## 8.2 JIT PRODUCTION AND BACKFLUSH ACCOUNTING

### 8.2.1 JIT production and JIT purchasing

Just-in-Time (JIT) management methods originated in Japan in the 1970s. The principle of JIT is that producing items for inventory is wasteful, because inventory adds no value, and holding inventory is therefore an expense for which there is no benefit.

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

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

It follows that in an ideal production system:

(a) there should be no inventory of finished goods: items should be produced just in time to meet customer orders, and not before (**just in time production**)

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

**Definition**

Just-in-time purchasing is a purchasing system in which material purchases are contracted so that the receipt and usage of the materials, to the maximum extent, coincide

(CIMA Official Terminology).

## 8.3 Introduction to backflush accounting

Backflush accounting is a method of cost accounting that is consistent with JIT systems.

(a) Traditional cost accounting systems for manufacturing costs are 'sequential tracking' systems. They track the costs of items as they progress through the manufacturing process, from raw materials, through work in progress to finished goods. At each stage of the manufacturing process, more costs are added and recorded within the cost accounting system.

(b) The main benefit of sequential tracking costing systems is that they can be used to put a cost to items of inventory. When inventory is large, there is a need to measure inventory costs with reasonable 'accuracy'.

(c) With a JIT philosophy, this benefit does not exist. Inventory should be small, or even non-existent. The cost of inventory is therefore fairly insignificant. A costing system that measures the cost of inventory is therefore of little or no value, and is certainly not worth the time, effort and expenditure involved.

(d) Backflush accounting is an alternative costing system that can be applied in a JIT environment. It is ideally suited to a manufacturing environment where production cycle times are fairly short and inventory levels are low.

As the term 'backflush' might suggest, costs are calculated after production has been completed. They are allocated between the cost of goods sold and inventories in retrospect. They are not built up as work progresses through the production process.

It is important to recognise that the great advantage of backflush accounting is that costs can be worked 'backwards', after the goods have been produced and sold. There is no need for a complex cost accounting system that records costs of production sequentially.

### 8.3.1 Backflush accounting with two 'trigger points'

An event that leads to the recognition of costs is called a trigger point.

A backflush accounting system has one or two trigger points, when costs are recorded. When there are two trigger points, these are usually:

(a) the purchase of raw materials; and

(b) the manufacture of completed products.

**Trigger point 1**

Direct material costs and other direct production costs are recorded in the usual way by debiting the costs to the appropriate account. It is helpful to think of these accounts as being like expense accounts where the costs are held until they can be included into the cost of sales and to a much lesser extent into closing inventory.

**Trigger point 2**

The cost of production is debited into finished inventory when production is complete. The credit entries are to the suspense accounts at standard costs.

Balances on the suspense accounts after these entries represent closing inventory of finished goods or cost variances.

The debit recognised in the finished inventory account moved to a cost of goods sold account almost immediately (remember what just in time manufacture means).

A numerical example will be used to illustrate the costing method.

### Example: Backflush accounting

A manufacturing company makes a single product (P), which has the following standard cost:

| | ₦ |
|---|---|
| Raw materials | 20 |
| Direct labour | 8 |
| Overheads | 22 |
| | 50 |

During the period, it incurred the following costs:

| | |
|---|---|
| Raw materials purchased | ₦775,000 |
| Conversion costs: | ₦2,080,000 |
| Direct labour costs incurred | ₦2,260,000 |
| Overhead cost incurred | ₦ 3,035,000 |

The company produced 100,000 units of Product P and sold 98,000 units.

The company uses a backflush costing system, with trigger points at raw materials purchase and at completion of production.

**Trigger point 1:** Record the purchase of raw materials

Other conversion costs are also recorded

| | |
|---|---|
| Debit: conversion costs | ₦ 3,035,000 |
| Credit: payables | ₦ 3,035,000 |

Raw materials inventory account

| | ₦ | | ₦ |
|---|---|---|---|
| Payables | 2,030,000 | | |

Conversion cost account

| | ₦ | | ₦ |
|---|---|---|---|
| Bank (labour cost) | 775,000 | | |
| Payables (overheads) | 2,260,000 | | |

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Debit: Raw materials inventory ₦2,030,000

Credit: Payables ₦2,030,000

| | ₦ | | ₦ |
|---|---|---|---|
| Payables | 2,030,000 | Finished goods inventory | 2,000,000 |
| | | Closing balance c/f | 30,000 |
| | 2,030,000 | | 2,030,000 |

**Conversion costs account**

| | ₦ | | ₦ |
|---|---|---|---|
| Bank (labour cost) | 775,000 | Finished goods inventory | 3,000,000 |
| Payables | | Balance | 35,000 |
| | 3,035,000 | | 3,035,000 |

| | ₦ | | ₦ |
|---|---|---|---|
| Raw materials | 2,000,000 | Cost of goods sold (98,000 □ 50) | 4,900,000 |
| Conversion costs (overheads) | 3,000,000<br>2,260,000 | Closing inventory (2,000 □ 50) | 100,000 |
| | 5,000,000 | | 5,000,000 |

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**Example (continued): Backflush accounting**

**Trigger point 2:** Record the manufacture of the 100,000 units

**Raw materials inventory**

| | ₦ | | ₦ |
|---|---|---|---|
| Raw materials (100,000 × 20) | 2,000,000 | | |
| Conversion | 3,000,00 | | |

The closing balance on the raw materials account may represent the cost of closing inventory. If so, it is carried forward as an opening balance to the start of the next period. However, any cost variance (difference between standard and actual material cost) should be taken to the income statement for the period.

Similarly, the balance on the conversion costs account represents cost variances for labour and overhead, and this should be written off to the income statement for the period.

**Almost immediate recognition of cost of sales**

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**Backflush accounting with one 'trigger point'**

An even simpler backflush accounting system has just one trigger point, the manufacture of finished units. In this system, the purchase of direct materials is not recorded.

Conversion costs are debited, initially to a suspense account (or accounts as before).

The cost of production is debited into finished inventory when production is complete with the credit entries are to the suspense accounts at standard costs and to payables for raw materials.

**Example: Backflush accounting**

A manufacturing company makes a single product (P), which has the following standard cost:

| | ₦ |
|---|---|
| Raw materials | 20 |
| Conversion costs | 30 |
| | 50 |

During the period, it incurred the following costs:

| | |
|---|---|
| Raw materials purchased | ₦2,030,000 |
| Conversion costs: | ₦3,035,000 |

The company made 100,000 units of Product P and sold 98,000 units.

The company uses a backflush costing system trigger point at completion of production.

| | ₦ | | ₦ |
|---|---|---|---|
| Bank (labour cost) | 775,000 | Finished goods inventory | 3,000,000 |
| Creditors (overheads) | 2,260,000 | Balance | 35,000 |
| | 3,035,000 | | 3,035,000 |

**Finished goods inventory account**

| | ₦ | | ₦ |
|---|---|---|---|
| Raw materials (payables) (100,000 x 20) | 2,000,000 | Cost of goods sold (98,000 x 50) | 4,900,000 |
| Conversion costs (100,000 x 30) | 3,000,000 | Closing inventory (2,000 x 50) | 100,000 |
| | 5,000,000 | | 5,000,000 |

The only difference is that there is no raw materials inventory account. The ₦30,000 of materials that has been purchased but not used is simply not recorded in the costing system and is therefore not included in closing inventory at the end of the period.

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## 8.4 KAIZEN COSTING

### 8.4.1 An introduction to Kaizen costing

For companies that practise TQM and continuous improvement methods, Kaizen costing takes over where target costing ends.

Target costing is used in the design and development stage for a new product.

Kaizen costing is applied from the time that a product goes into full production until the end of the product's life.

Taken together, target costing and Kaizen costing are systems for life cycle costing.

The philosophy of continuous improvement (Kaizen) is based on the view that markets are highly competitive and industry must try to keep reducing costs in order to reduce selling prices in order to maintain a competitive advantage.
Kaizen costing is a management accounting system that provides cost information to help with achieving improvements without loss of product quality or value.

Most of the costs of a product over its entire life cycle are committed during the design and development stage. This is why target costing is a valuable technique for the control of costs (without loss of value). However, there is still some scope for further cost reduction after commercial production and marketing of the product has begun.

A Kaizen costing system is therefore a costing system that is designed to help a company to reduce product costs.

(a) A target for cost reductions is set. This target is below the current cost. The cost reduction must be achieved without any loss of value for the customer. For example, a target might be set to reduce unit costs of production by 5% within two years.
(b) Teams are established to identify methods of making improvements.
(c) Kaizen focuses on making small improvements, as it is unlikely that a single improvement will be sufficient to achieve the target cost reductions. Many different improvements might be needed over a period of time.
(d) Actual costs are continually compared with the target costs, and progress towards achieving the target cost is monitored through regular reporting.
(e) The project teams must continually review production conditions to find ways of making more improvements and more cost reductions.
(f) Normally, teams are rewarded with bonuses if they achieve their cost reduction target.

(g) When one cost reduction target is met, another cost reduction target takes its place. With Kaizen, the process of seeking improvements never ends.

### 8.4.2 Techniques for continuous improvement

Teams that are given the responsibility for making improvements might use value analysis (VA) methods. VA is similar to value engineering, except that VA is applied to existing products and VE to products during their design and development stage.

The types of questions that might be asked are as follows:

(a) Can common materials and parts be used? The same part might be used in two or more parts of the product, or the same part might be used for several different products that the company manufactures.

(b) How much of the cost consists of purchased materials and components? Can

major suppliers be persuaded to reduce their own costs and prices?

(c) Can improvements be made in logistics (distribution) or packaging?

(d) Can the investment in the product (for example, working capital) be reduced?

(e) Can improvements be made in production systems or maintenance methods?

(f) Can the work be organised in a different way?

(g) A system of value analysis must be supported by a management accounting system that provides relevant cost data.

### 8.4.3 Kaizen costing compared with standard costing

It is useful to compare Kaizen costing with traditional standard costing.

(a) With standard costing, expected costs are established based on current production methods. Variances between actual and standard costs are calculated, and variance reports focus on significant variations between actual costs and the current standard. There is no motivation to make improvements and reduce costs below the existing standard.

(b) With Kaizen costing, actual costs are compared with the target, not an existing standard. The variance reporting system is used to monitor progress towards the target cost.

(c) With standard costing, managers are encouraged to prevent adverse variances. For example, if there is an adverse material price variance, the manager responsible might decide to buy materials at a lower price from a different supplier. The result could be a loss of quality, a fall in value and a reduction in customer satisfaction.

(d) With Kaizen costing, reductions in cost must be achieved without any loss of value.

A 1993 article on Kaizen and Kaizen costing concluded: 'In the US, changes in the focus and methods of production need to be accompanied by changes in management accounting systems. The Japanese have provided guidance on how management accounting can play a significant role in creating sustainable

competitive advantage for a firm. The more organisations rid themselves of traditional management accounting practices, the better is the chance that the new ideas about manufacturing can take over and really show their worth. Old ways of product costing blunt a firm's ability to compete effectively and hinder their ability to focus on world-class performance.'

## 8.5 PRODUCT PROFITABILITY ANALYSIS

### 8.5.1 Introduction

It would be very unusual to find a company with a single product. Many companies have wide product ranges.

Manufacturing companies often have complex costing systems to establish the cost of production. Traditional accounting systems identify the direct costs associated with a product and incorporate systems to apportion production overheads into cost units. More modern techniques are discussed elsewhere in this chapter. If cost allocation is reliable it is relatively helpful.

### 8.5.2 Direct product profitability

Retailers know how much units of inventory have cost them and how much they are sold for. However, simply understanding the gross margin of different products does not always indicate the true profitability of those products.

A retailer might be interested in understanding the impact that sales of individual products and product lines have on profitability. Direct product profitability (an approach developed by McKinsey & Co) is a technique which allows them to do this. Direct product profitability attempts to attribute the purchase price and indirect costs to individual products and product lines. This allows the identification of a net profit for each of these.

**Illustration: Direct product profitability**

Direct product profitability of a given product for a given period is found as follows.

| | ₦ |
|---|---|
| Sale revenue | X |
| Purchase price (net of discounts received) | (X) |
| Gross profit | X |
| Less: | |
| Ordering costs | X |
| Storage costs | X |
| Distribution costs | X |
| Cost of obsolescence | X |
| | (X) |
| Direct product profit | X |

Notice that direct product profitability is expressed in profit per period rather than per unit. Looking at unit profitability might be misleading as it would fail to take sales volumes into account.

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**Example: Direct product profitability**

A retailer sells two products (A and B) as follows:

| | A | B |
|---|---|---|
| Sales price | ₦4,000 | ₦3,000 |
| Purchase cost | ₦3,000 | ₦2,000 |
| Gross profit per unit | ₦1,000 | ₦1,000 |
| Gross margin | 25% | 33.33% |
| Shelf space per unit | 20 $cm^2$ | 10 $cm^2$ |
| Gross profit per unit of $cm^2$ of shelf space | ₦50 | ₦100 |

It looks as if the retailer should be concentrating on selling B from the above information. However, further data for weekly performance shows that this is not the case.

| | A | B |
|---|---|---|
| Gross profit per unit | ₦1,000 | ₦1,000 |
| Unit sales | 400 | 20 |
| Gross profit | ₦400,000 | ₦20,000 |
| Area used ($cm^2$) | 2,000 $cm^2$ | 1,000 $cm^2$ |
| Cost per $cm^2$ per week | ₦50 | ₦50 |
| Storage cost | ₦100,000 | ₦50,000 |
| Direct product profit | ₦300,000 | ₦(30,000) |

The above example demonstrates the importance of obtaining sufficient information before meaningful analysis can be carried out.

DPP can be useful for a company that adopts a product based approach to marketing. It suggests better results can be achieved by selling more of the products which generate the highest product profitabilit

DPP analysis suggests ways of improving product profitability. For example, moving items to more prominent positions to increase turnover or reducing the size of product packaging. It might also be used to justify retailers seeking product support from suppliers.

**Problems with DPP**

It depends on cost allocation and this might be difficult in practice.

It can be said to provide an incorrect marketing focus as it disregards the needs of the customers.

## 8.6 SEGMENT PROFITABILITY ANALYSIS

### 8.6.1 Introduction to segmental profitability analysis

All businesses exist to make a profit. They do this by producing goods and services and selling them for more than the cost of their production. The ability to measure performance in terms of profitability is very important.

It is highly unlikely that a business will have only one product. Single product businesses are useful to illustrate accounting principles but exist only in theory. Many companies have hundreds of products which they sell in many regions.

Given the existence of many products and many different areas of operations, it is unlikely that all products or areas will be profitable over time. Companies need to evaluate profit performance systematically and regularly on a segmental basis and unprofitable segments should be discontinued if they cannot be made profitable.

A business can segment its operations in several ways, including:

(a) by product line;

(b) by geographical area (town, district, country)

There are two main ways of measuring segment profitability:

(a) the full cost approach; and

(b) the contribution approach.

### 8.6.2 Full cost approach

The full cost approach attempts to measure the total profit earned by each segment.

The basic principles of this approach are as follows:

(a) The objective is to measure net profit of each operating segment.
(b) Overall net profit of a business is the sum of the net profit of the individual segments.
(c) All indirect expenses (common) must be allocated.
(d) Allocation of indirect expenses involves selecting bases of allocation.

**Illustration: Segmental profit**

| | ₦ |
|---|---|
| Segment sales | x |
| Direct expenses | |
| Variable segment costs | (X) |
| | (X) |
| | X |
| Allocated indirect expenses | (X) |
| | |

At first sight, this might look like a logical approach as a business cannot be successful without profit (net income). However, measuring the profit of a segment is more difficult than measuring the profit of a business in its entirety due to the need to identify segment expenses.

From the segment's point of view, there are two types of expenses:

(a) segment direct expenses; and

(b) segment indirect expenses.

### Segment direct expenses

These are segment expenses that result from the existence and operation of the segment. These expenses would be avoided by a company if it closed the segment.

Examples of segment direct expenses include the following:

(a) direct costs (material, labour and variable overhead); and

(b) fixed costs that relate directly to a segment (e.g. factory rental).

### Segment indirect expenses

These are segment expenses that are not directly caused by a particular segment. They relate to the company as a whole but are shared to the segments to which they relate in order to calculate segment profitability. These expenses would not be avoided by a company if it closed the segment.

Examples of indirect expenses include the following:

(a) directors' remuneration;

(b) head office expenses;

(c) costs of central functions (e.g. accounting, treasury, human resources etc.)

There are different methods that might be used for allocating expenses so it might be said that the final allocation is somewhat arbitrary. An unfair allocation method can cause one segment to appear to be more profitable than another when in fact this is not the case.

## 8.6.3 Segment contribution approach

The segment contribution approach attempts to measure the contribution made by each segment.

The basic principles of this approach are as follows:

(a) Only the contribution of each segment is computed. No attempt is made to compute the net income of the segment.

(b) Indirect or common expenses of each segment are not allocated.

(c) Indirect or common expenses, however, are usually deducted from total segmental contribution in order to arrive at overall business net income.

A segment is considered profitable if sales of the segment exceed the direct expenses of the segment

**Illustration: Segmental contribution**

| | ₦ |
|---|---|
| Segment sales | x |
| Direct expenses | |
| Variable segment costs | (X) |
| | (X) |
| | x |

The major problem of the full cost approach is that it is possible for a segment to show an operating loss yet at the same time be making a positive contribution to net income. In other words, if the seemingly unprofitable segment is closed, then the overall net income of the business will decrease. This will be examined later in this chapter.

To overcome this adverse feature of the full cost approach, many businesses prefer to use the contribution approach to measuring segmental profitability.

The segmental contribution approach as indicated by its name measures segmental contribution. Segmental contribution may simply be defined as sales less direct expenses.

There is a difference between segmental contribution and contribution as discussed in earlier chapters.

(a) Contribution (as discussed in earlier chapters) is sales less variable expenses.

(b) Segmental contribution is segment sales less segment direct costs. Segment direct costs might include fixed costs. This is because they would vary if the segment was closed.

### 8.6.4 Comparison of the two approaches

The indirect expenses of a segment will continue to be incurred regardless of whether the segment is continued or not continued.

Therefore, as long as the segment is making a contribution towards indirect fixed expenses, continuing operations at least in the short run makes the business better off.

The following example illustrates the basic principles of the full cost and segmental contribution approaches.

**Example: Segment profitability**

A company operates as two segments (X and Y).

The following results relate to the most recent accounting period.

| | X | Y | Total |
|---|---|---|---|
| | ₦000 | ₦000 | ₦000 |
| Sales | 300 | 200 | 500 |
| Direct costs | (215) | (170) | (385) |
| Segmental contribution | 85 | 30 | 115 |
| Indirect costs | (60) | (40) | (100) |
| Segmental profit/(loss) | 25 | (10) | 15 |

**Analysis**

The full cost approach shows that segment Y is operating at a net loss of ₦10,000. This makes it look as if the business would be better off by ₦10,000 if it were to close segment Y.

The segmental contribution approach shows that segment Y is making a contribution of ₦30,000.

The contribution approach shows that segment Y actually makes a

contribution to the total fixed costs. If segment Y were closed this contribution would be lost but the indirect costs would not be avoided. Therefore, the company would be ₦30,000 worse off if segment Y were closed and this would result in the company making a loss of ₦15,000.

## 8.7 Chapter review

Before moving to the next chapter, ensure that you can:

(a) Discuss advanced costing techniques like:

- backflushing accounting,
- Kaizen costing and method of profit analysis

(b) Discuss product profitability analysis and segment profitability analysis .and the use of all the mentioned techniques in accelerating decision making.

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**Skills level**
**Performance management**




# COST TYPES AND COSTS ANALYSIS

## Chapter Content

9.0 Learning objective
9.1 Learning outcomes
9.2 Explain the concept of costs and types of costs
9.3 Discuss the concept of cost estimation and techniques
9.4 Cost analysis using marginal and absorption costing approaches
9.5 Chapter review

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# 9 Cost Types and Costs Analysis

## 9.0 Learning objective

This chapter discusses costing, management accounting and quantitative methods linking them with critical success factors and operational strategic objectives whether financial, operational.

## 9.1 Learning outcomes

On successful completion of this chapter, readers should be able to:

(a) understand the concept of cost and cost analysis;

(b) identify cost types and classes;

(c) calculate cost of product using marginal costing and absorption costing approaches; and

(d) compare absorption and marginal costing statements.

## 9.2 Explain the concept of cost and types of cost.

### 9.2.1 Concept of cost

Cost refers to the value of resources sacrificed to obtain or produce something. It represents the amount that must be given up to acquire a good or service and is fundamental in accounting, economics, and decision-making.

### 9.2.2 Cost classification

Cost classification involves grouping expenses based on similar characteristics or behaviour, to aid analysis, financial reporting, and decision-making. It helps to understand where money is spent and how costs relate to different activities or products. Classification of cost is the categorisation of expenses by a company to help make accounting and financial decisions. There are several ways to classify costs, including direct and indirect, as well as fixed cost and variable cos

**Classification of Costs**

i. By Nature
This groups costs based on the type of resources consumed e.g material, labour, overheads etc.

ii. By Function
This groups cost based on the business function or department they relate to e.g production administration, selling, and distribution.

iii. By Traceability
This refers to how easily a cost can be traced to a product, department, or activity e.g direct costs and indirect costs.

Vi. By behaviour

This classification shows how costs react to changes in output or activity level, for example variable costs, fixed costs, and mixed costs.

Fixed costs are costs that remain constant in total as output increases but the cost per unit decreases as output increases within the relevant range.

Variable costs are those costs that increase in total as output increases but the cost per unit is constant at all levels of output within the relevant range.

Mixed costs are costs that are partly variable and partly fixed. The total costs increase as output increases but the cost per unit decreases with increase in output.

**Separation of costs**

In many areas of cost and management accounting, we need to separate total mixed cost into variable and fixed components in the following format:

Y = a + bX, where

Y = total cost

a = total fixed cost

b = variable cost per unit

X = number of units

Mixed costs can be separated into their fixed and variable components using any of the following methods:

(a) scatter diagram: When applying this method, individual data points are displayed on a graph, and a smooth trend line is sketched freely across the scatter to visually represent the overall distribution.

(b) engineering: referred to as the work measurement method determines cost function by analysing the relationship between inputs and outputs in physical terms. This is useful in a repetitive processes where input-output relationships are clearly defined.

(c) account analysis;

(d) high-low; and

(e) regression analysis.

Under the account analysis method, the ledger records are used to analyse information into variable, semi-variable and fixed elements.

## 9.3 Discuss the concept of cost estimation and techniques

### 9.3.1 The need to estimate fixed and variable costs

To prepare accurate cost budgets, it is important to understand how costs 'behave'. Cost behaviour refers to the way in which total costs increase as the volume of an activity increases.

It is normally assumed that total costs can be analysed into fixed costs and a variable cost per unit of activity, such as a variable cost per unit of product or per hour of service. Some overhead costs are a mixture of fixed costs and variable costs, but these can be separated into a fixed cost portion and a variable cost portion.

To prepare reliable cost budgets or cost estimates, it may be necessary to estimate fixed costs and variable costs.

Direct material costs are normally 100% variable costs.

Direct labour costs may be treated as variable costs. However, when there is a fixed labour force, direct labour costs may be budgeted as fixed costs.

Overhead costs may be treated as fixed costs. However, for an accurate analysis of overhead costs, it may be necessary to make an estimate of fixed costs and variable costs. These estimates are often based on an analysis of historical costs.

You will be familiar with the following two techniques for estimating fixed and variable costs from your previous studies:

(a) the high low method; and

(b) linear regression analysis.

A **full explanation of each of these techniques is repeated here for your convenience.**

### High/low analysis

High/low nalysis 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

(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

(b) the lowest activity level.

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

difference in total costs / difference in the number of units of activity.

**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.

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**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 |
| | 2,400 | 8,400 |

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

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

Therefore: The variable cost per unit = ₦8,400/2,400 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

## 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

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### 9.3.2 High/low analysis with 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 step for cost separation include:

**Step 1:** Take the activity level and cost for:

(a) the highest activity level
(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 of activity can be calculated as:

difference in total costs /difference in the number of units of activity.

**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 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

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**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 is 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 the other side of the step can be calculated from the first fixed cost.

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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

+ 1

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

### 9.3.4 High/low analysis with 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.

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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 units = ₦7.2 per unit

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

= ₦7.2 per unit □ 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

## Linear Regression Analysis

### Section overview

- The purpose of linear regression analysis
- The linear regression formulae
- Linear regression analysis and forecasting

### 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.

(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.

(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.

**The linear regression formulae**

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

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

**Formula: Regression analysis formula**

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

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

**Where:**

x, y = values of pairs of data.

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

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

x = Independent variable (units of activity) y = Dependent variable (Amounts **/** Costs) a = Fixed costs **/** yintercept

b = Variable costs per unit of activity /Slope/Gradient/Regression coefficient.

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

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 | $x^2$ | X y |
|---|---|---|---|---|
| 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 |
| | = □x | = □y | = □$x^2$ | = □xy |

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

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

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:

$$y = 19.74 + 3.585x$$

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### Linear regression analysis and forecasting

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

**Example: Linear regression analysis**

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

$$y = 19.74 + 3.585x$$
$$y = 19.74 + 3.585 \times 9$$
$$y = 52.00$$

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

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

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

## 9.4 Cost analysis using marginal costing and absorption costing

### 9.4.1 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 variable production overheads); plus

(b) 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

This was covered in an earlier chapter but a brief revision is provided here for your convenience.

Production overheads are indirect costs. This means that the costs (unlike direct costs) cannot be attributed directly to specific items (products) for which a cost is calculated.

A 'fair' share of overhead costs is added to the direct costs of the product, using an absorption rate.

A suitable absorption rate is selected. This is usually a rate per direct labour hour, a rate per machine hour, a rate per amount of material or possibly a rate per unit of product.

Production overheads may be calculated for the factory as a whole; alternatively, separate absorption rates may be calculated for each different production department. (However, it is much more likely that a question involving absorption costing will give a factory-wide absorption rate rather than separate departmental absorption rates.)

The overhead absorption rate (or rates) is determined in advance for the financial year. It is calculated as follows:

**Formula: Overhead absorption rate**

$$\frac{\text{Total allocated and apportioned overheads}}{\text{Volume of activity in the period}}$$

Which is:

$$\frac{\text{Budgeted production overhead expenditure for the period}}{\text{Budgeted activity in the period}}$$

The 'activity' is the number of labour hours in the year, the number of machine hours or the number of units produced, depending on the basis of absorption (labour hour rate, machine hour rate or rate per unit) that is selected.

### Under- and over-absorption

Overhead absorption rates are decided in advance (before the period under review).

Actual overhead expenditure and actual production volume might differ from the estimates used in the budget to work out the absorption rate.

As a consequence, the amount of overheads added to the cost of products manufactured is likely to be different from actual overhead expenditure in the period. The difference is under- or over-absorbed overheads.

**Illustration: Under of over-absorbed fixed overhead**

| | | | ₦ |
|---|---|---|---|
| Amount absorbed: | | | |
| Actual number of units made (or hours used) | × | Predetermined absorption rate | X |
| Actual expenditure in the period | | | (X) |
| Over/(under) absorbed | | | X |

Overheads are under-absorbed when the amount of overheads absorbed into production costs is less than the actual amount of overhead expenditure.

Overheads are over-absorbed when the amount of overheads absorbed into

production costs is more than the actual amount of overhead expenditure.

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**Example: Absorption costing**

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.

The above information would be used as follows:

**a.** The predetermined absorption rate is ₦150,000/50,000 hours = ₦3 per direct labour hour.

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

| **c** | **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.

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

The amount of under- or over-absorbed overheads is written to profit or loss for the year as an adjusting figure.
If overhead is under-absorbed overhead the profit is adjusted down (because production costs have been understated)
If overhead is over-absorbed the profit is adjusted upwards.

Note that the recognition of the under or over absorbed overhead in the statement of profit or loss results in the fixed production overhead figure (which was originally based on an absorption rate) being restated to the actual fixed overhead incurred.

**Example: Absorption costing**

Returning to the facts of the previous example.

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

**Marginal costing**

Marginal costing is an alternative to absorption costing. In marginal costing, fixed production overheads are not absorbed into product costs but expensed in the period.

Marginal costing is useful in decision making as it focuses on the change in total costs brought about by an increase or decrease in a level of activity. This is covered in more detail in later chapters of this text.

**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 due **entirely** to the differences in inventory valuation.

The main difference between absorption costing and marginal costing is that in absorption costing, inventory cost includes a share of fixed production overhead costs.
The opening inventory contains fixed production overhead that was incurred last period. Opening inventory is written off against profit in the current period. Therefore, part of the previous period's costs are written off in the current period income statement.
The closing inventory contains fixed production overhead that was incurred in this period. Therefore, this amount is not written off in the current period income statement but carried forward to be written off in the next period income statement.

The implication of this is as follows (assume costs per unit remain constant):

(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);
(c) the increase is a credit to the income statement reducing the cost of sales and increasing profit;
(d) the increase will be bigger under total absorption valuation than under marginal costing valuation (because the absorption costing inventory includes fixed production overhead); therefore
(e) the total absorption profit will be higher.
(f) if inventory decreases in the period (closing inventory is less than opening inventory),
(g) the decrease is a debit to the income statement;
(h) the decrease will be bigger under total absorption valuation than under marginal costing valuation (because the absorption costing inventory includes fixed production overhead); therefore
(i) the total absorption profit will be lower.

**Example: Absorption costing**

Makurdi Manufacturing makes and sells a single product:

| | ₦ |
|---|---|
| Selling price per unit | 150 |
| Variable production costs per unit | 70 |
| Fixed overhead per unit (see below) | 50 |

| | |
|---|---|
| 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)

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**Example (continued): Total absorption cost profitstatement**

| | | August |
|---|---|---|
| Sales: | | |
| 1,500 units × ₦150 | 225,000 | |
| Opening inventory | nil | 60,000 |
| Variable production costs | | |
| 2,000 units □ ₦70 | 140,000 | |
| 2,500 units □ ₦70 | | 175,000 |
| 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) |
| | 250,000 | 345,000 |
| 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 |

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₦

Example (continued): Marginal costing

Makurdi Manufacturing makes and sells a single product:

| | |
|---|---|
| Selling price per unit | 150 |
| Variable production costs per unit | 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.

Marginal costing profit statements are as follows:

| | July | August |
|---|---|---|
| Sales: | | |
| 1,500 units □ ₦150 | 225,000 | |
| 3,000 units □ ₦150 | | 450,000 |
| Opening inventory | nil | 35,000 |
| Variable production costs | | |
| Direct material: 2,000 units □ ₦35 | 70,000 | |
| Direct labour: 2,000 units □ ₦25 | 50,000 | |
| Variable overhead 2,000 units □ ₦10 | 20,000 | |
| | | 87,500 |
| Direct material: 2,500 units □ ₦35 | | 62,500 |
| Direct labour: 2,500 units □ ₦25 | | 25,000 |
| Variable overhead 2,500 units □ ₦10 | | |
| Closing inventory | (35,000) | |
| 500 units @ (70) | | nil |
| Zero closing inventory | | |
| Cost of sale | (105,000) | (210,000) |
| Contribution | 120,000 | 240,000 |

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| | | |
|---|---|---|
| Fixed production costs (expensed) | (110,000) | (110,000) |
| Profit for the period | 10,000 | 130,000 |

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The difference between the two profit figures is calculated as follows:

**Formula: Profit difference under absorption costing (TAC = total absorption costing) and marginal costing (MC)**

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

Number of units increase or decrease × Fixed production overhead per unit

Returning to the previous example:

**Example(continued): 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 |

| | | | |
|---|---|---|---|
| | Units | Units | Units |
| Closing inventory | | nil | nil |
| 2,000 units made less 1,500 sold | 500 | | |

This profit can be explained the different way the inventory movement is costed under each system:

| | | | |
|---|---|---|---|
| Opening inventory | nil | 500 | nil |
| Absorbed fixed production overhead per unit (₦) | 500 | (500) | nil |
| | 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 |

**Example: MC vs TAC**

A company manufactures and sells a product.

The following information is relevant about the product

| | ₦ |
|---|---|
| Selling price per unit | 35 |
| Variable cost per unit | 8 |
| Fixed cost per unit (based on budgeted overhead of ₦120,000 | |

| | **Units** |
|---|---|
| Opening inventory | 4,000 |
| Actual production | 20,000 |
| Closing inventory | 3,000 |

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**Example (continued): MC vs TAC**

Operating statements can be prepared as follows:

| | MC | TAC |
|---|---|---|
| Sales (21,000 □ ₦35) | 735,000 | 735,000 |
| Cost of sales | | |
| MC = (21,000 □ ₦8) | (168,000) | |
| TAC = (21,000 □ ₦14) | | (294,000) |
| Fixed production cost | (120,000) | |
| | 447,000 | 441,000 |

The profit figures are reconciled as follows:

| | Units |
|---|---|
| Opening inventory | 4,000 |
| Closing inventory | 3,000 |
| Decrease | 1,000 |
| Difference in cost per unit | ₦6 |
| | ₦6,000 |

| | ₦ |
|---|---|
| MC profit | 447,000 |
| Inventory valuation difference | (6,000) |
| TAC profit | 441,000 |

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**Practice question** **1**

The following information is relevant about a product

| | ₦ |
|---|---|
| Selling price per unit | 35 |
| Variable cost per unit | 8 |
| Fixed cost per unit (based on budgeted overhead of ₦120,000 and normal level of activity of 20,000 units) | |

| | Units |
|---|---|
| Opening inventory | 2,000 |
| Actual production | 20,000 |
| Closing inventory | 4,000 |
| Therefore, sales are (2,000 + 20,000 – 4,000) | |

**Required:**

Prepare MC and TAC operating statements and reconcile the profit difference.

**Practice question** **2**

A company manufactures and sells product X.

The following information is relevant about the product:

| | ₦ |
|---|---|
| Selling price per unit | 50 |
| Variable cost per unit | 30 |
| Fixed cost per unit (based on budgeted overhead of ₦100,000 and normal level of activity of 25,000 units) | |

| | Units |
|---|---|
| Opening inventory | 2,000 |
| Closing inventory | 1,500 |

**Required**

a) Prepare a marginal cost profit statement.

b) Prepare an absorption cost profit statement. (Remember to adjust for the over absorption of overhead).

c) Reconcile the two profit figures by comparing the impact of the inventory movement under each approach.

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### Advantages and disadvantages of absorption costing

#### 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 for a product and comparing it will 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).

### Advantages and disadvantages of marginal costing

#### 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 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 necessary in the income statement at the end of an 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 enough. Total contribution has to be big enough to cover fixed costs and make a profit.

## 9.5 Chapter review

Before moving on to the next chapter, candidates are to check that they now know how to:

analyse cost data into fixed and variable elements and that they can use such information to support management decisions.

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**Skills level**
**Performance management**




# RELEVANT COSTING TECHNIQUES

## Chapter Contents

1 Learning objective
2 Learning outcomes
3 The concept of relevant cost and revenue
4 Identifying relevant costs for specific decision situations from given data
5 Explain and apply the concept of opportunity costs.
6 Chapter review

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# 10 Relevant Costing Techniques

## 10.0 Learning objective

This chapter introduces the concept of relevant costing as a tool for decision making. It deepens readers' capability to provide formation and decision support to management in operational and strategic contexts with a focus on linking costing, management accounting and quantitative methods to critical success factors and operational strategic objectives, whether financial, operational or with a social purpose.

## 10.1 Learning outcomes

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

(a) Understand and explain the concept of relevant costing

(b) Explain the terms, incremental cost, differential cost, committed cost, sunk cost and opportunity cost

(c) Identify relevant costs (revenues) in a variety of situations

## 10.2 The Concept of relevant cost and revenue costs

### 10.2.1 Information for decision-making

Management make decisions about the future. When they make decisions for economic or financial reasons, the objective is usually to increase profitability or the value of the business, or to reduce costs and improve productivity.

When managers make a decision, they make a choice between different possible courses of action (options), and they need relevant and reliable information about the probable financial consequences of the different options available. A function of management accounting is to provide information to help managers to make decisions, by providing estimates of the consequences of selecting any option.

Traditionally, cost and management accounting information was derived from historical costs (a measurement of actual costs). For example, historical costs are used to assess the profitability of products, and control reporting typically involves a comparison of actual historical costs with a budget or standard costs.

Accounting information for decision-making is different, because decisions affect the future, not what has already happened in the past. Accounting information for decision-making should therefore be based on estimates of future costs and revenues.

Decisions affect the future, but cannot change what has already happened. Decision-making should therefore look at the future consequences of a decision, 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

### 10.2.2 Marginal costing and decision-making

Marginal costing might be used for decision-making. For example, marginal costing is used for limiting factor analysis and linear programming.

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.

### 10.2.3 Relevant costs and decision-making

Relevant costs should be used for assessing the economic or financial consequences of any decision by management. Only relevant costs and benefits should be taken into consideration when evaluating the financial consequences of a decision.

A relevant cost is a future cash flow that will occur as a direct consequence of making a particular decision.

The key concepts in this definition of relevant costs are as follows:

(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.

(c) Relevant costs are **cash flows**. Notional costs, such as depreciation charges, notional interest costs and absorbed fixed costs, cannot be relevant to a decision.

### 10.2.4 Terms used in relevant costing

Several terms are used in relevant costing, to indicate how certain costs might be relevant or not relevant to a decision.

#### Incremental cost

An incremental cost is an additional cost that will occur if a particular decision is taken. Provided that this additional cost is a cash flow, an incremental cost is a relevant cost.

**Example: Incremental cost**

A company has identified that each cost unit it produces has the following costs:

| | ₦ '000 |
|---|---|
| Direct materials | 50 |
| Direct labour | 20 |
| | 70 |
| Fixed production overhead | 30 |
| Total absorption cost | 100 |

The incremental cost of making one extra unit is ₦70,000. Making one extra unit would not affect the fixed cost base.

The above example assumes that the fixed cost per unit is the result of overhead absorption and that making one extra unit does not affect the fixed cost of the company.

If making extra units would result in the business incurring new fixed costs, these would be incremental and must be included as a relevant cost in any decision making process.

**Example: Incremental fixed cost (stepped fixed costs)**

A company owns a factory which has the capacity to produce 100,000 units per annum.

The factory is operating at 80% of this capacity (i.e. 80,000 units per annum are being made but the company could make an additional 20,000 units if required).

The variable cost per unit is ₦60.

The company has received an enquiry to supply 30,000 units per annum for the next 5 years at a sales price of ₦100.

In order to fulfil this order the company would have to rent additional premises to make the 10,000 units which it is unable to make in its current premises.

The rent of the additional premises is a fixed cost but it is incremental to the project and must be included in the decision making process.

What would the decision be if the rent were:

| a) ₦300,000<br>b) ₦300,000?<br><br>Incremental annual amounts | **a**<br>₦ in '000 | | **b**<br>₦ in '000 |
|---|---|---|---|
| Revenue (10,000 units □ **₦100)** | 1,000 | | 1,000 |
| Variable costs (10,000 units □ **₦60)** | (600) | | (600) |
| | 400 | | 400 |
| Fixed costs | (300) | | (500) |
| | 100 | | (100) |
| Decision | Accept the offer | | Reject the offer |

Making and selling 10,000 extra units would generate extra contribution of

₦400,000. However, the company must also consider the incremental fixed costs in order to make the correct decision.

### 10.2.5 Differential 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 needs to hire a photocopier for the next six months. It has to decide whether to continue using a particular type of photocopier, which it currently rents for ₦2,000 each month, or whether to switch to using 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.

One way of analysing the comparative costs is to say that the larger copier will be more expensive to rent, by ₦1,600 each month for six months.

The differential cost of hiring the larger copier for six months would therefore be ₦9,600.

### 10.2.6 Avoidable and unavoidable costs

An avoidable cost is a cost that could be saved (avoided), depending whether or not a particular decision is taken. An unavoidable cost is a cost that will be incurred anyway.

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, because operations have been moved to another warehouse that has spare capacity.

If a decision is taken to close down the warehouse, the company 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 it would no longer need to hire the services of a security company to look after the empty building, which currently costs ₦40,000 each year.

The decision about whether to close down the unwanted warehouse should be based on relevant costs only.

Local taxes and the costs of the security services (₦56,000 in total for the next year) could be avoided and so these are relevant costs.

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.

### 10.2.7 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.

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.

### 10.2.8 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**

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.

This cost 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.

What would the decision be if the special job would generate a contribution of:

a) ₦15,000

b) ₦10,000?

| | A | | B |
|---|---|---|---|
| | ₦ | | ₦ |
| Contribution earned | 15,000 | | 10,000 |
| Contribution lost | (12,000) | | (12,000) |
| | 3,000 | | (2,000) |
| Decision | Accept the offer | | Reject the offer |

An opportunity cost is not an actual cost in the sense of an amount paid out as an expense. It is a comparative cost. In other words, it is a change in the overall cost that results from making one choice over another.

Similar comments can be made in respect of opportunity revenues (gains).

## 10.3 Identify and Calculate relevant costs for specific decision situations from given from given data

There are certain rules or guidelines that might help you to identify the relevant costs for evaluating any management decision.

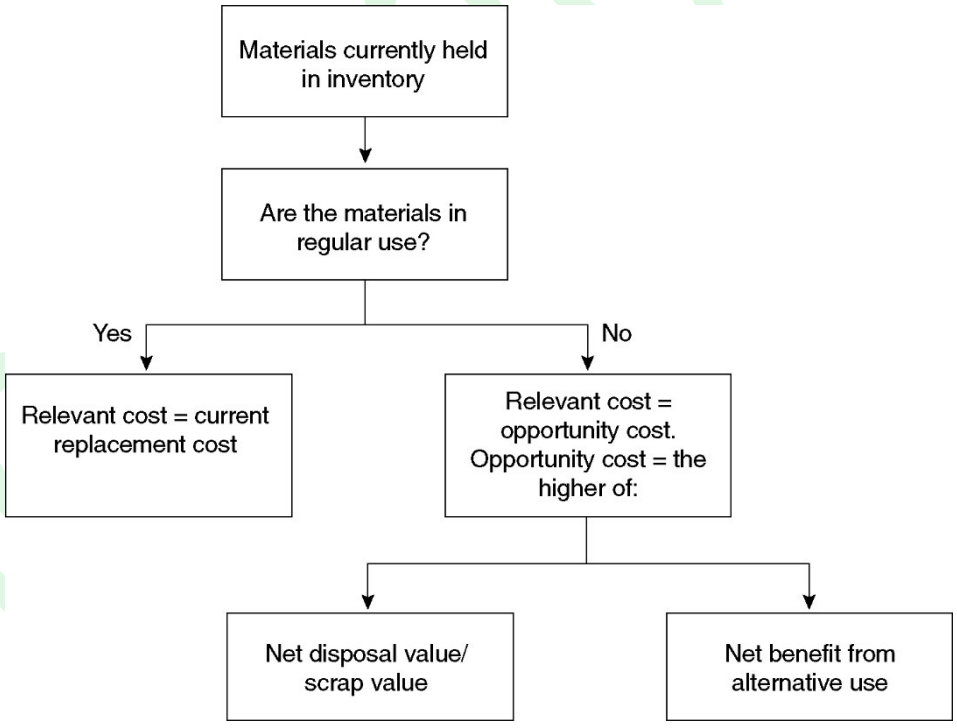
### 10.3.1 Relevant cost of materials

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 **none of the required materials are currently held as inventory**, the relevant cost of the materials is simply their purchase cost. In other words, the relevant cost is the cash that will have to be paid to acquire and use the materials.

If **the required materials are currently held as inventory**, the relevant costs are identified by applying the following rules:

**Illustration: Relevant cost of materials**




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.

(a) 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).

(b) 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 materials**

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.

The contract would also require 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 ₦144,000, and have a scrap value of ₦36,000. New purchases of material Y would cost ₦100 per kilogram.

The relevant costs of the materials, to assist management in identifying the minimum price to charge for the contract are as follows.

Material X

This is in regular use. Any units of the material that are held in inventory will have to be replaced for other work if they are used for the contract. The relevant cost is their replacement cost.

Relevant cost = replacement cost = 5,000 kilograms × ₦420 = ₦2,100,000.

**Material Y**

This 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 (scrap value) | 36,00 |
| 0 New purchases (500 □ ₦100) | 50,000 |

### 10.3.2 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.

a. **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 ₦180 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 N 180 per hour or N18,000 in total.

b. **If labour is a fixed cost and there is spare labour time available**, the relevant cost of using labour is zero. The spare time would otherwise be paid for 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 ₦200 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 zero. The 30 labour hours must be paid for whether or not the contract work is undertaken.

c. **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. The cost of an hour of labour would be the pay per hour plus the lost contribution.

**Example: Relevant cost of labour**

**Department 1.** The contract would require 200 hours of work in department 1, where the workforce is paid ₦160 per hour for a fixed 40-hour week. There is currently spare labour capacity in department 1 and there are no plans to reduce the size of the workforce in this department.

**Department 2.** The contract would require 100 hours of work in department 2 where 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.

**Department 3.** The contract would require 300 hours of work in department 3 where 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 |

**Required**

What is the relevant cost for the contract of labour in the three departments?

**Answer**

**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 = zero

**Department 2.** There is restricted labour capacity. If the contract is undertaken, there would be a choice between:

overtime work at a cost of ₦360 per hour (₦240 plus overtime premium of 50%) – this would be an additional cash expense, or

diverting the labour from other work, and losing contribution of ₦80 per hour – cost per hour = ₦240 basic pay + contribution forgone ₦80 = ₦320 per hour.

It would be better to divert the workforce from other work, and the relevant cost of labour is therefore 100 hours × ₦320 per hour = ₦32,000.

**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. |

| Summary of relevant costs of labour | |
|---|---|
| Department 1 | 0 |
| Department 2 | 32,000 |
| Department 3 | 102,000 |
| | 134,000 |

## 10.4 Relevant cost of overheads

Relevant costs of expenditures that might be classed 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.

## 10.5 Chapter review

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

(a) Understand and explain the concept of relevant costing

(b) Explain the terms, incremental cost, differential cost, committed cost, sunk cost and opportunity cost

(c) Identify relevant costs (revenues) in a variety of situation

**Practice** **1**

**1** A company bought a machine six years ago for ₦125,000. Its written down value is now ₦25,000. The machine is no longer used for normal production work, and it could be sold now for ₦17,500. A project is being considered that would make use of this machine for six months. After this time the machine would be sold for ₦10,000.

**Required**

Calculate the relevant cost of the machine to the project.

**2** A contract is under consideration which would require 1,400 hours of direct labour. There is spare capacity of 500 hours of direct labour, due to the cancellation of another order by a customer. The other time would have to be found by asking employees to work in the evenings and at weekends, which would be paid at 50% above the normal hourly rate of ₦15.

Alternatively, the additional hours could be found by switching labour from other work which earns a contribution of ₦5 per hour.

**Required**

Calculate the relevant cost of direct labour if the contract is accepted and undertaken.

## SOLUTIONS TO PRACTICE QUESTION

**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 contract is undertaken, labour will therefore be diverted from the other work.

It is assumed that the 500 hours of free labour time (idle time) available would be paid for anyway, even if the contract is not undertaken. The relevant cost of

| **Relevant cost of labour** | **₦** |
|---|---|
| 500 hours | 0 |
| 900 hours (× ₦20) | 18,000 |
| Total relevant cost of labour | 18,000 |

ICAN 2023

**Skills level**
**Performance management**




# COST-VOLUME-PROFIT (CVP) ANALYSIS

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## 11.0 Learning objectives

This chapter introduces candidates to cost volume profit analysis (CVP) It helps Candidate to provide cost, revenue and profit information that will help Management in decision making. It helps Candidate to also be in a position to select, calculate and present cost-volume-profit analyses based on a given data and information (including single and multiple products) using
both numerical and graphical techniques.

## 11.1 Learning outcome

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

(a) Calculate the number of units that must be sold to achieve break-even
(b) Calculate the revenue that must be earned to achieve break-even
(c) Calculate the margin of safety associated with a given level of production in terms of the number of units sold or revenue
(d) Calculate the number of units that must be sold to achieve a target profit
(e) Calculate the revenue that must be earned to achieve a target profit

## 11.2 The concept and nature of CVP analysis

### 11.2.1 Introduction to CVP analysis

CVP analysis stands for ***cost-volume-profit analysis***'. It is used to show how costs and profits change with changes in the volume of activity. CVP analysis is an application of marginal costing concepts.

This chapter explains CVP analysis and some of its applications.

### 11.2.2 Assumptions in CVP analysis

Costs are either fixed or variable. The variable cost per unit is the same at all levels of activity (output and sales). Total fixed costs are a constant amount in each period.

Fixed costs are normally assumed to remain unchanged at all levels of output.

The contribution per unit is constant for each unit sold (of the same product).

The sales price per unit is constant for every unit of product sold; therefore the contribution to sales ratio is also a constant value at all levels of sales.

If sales price per unit, variable cost per unit and fixed costs are not affected by volume of activity, sales and profits are maximised by maximising total contribution.

### 11.2.3 Contribution

Contribution is a key concept. Contribution is measured as sales revenue less variable costs.

Profit is measured as contribution minus fixed costs.

**Illustration:**

| | ₦ |
|---|---|
| Sales (Units sold × sales price per unit) | X |
| Variable costs (Units sold × variable cost price per unit) | (X) |
| Contribution | X |
| Fixed costs | (X) |
| Profit | X |

Total contribution = Contribution per unit × Number of units sold.

Many problems solved using CVP analysis use either contribution per unit (CPU) or the C/S (Contribution/Sales) ratio.

**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 ₦1per unit.

Total fixed costs (production, administration and sales and distribution fixed costs) are expected to be ₦500,000.

The selling price of the product is ₦16.

The profit at sales volumes of 70,000, 80,000 and 90,000 units can be calculated as follows

| | **70,000 units** | **80,000 units** | **90,000 units** |
|---|---|---|---|
| | ₦ | ₦ | ₦ |
| Sales revenue (₦16/unit) | 1,120,000 | 1,280,000 | 1,440,000 |
| Variable cost (₦9/unit) | (630,000) | (720,000) | (810,000) |
| Contribution (₦7/unit) | 490,000 | 560,000 | 630,000 |
| Fixed costs | (500,000) | (500,000) | (500,000) |
| Profit/(loss) | (10,000) | 60,000 | 130,000 |

**Notes**

A loss is incurred at 70,000 units of sales because total contribution is not large enough to cover fixed costs. Profit increases as sales volume increases, and the increase in profit is due to the increase in total contribution as sales volume increases.

Somewhere between 70,000 and 80,000 there is a number of units which if sold would result in neither a profit nor a loss. This is known as the break-even position.

The contribution line could have been completed without calculating the sales and variable costs by simply multiplying the quantity sold by the contribution pper 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 |
| | 32 |

| | 70,000 units ₦ | 80,000 units ₦ | 90,000 units ₦ |
|---|---|---|---|
| 70,000 ´ ₦7 per unit | 490,000 | | |
| 80,000 ´ ₦7 per unit | | 560,000 | |
| 90,000 ´ ₦7 per unit | | | 630,000 |
| Fixed costs | (500,000) | (500,000) | (500,000) |
| Profit/(loss) | (10,000) | 60,000 | 130,000 |

*C/S (Contribution/Sales) ratio*

The sales revenue in each case could be calculated by dividing the total contribution for a given level of activity by the C/S ratio.

**Formula: C/S ratio (contribution to sales ratio)**

$$\frac{\text{Contribution per unit}}{\text{Selling price per unit}}$$

**Example: C/S ratio Contribution to sales ratio:**

| | 70,000 units | 80,000 units | 90,000 units |
|---|---|---|---|
| | ₦ | ₦ | ₦ |
| Contribution (₦7/unit) | 490,000 | 560,000 | 630,000 |
| C/S 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.

**Calculate and interpret break-even analysis and margin of safety**

## 11.3 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:

(a) identify the minimum volume of sales that must be achieved in order to avoid a loss, or
(b) assess the amount of risk in the budget, by comparing the budgeted volume of sales with the break-even volume.

### *Two methods of calculating the break-even point*

There are a number of methods of calculating the break-even point when the total fixed costs for the period are known:

***Method 1: Break-even point expressed as a number of units.***

The first method is to calculate the break-even point using the contribution per unit. This method can be used where a company makes and sells just one product.

**Formula: Break-even point expressed as a number of units**

$$\text{Break-even point in sales units} = \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Total fixed costs are the same as the total contribution required to break even, and the break-even point can therefore be calculated by dividing the total contribution required (total fixed costs) by the contribution per unit.

Remember to include any variable selling and distribution costs in the calculation of the variable cost per unit and contribution per unit.

Once the break-even point is calculated as a number of units it is easy to express it in terms of revenue by multiplying the number of units by the selling price per item.

**Example: Break-even point as number of units**

A company makes a single product that has a variable cost of sales of ₦12 and a selling price of ₦20 per unit. Budgeted fixed costs are ₦600,000.

What volume of sales is required to break even?

$$\text{Break-even point in sales units} = \frac{\text{Total fixed costs}}{\text{Contribution per unit}}$$

Contribution per unit = ₦20 – ₦12 = ₦8

Therefore break-even point:

In units: ₦600,000/₦8 per unit = 75,000 units of sales.

### *Method 2: Break-even point expressed in sales revenue*

The second method calculates the break-even point in sales revenue.

**Formula: Break-even point expressed in sales revenue**

$$\text{Break-even point in revenue} = \frac{\text{Fixed costs}}{\text{Contribution to sales ratio}}$$

Once the break-even point is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.

**Example: Break-even point as revenue**

A company makes a single product that has a variable cost of sales of ₦12 and a selling price of ₦20 per unit. Budgeted fixed costs are ₦600,000.

What volume of sales is required to break even?

**Method 2**

$$\text{Break-even point in revenue} = \frac{\text{Total fixed costs}}{\text{C/S ratio}}$$

C/S ratio = ₦8/₦20 = 40%

Therefore break-even point:

In sales revenue = ₦600,000/0.40 = ₦1,500,000 in sales revenue.

In units = ₦1,500,000 ÷ ₦20 (sales price per unit) = 75,000 units.

### 11.3.1 Margin of safety

The margin of safety is the difference between:

(a) the budgeted sales (in units or ₦) and
(b) the break-even amount of sales (in units or ₦).
(c) It is usually expressed as a **percentage of the budgeted sales**. However, it may also be measured as:
(d) a quantity of units (= the difference between the budgeted sales volume in units and the break-even sales volume), or
(e) an amount of sales revenue (= the difference between the budgeted sales revenue and the total sales revenue required to break even).

It is called the margin of safety because it is the maximum amount by which actual sales can be lower than budgeted sales without incurring a loss for the period. A high margin of safety therefore indicates a low risk of making a loss.

**Example:**

A company budgets to sell 25,000 units of its product. This has a selling price of ₦16 and a variable cost of ₦4. Fixed costs for the period are expected to be ₦240,000.

The break-even point = ₦240,000/(₦16 – 4) = 20,000 units. The budgeted sales are 25,000 units.

Margin of safety = Budgeted sales – break-even sales
= 25,000 – 20,000 = 5,000 units

The margin of safety is often expressed as a percentage of budgeted sales.

Formula: Margin of safety ratio

$$\text{Margin of safety ratio} = \frac{\text{Margin of safety (units)}}{\text{Budgeted sales (units)}}$$

$$\text{Margin of safety ratio} = \frac{\text{Margin of safety (revenue)}}{\text{Budgeted revenue}}$$

**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.

### 11.3.2 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: Target volume 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**

$$\text{Target volume in revenue} = \frac{\text{Total fixed costs + target profit}}{\text{Contribution to sales ratio}}$$

Once the target volume is calculated as an amount of revenue it is easy to express it as a number of units by dividing the revenue by the selling price per item.

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**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:

₦700,000/₦4 per unit = 175,000 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 ¸ (4/9) = ₦1,575,000.

Therefore the number of units required to achieve target profit

₦1,575,000 ÷ ₦9 = 175,000 units

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***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%.

**Require**

**d**

Calculate

:

(i) the monthly fixed costs
(ii) the level of monthly sales needed to increase the monthly profit to ₦5,000.

### 11.3.1 Break-even chart for single product

A break-even chart is a chart or graph showing, for all volumes of output and sales:

(a) total costs, analysed between variable costs and fixed costs
(b) sales
(c) profit (the difference between total sales and total costs)
(d) the break-even point (where total costs = total sales revenue, and profit = zero).

The concept of a break-even chart is similar to a cost behaviour chart, but with sales revenue shown as well.

If the chart also indicates the budgeted volume of sales, the margin of safety can be shown as the difference between the budgeted volume and the break-even volume of sales.

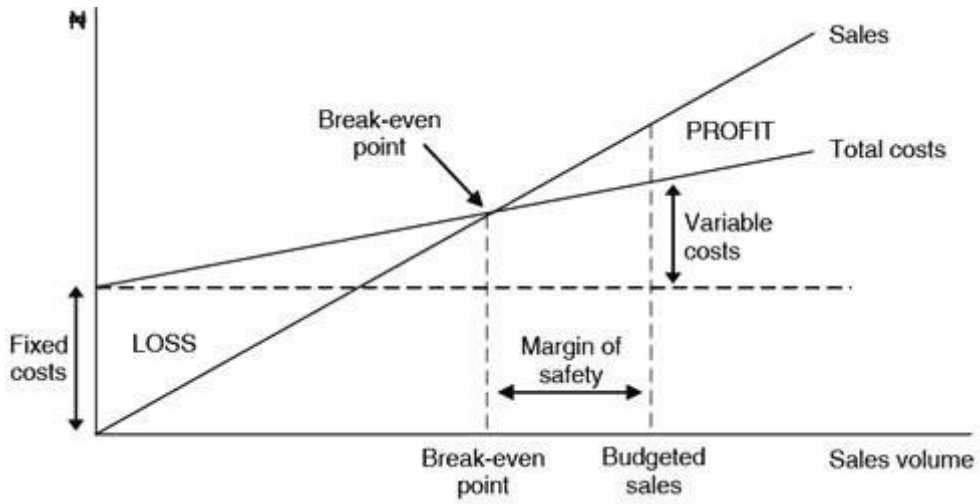
Two examples of break-even charts are shown below. The only difference between them is the way in which variable costs and fixed costs are shown.

(a) 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 sales of ₦0. Total costs are shown as the sum of fixed costs and variable costs.
(b) 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.
(c) Total costs are exactly the same in both diagrams.

Because the sales price per unit is constant, the total sales revenue line rises in a straight line from the origin of the graph (i.e. from x = 0, y = 0).

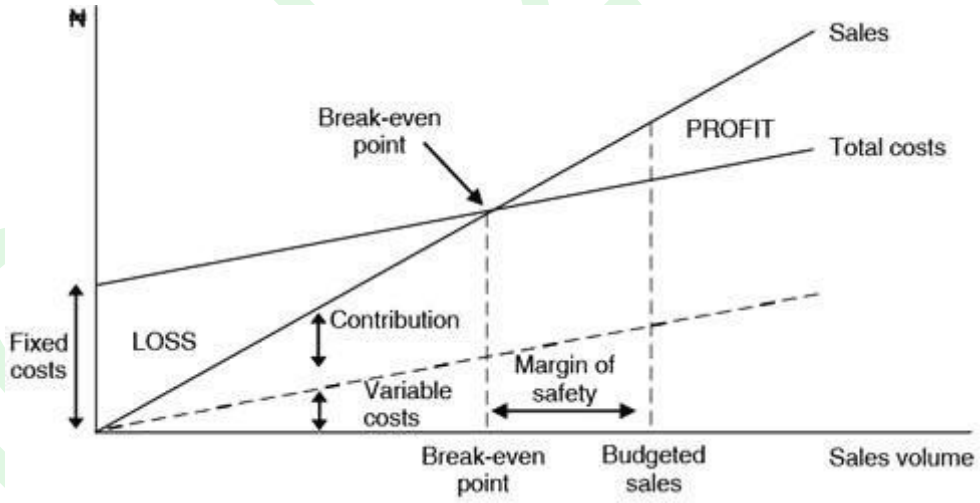
### *First break-even chart: variable costs on top of fixed costs*

**Illustration:**




### Second break-even chart: fixed costs on top of variable costs

**Illustration:**




### Points to note

You should be able to identify the following points on these charts.

(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.

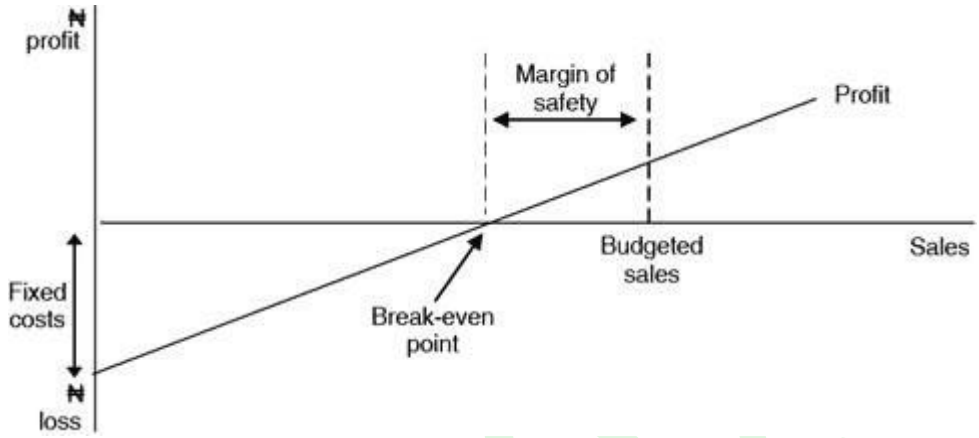
(c) If budgeted sales are shown on the chart, the margin of safety can also be show, as the difference between budgeted sales and the break-even point.

### 11.4.2 Profit/volume chart (P/V chart)

A profit volume chart (or P/V chart) is an alternative to a break-even chart for presenting CVP information. It is a chart that shows the profit or loss at all levels of output and sales.

An example is shown below.

**Illustration:**




At ₦0 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.

We could draw a line 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 ₦0 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**

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.

**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.

## 11.4 Multi-Product CVP Analysis

### 11.5.1 Introduction to multi-product break-even analysis

So far we have assumed that the company is making and selling a single product. The techniques can be extended to multi-product situations. However, in order to do this we need to make a further assumption (which might seem very unrealistic).

This assumption is that products are sold in a set ratio which does not change with volume. This assumption allows us to tackle similar problems to those dealt with above in one of two ways. We could either use:

(a) weighted average contribution per unit and weighted average C/S ratio per unit; or

(b) contribution per batch and weighted average C/S ratio for the batch (assuming that goods are sold in the budgeted sales mix).

Note that there will be a single weighted average C/S ratio whether it is calculated using average units or from a batch. Problems will be solved using each of these in turn.

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## 11.5.2 Multi-product break-even analysis – weighted average unit approach

### Weighted average contribution per unit

**Example: Multi-product break-even using weighted average contribution per unit** The following budget information refers to the two products of a company.

| | X | Y | |
|---|---|---|---|
| Sales price per unit | 100 | 120 | |
| Variable cost per unit | (75) | (111) | |
| Contribution per unit | | | 25 |
| Sales volume | | | 15,000 |
| Sales mix | | | 3 |
| Fixed costs | | | |

The number of units at which the company will break even using the average contribution per unit is calculated as follows:

| | ₦ | ₦ | ₦ |
|---|---|---|---|
| Contribution per unit | 25 | 9 | |
| Sales mix | 15,000 | 5,000 | |
| Contribution | 375,000 | 45,000 | 420,000 |

Therefore, the weighted average contribution per unit is:

₦420,000/20,000 units = ₦21 per unit

**Break-even as a number of units is given by:**

Fixed costs/Contribution per unit = ₦315,000/₦21 = 15,000 units These units are in the ratio of 3:1

The break-even in revenue can be found by multiplying the number of units above (15,000) by the weighted average revenue as follows:

| | ₦ | ₦ | ₦ |
|---|---|---|---|
| Revenue per unit | 100 | 120 | |
| Sales mix | 15,000 | 5,000 | |
| Revenue | 1,500,000 | 600,000 | 2,100,000 |

Therefore, the weighted average revenue per unit is:

₦2,100,000/20,000 units = ₦105 per unit

The break-even revenue is therefore 15,000 units ´ ₦105 = ₦1,575,000

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The break-even sales volume of 15,000 units and the break-even revenue of ₦1,575,000 are totals for X and Y together. The next step is to work out the numbers for X and Y individually.

The 15,000 units are made up of units of X and Y in the ratio of 3 to 1. The ratio can be used to pro-rate the total to find the number of units of X and the number of units of Y sold at the break-even point.

The selling price for X and for Y can then be applied to these figures to arrive at the revenue from selling X and the revenue from selling Y.

**Example (continued): Multi-product break-even using weighted average contribution per unit**

Following on from the above:

The calculations of the sales volume of X and Y and the revenue from those sales are calculated as follows:

| | | Units | |
|---|---|---|---|
| | **Units** | **X (3 of 4)** | **Y (1 of 4)** |
| Break-even | 15,000 | | |
| Revenue per unit | | ₦1,125,000 | ₦450,000 = ₦1,575,000 |

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| | | | |
|---|---|---|---|
| 11,250<br>₦100 | | | 3,750<br>₦120 |
| | | | |

**Example (continued): Multi-product break-even using weighted average contribution per unit**

Following on from the above:

The calculations of the sales volume of X and Y and the revenue from those sales are calculated as follows:

| | | Units | |
|---|---|---|---|
| | **Units** | **X (3 of 4)** | **Y (1 of 4)** |
| Break-even | 15,000 | | |
| Revenue per unit | | | |
| Revenue | | ₦1,125,000 | ₦450,000 = ₦1,575,000 |

***Weighted average C/S ratio***

**Example: Multi-product break-even using weighted average C/S ratio**

The weighted average C/S ratio can be calculated as follows:

| **Total contribution** | **₦** | **₦** | **₦** |
|---|---|---|---|
| Contribution per unit | 25 | 9 | |
| Sales mix | 15,000 | 5,000 | |
| Contribution | 375,000 | 45,000 | 420,000 |
| | | | |
| **Total revenue** | **₦** | **₦** | **₦** |
| Revenue per unit | 100 | 120 | |
| Sales mix | 15,000 | 5,000 | |
| Revenue | 1,500,000 | 600,000 | 2,100,000 |

Weighted average C/S ratio ₦420,000/₦2,100,000 = 0.20

**Break-even in revenue is given by**

The break-even revenue of ₦1,575,000 is the total for X and Y together. The next step is to work out the numbers for X and Y individually.

The total budgeted revenue of 2,100,000 (see the workings above) is made up of revenue from X of 1,500,000 and revenue from Y of 600,000. The same ratios are assumed to apply to all sales volumes. Therefore, the break-even revenue can be prorated on this basis to find the revenue from X and the revenue from Y at the break-even point. These figures can then be divided by the budgeted revenue for each to calculate the number of units of each sold at break-even.

The selling price for X and for Y can then be applied to these figures to arrive at the revenue from selling X and the revenue from selling Y.

**Example (continued): Multi-product break-even using weighted average C/S ratio**

Following on from the above:

The calculations of the revenue from sales of X and Y and the number of units sold to achieve these revenue figures are calculated as follows:

| | | X ($^{1,500}/_{2,100}$) | Y ($^{600}/_{2,100}$) | |
|---|---|---|---|---|
| | **Revenue** | | | |
| Break-even Revenue | ₦1,575,000 | ₦1,125,000 | ₦450,000 | |
| Revenue per unit | | ₦100 | ₦120 | |
| Units | | 11,250 | 3,750 | 15,000 |

### 11.5.3 Multi-product break-even analysis – Batch approach

#### Contribution per batch

This approach uses the contribution from a batch of items to calculate the number of batches that must be sold in order to break-even. Once this is known the budgeted sales mix can be applied to provide information at the unit level.

Formula: Break-even point for batches

$$\text{Break-even point in batches} = \frac{\text{Total fixed costs}}{\text{Contribution per batch}}$$

$$\text{Break-even point in revenue} = \frac{\text{Total fixed costs}}{\text{CS ratio for the batch}}$$

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Example: Multi-product break-even using contribution per batch

The following budget information refers to the two products of a company.

| | X | Y |
|---|---|---|
| Sales price per unit | 100 | 120 |
| Variable cost per unit | (75) | (111) |
| Contribution per unit | 25 | 9 |
| Sales volume | 15,000 | |
| Sales mix | 3 | 1 |
| Fixed costs | | |

The number of units at which the company will break even using the average contribution per batch is calculated as follows:

| **Batch** | ₦ | ₦ | ₦ |
|---|---|---|---|
| Contribution per unit | 25 | 9 | |
| Sales mix | 3 | 1 | |
| Contribution (single batch) | 75 | 9 | 84 |

Therefore, the contribution from selling a single batch is ₦84.
Break-even as a number of batches is given by:

Fixed costs/Contribution per batch = ₦315,000/₦84 = 3,750 batches

The break-even in revenue can be found by using the weighted average revenue per batch.

| | ₦ | ₦ | ₦ |
|---|---|---|---|
| Revenue per unit | 100 | 120 | |
| Sales mix | 3 | 1 | |
| Revenue (single batch) | 300 | 120 | 420 |

Therefore, the revenue from selling a single batch is ₦420.

The break-even revenue is therefore 3,750 batches ´ ₦420 = ₦1,575,000

The next step is to identify the number of units of X and Y in 3,750 batches and how much revenue is generated by each.

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**Example (continued): Multi-product break-even using contribution per batch**

Following on from the above: The calculations of the number of units of X and Y in 3,750 batches and the revenue from selling each are as follows:

| **Units** | **Batches** | **X (3 per batch)** | **Y (1 per batch)** | |
|---|---|---|---|---|
| Break-even | 3,750 | 11,250 | 3,750 | |
| Revenue per unit | | ₦100 | ₦120 | |
| Revenue | | 1,125,000 | 450,000 | = 1,575,000 |

Alternatively, the break-even in revenue for X and Y can be found by using the weighted average revenue per batch and these figures could be divided by the revenue per unit to arrive at the numbers of units.

| | **Total** | **X (300/420)** | **Y (120/420)** |
|---|---|---|---|
| Break-even revenue | ₦1,575,000 | ₦1,125,000 | ₦450,000 |
| Revenue per unit | | ÷₦100 | ÷₦120 |
| Number of units | | 11,250 | 3,750 |

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### *C/S ratio using a batch*

**Example:**

The following budget information refers to the two products of a company.

| | X | Y | |
|---|---|---|---|
| Sales price per unit | 100 | 120 | |
| Variable cost per unit | (75) | (111) | |
| Contribution per unit | 25 | 9 | |
| Sales volume | 15,000 | 5,000 | |
| Sales mix | 3 | 1 | |
| Fixed costs | | | 315,000 |

The break-even revenue using the average C/S ratio for the batch can be calculated as follows:

| | ₦ | ₦ | ₦ |
|---|---|---|---|
| Sales price per unit | 100 | 120 | |
| Sales mix | 3 | 1 | |
| Revenue (single batch) | 300 | 120 | 420 |
| Contribution per unit | 25 | 9 | |
| Sales mix | 3 | 1 | |
| Contribution (single batch) | 75 | 9 | 84 |

Weighted average CS ratio: ₦84/₦420 = 0.20 (Note that ₦300 out of every ₦420 will be revenue from selling X and ₦120 from selling Y).

| | Revenue | X ($^{300}/_{420}$) | Y ($^{120}/_{420}$) | |
|---|---|---|---|---|
| Break-even Revenue | ₦1,575,000 | | | |
| per unit | | | | |
| Units | | 11,250 | 3,750 | 15,000 |

| | |
|---|---|
| ₦1,125,000 | ₦450,000 |
| ÷ ₦100 | ÷ ₦120 |

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**Practice question** **3**

X Ltd has budgeted fixed overheads of ₦6,000,000 for the next period. X Ltd is preparing a budget to sell three products.

Calculate the number of units that X Ltd must sell in order to break even and calculate the total revenue at that point.

| | P | Q | R | Total |
|---|---|---|---|---|
| Sales volumes (units) | 10,000 | 6,000 | 4,000 | 20,000 |
| Sales mix ratio | 10 | 6 | 4 | |
| Sales mix as % | 50% | 30% | 20% | |
| Sales price per unit (₦) | 250 | 400 | 1600 | |
| Budgeted revenue (₦) | 2,500,000 | 2,400,000 | 6,400,000 | 11,300,000 |
| Contribution per unit (₦) | 150 | 250 | 800 | |
| Budgeted total contribution (₦) | 1,500,000 | 1,500,000 | 3,200,000 | 6,200,000 |

## Margin of safety

The margin of safety is calculated in the same way as for single products by comparing the budgeted activity level to the break-even. The break-even point can be compared to the budgeted activity level using batches, units or revenue.

This will be illustrated using the previous example.

**Example: Margin of safety**

Continued….

Margin of safety

| | Batches | Units | Revenue (₦) |
|---|---|---|---|
| Budgeted activity | 5,000 | 20,000 | 2,100,000[1] |
| Break-even point | 3,750 | 15,000 | 1,575,000 |
| Margin of safety | 1,250 | 5,000 | 525,000 |
| Margin of safety as percentage of sales | 25% | 25% | 25% |

[1] Budgeted revenue = (₦100 × 15,000) + (₦120 × 5,000) = ₦2,100,000

### 11.6.1 Target profit

The target profit is calculated in the same way as for single products. The necessary contribution to earn the target profit is the target profit plus the fixed costs. The activity level required to achieve the necessary contribution may be found using contribution per unit, contribution per batch or the CS ratio.

This will be illustrated using the previous example.

**Example: target profit**

Continued….

The company wishes to make a profit of ₦189,000 on a fixed cost base of ₦315,000

| | |
|---|---|
| Average contribution per batch | = ₦84 |
| Average contribution per unit | = ₦21 |
| Weighted average CS ratio | = 0.20 |

| **Target profit** | **Batches** | **Units** | **Revenue** |
|---|---|---|---|
| Target profit | | | |
| (₦189,000 + ₦315,000) | ₦504,000 | ₦504,000 | ₦504,000 |
| Contribution per batch | ₦84 | | |
| Contribution per unit | | ₦21 | |
| C/S ratio | | | ÷0.20 |
| | 6,000 | 24,000 | ₦2,520,000 |
| Sales (units) of X | | | |
| 3 in each batch; or | 18,000 | | |
| 3 out of 4 units | | 18,000 | |
| Sales (units) of Y | | | |
| 1 in each batch; or | 6,000 | | |
| 1 out of 4 units | | 6,000 | |

| **Proof of revenue** | **X** | **Y** | |
|---|---|---|---|
| Units to be sold | 18,000 | 6,000 | |
| Selling price per unit | 100 | 120 | |
| Revenue | 1,800,000 | 720,000 | ₦2,520,000 |

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### 11.6.2 Multi-product break-even charts

A break-even chart can be drawn for a company selling more than one product.

Such charts are usually drawn as a profit–volume graph.

The graph usually contains a plot of two lines:

- One line is based on the assumption that the most profitable good is sold first then the second most profitable and so on. This is a bow shaped line.
- The second line is based on the assumption that goods are sold in the budgeted mix. This is a straight line. Break-even is where this line crosses the horizontal axis.

The following steps must be taken in order to draw the graph:

**Step 1:** Calculate the C/S ratio of each product being sold.

**Step 2:** Rank the products in order of profitability.

**Step 3:** Draw a table showing the following:

| Product (in order of profitability) | Revenue (from sales in this order) | Cumulative revenue | Contribution | Cumulative profit/(loss) |
|---|---|---|---|---|
| | nil | nil | nil | (fixed cost) |
| A | X | X | X | X |
| B | X | X | X | X |
| C | X | X | X | X |

**Step 4**: Construct the graph as a plot of cumulative revenue against cumulative profit/(loss).

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Example: Multi-product break-even chart

The following budget information refers to the two products of a company.

| | X | Y | |
|---|---|---|---|
| Sales volume | 15,000 | 5,000 | |
| Sales price per unit | 100 | 120 | |
| Revenue | 1,500,000 | 600,000 | |
| Contribution per unit | 25 | 9 | |
| Contribution | 375,000 | 45,000 | |
| Fixed costs | | | 315,000 |

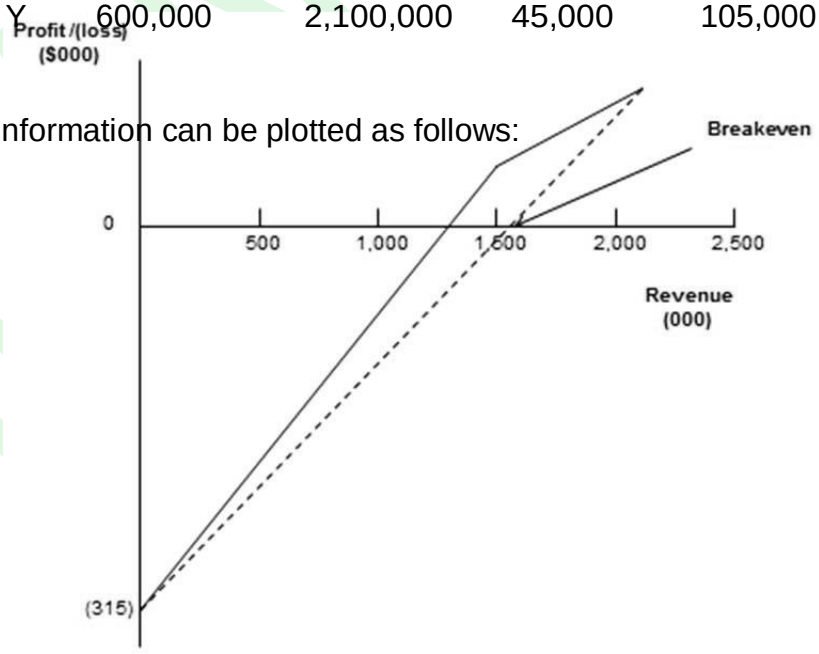
A profit volume chart to show the break-even point can be constructed as follows:

| **Step 1: C/S ratio** | ₦ | ₦ |
|---|---|---|
| Sales price per unit | 100 | 120 |
| Contribution per unit | 25 | 9 |
| C/S ratio | 0.25 | 0.075 |
| **Step 2: Ranking** | 1 | 2 |

**Step 3: Profit volume chart**

| Product | Revenue | Cumulative revenue | Contribution | Cumulative profit or loss |
|---|---|---|---|---|
| | | | | (315,000) |
| X | 1,500,000 | 1,500,000 | 375,000 | 60,000 |
| Y | 600,000 | 2,100,000 | 45,000 | 105,000 |

This information can be plotted as follows:



## 11.6 Discuss the importance and limitation of CVP analysis

### (a) Importance of CVP analysis

The profit made by an organisation is a function of sales volume, selling price, variable cost per unit and fixed costs.

CVP analysis provides a valuable insight into the relationship between costs, revenues and profit at various levels of activity. This can focus attention on those factors which might be controllable and which might have an impact on profit.

It allows a manager to understand the profit impact of decisions under consideration. For example, a manager could use the model to understand the profit impact of dropping selling price in order to try to increase sales volume (subject, of course, to the availability of information on the relationship between price and volume). Thus, CVP analysis can provide important information for:

(a) sales strategies;
(b) cost control; and
(c) decision making.

It allows managers to understand the minimum number of items that need to be sold (given the information about sales price and costs) in order to generate profit. This can be very useful when launching new products.

CVP analysis provides a focus on the effects of differing levels of activity on the financial results of a business. Production costs are often known with a degree of accuracy but sales volume is much more difficult to predict. It is relatively straight forward for managers to flex the model to show the possible impact of different sales volumes in the future.

### (b) Limitations and weaknesses of CVP analysis

CVP analysis rests on a series of simplifying assumptions. These assumptions are a weakness of the technique to the extent that they may not hold true in reality.

| Assumptions | Comment |
|---|---|
| Costs are either fixed or variable and can be identified. | It can be difficult to classify costs as either fixed or variable. Some costs are semi-variable in nature. |
| The variable cost per unit is constant at all levels of output | This might be true over a given range, but the analysis might provide answers outside the range. For example, the management might be confident of the variable cost per unit up to 10,000 units per annum, but a target profit might require production of 15,000 units thus undermining the analysis.<br><br>Variable cost per unit might be affected by the level of activity. For example, if a factory is operating near capacity it might be necessary |

| | |
|---|---|
| | to pay workers an overtime premium to fulfil new orders.<br>On the other hand, the assumption ignores the possibility of possible economies of scale at higher levels of activity. |
| Total fixed costs are constant at all levels of output. | This might be true over a given range but the analysis might provide answers outside the range.<br>This ignores the possibility of possible economies of scale at higher levels of activity. |
| The sales price per unit is constant for every unit of product sold. | Sales price is often adjusted to take account of market conditions. This would undermine decisions taken on the basis of the original analysis. |
| Companies make and sell a single product or several products in constant ratios to each other | Neither of these assumptions would hold out in practice. |

Furthermore, CVP analysis ignores the uncertainty inherent in the estimates of costs and revenues.

## 11.7 Chapter review

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

(a) Calculate the number of units that must be sold to achieve break-even

(b) Calculate the revenue that must be earned to achieve break-even

(c) Calculate the margin of safety associated with a given level of production in terms of the number of units sold or revenue

(d) Calculate the number of units that must be sold to achieve a target profit

**(e)** Calculate the revenue that must be earned to achieve a target profiz

## SOLUTIONS TO PRACTICE QUESTIONS

**Solution 1**

Contribution per unit = 60% × ₦80 = ₦48Fixed costs = ₦360,000

Break-even point = ₦360,000/₦48 per unit = 7,500 units Budgeted sales = 8,000 units

Margin of safety = (8,000 – 7,500) units = 500 units

**2a** Contribution per unit = ₦50 – ₦20 = ₦30

Contribution/sales ratio = 60%

Therefore variable costs/sales ratio = 40%.

Variable cost per unit = ₦20

Therefore sales price per unit = ₦20/0.40 = ₦50.

| | ₦ |
|---|---|
| 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/₦32 per unit = 8,125 units.

**Solutions 1**

**3** (a) 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 = 2,000 units.

(b) (i) The margin of safety is 6.25%. Therefore the break-even volume of sales = 93.75% of budgeted sales = 0.9375 × ₦128,000 = ₦120,000

| | **Budget** | **Break-even** |
|---|---|---|
| | **₦** | **₦** |
| Sales | 128,000 | 120,000 |
| Profit | 2,000 | 0 |
| Total costs | 126,000 | 120,000 |

| | **₦ 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 |

This gives us the information to calculate fixed and variable costs, using high/low analysis.

Therefore: variable costs = ₦6,000/₦8,000 = 0.75 or 75% fof 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 cost | 30,000 |

**Solution** **1**

**Alternative approach**

**3** (ii) At sales of ₦128,000, profit is ₦2,000.

The contribution/sales ratio = 100% – 75% = 25% or 0.25.

To increase profit by ₦3,000 to ₦5,000 each month, the increase in sales must be:

(Increase in profit and contribution) ÷ C/S ratio

= ₦3,000/0.25 = ₦12,000.

Sales must increase from ₦128,000 (by ₦12,000) to ₦140,000 each month.

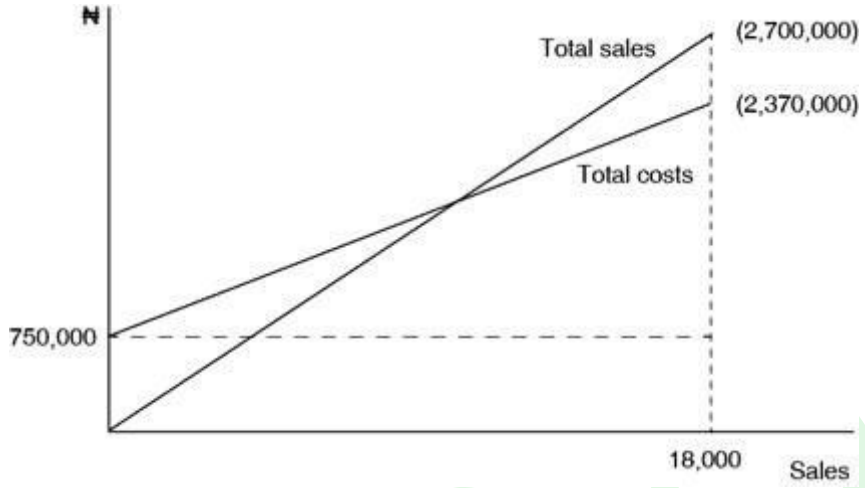
**Alternative approach to the answer**

| | ₦ |
|---|---|
| Target profit | 5,000 |
| C/S ratio | 0.25 |
| Therefore sales required (₦35,000/0.25) | ₦140,000 |

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Solutions 2

(a)




**Workings**

| | Sales | Sales (at ₦150) | Profit |
|---|---|---|---|
| | units | ₦ | ₦ |
| | 18,000 | 2,700,000 | 330,000 |
| | 12,000 | 1,800,000 | (30,000) |
| Difference | 6,000 | 900,000 | 360,000 |

An increase in sales from 12,000 units to 18,000 units results in an increase of ₦900,000 in revenue and ₦360,000 in contribution and profit.

From this, we can calculate that the contribution is ₦60 per unit (₦360,000/6,000) and the C/S ratio is 0.40 (₦360,000/₦900,000). Variable costs are therefore 0.6 or 60% of sales.

To draw a break-even chart, we need to know the fixed costs. **Substitute in high or low equation**

| When sales are 18,000 units: | ₦ |
|---|---|
| Sales (at ₦150 each) | 2,700,000 |
| Variable cost (sales ´ 60%) | 1,620,000 |
| Contribution (sales ´ 40%) | 1,080,000 |
| Profit | 330,000 |
| Therefore fixed costs | 750,000 |

| **When sales are 18,000 units:** | ₦ |
|---|---|
| Fixed costs | 750,000 |
| Variable cost (see above) | 1,620,000 |
| Total costs | 2,370,000 |

| | | |
|---|---|---|
| 9,677.5<br>₦250 | 5,806.5<br>₦400 | 3871<br>₦1,600 |

**Solution (continued)** **2**

(b) 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 are 15,000 units, the margin of safety is 2,500 units (15,000 – 12,500).

This is 1/6 or 16.7% of the budgeted sales volume.

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**Skills level**
**Performance management**




# LIMITING FACTORS DECISION

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## 12.0 Learning objective

This chapter introduces This chapter explains the concept of limiting factors, how to identify them and how to formulate an optimum production plan when there is a single limiting factor and how to determine linear programming models when two or more constraints are involved.

## 12.1 Learning outcomes

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

(a) explain the issue of limiting factors;
(b) identify limiting factors;
(c) carry out limiting factor analysis to formulate an optimal production plan (i.e. the production plan that maximises contribution and hence profit) in circumstances where there is a single limiting factor;
(d) determine how to solve linear programming issues graphically and by simultaneous equation; and
(e) determination of dual prices , prices and use of final tableau to determine final output from simplex results.

## 12.2 Identify Limiting factor in scarce resources situation and select appropriate techniques for allocation of the scarce resource(s).

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.

**Definition: Limiting factor**

The item that restricts or constraints the production or sale of a product or service.

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.

### 12.2.1 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.

| Product | X | Y | available |
|---|---|---|---|
| Machine type 1 | 10 minutes per unit | 6 minutes per unit | 3,000 hours |
| | (6 per hour) | (10 per hour) | |
| Machine type 2 | 5 minutes per unit | 12 minutes per unit | 4,200 hours |
| | (12 per hour) | (5 per hour) | |
| Sales demand in units | 12,000 | 15,000 | |

The time taken to make each product together with the maximum machine time availability and contribution per unit and demands are as follows:

| | 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

## 12.3 Maximising profit when there is a single limiting factor

When there is just one limiting factor (other than sales demand), total profit will be maximised in a period by maximising the total contribution earned with the available scarce resources.

The approach is to select products for manufacture and sale according to the contribution per unit of scarce resource in that product.

**Step 1:** Calculate the contribution per unit of each type of good produced.

**Step 2:** Identify the scarce resource.

**Step 3:** Calculate the amount of scarce resource used by each type of product.

**Step 4:** Divide the contribution earned by the scarce resource used by that product (project or item of goods) to give the contribution per unit of scarce resource for that product (project or item of goods).

**Step 5:** Rank the products (projects or items of 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 | available |
|---|---|---|---|
| Machine type 1 | 10 minutes per unit | 6 minutes per unit | 3,000 hours |
| | (6 per hour) | (10 per hour) | |
| Machine type 2 | 5 minutes per unit | 12 minutes per unit | 4,200 hours |
| | (12 per hour) | (5 per hour) | |
| 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*

| | | 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 in 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 per hour). This means that only 9,000 units of X can be made (found as 1,500 units ´ 1,500 hours/2,000 hours).

**Practice question** **1**

A company makes four products, A, B, C and D, using the same direct labour work force on all the products.

The company has no inventory of finished goods.

Direct labour is paid ₦12 per hour.

To meet the sales demand in full would require 12,000 hours of direct labour time.

Only 6,000 direct labour hours are available during the year.

Budgeted data for the company is as follows:

| Product | A | B | C | D |
|---|---|---|---|---|
| Annual sales demand (units) | 4,000 | 5,000 | 8,000 | 4,000 |
| | ₦ | ₦ | ₦ | ₦ |
| Direct materials cost | 3.0 | 6.0 | 5.0 | 6.0 |
| Direct labour cost | 6.0 | 12.0 | 3.0 | 9.0 |
| Variable overhead | 2.0 | 4.0 | 1.0 | 3.0 |
| Fixed overhead | 3.0 | 6.0 | 2.0 | 4.0 |
| Full cost | 14.0 | 28.0 | 11.0 | 22.0 |
| Sales price | 15.5 | 29.0 | 11.5 | 27.0 |
| Profit per unit | 1.5 | 1.0 | 0.5 | 5.0 |

Calculate the optimal production plan

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**Practice question**

A company makes four products, W, X, Y and Z, using the same direct material in the manufacture of all the products.

Budgeted data for one month is as follows: **2**

| **Product** | **W** | **X** | **Y** | **Z** |
|---|---|---|---|---|
| Monthly sales demand (units) | 400 | 400 | 600 | 300 |
| | ₦ | ₦ | ₦ | ₦ |
| Direct materials cost | 500 | 400 | 800 | 600 |
| Direct labour cost | 400 | 600 | 300 | 500 |
| Variable overhead | 100 | 150 | 75 | 125 |
| Fixed overhead | 800 | 1200 | 600 | 1,000 |
| Full cost | 1,800 | 2,350 | 1,775 | 2,225 |
| Sales price | 5,000 | 3,150 | 5,975 | 5,425 |
| Profit per unit | 3,200 | 800 | 4,200 | 3,200 |

Due to restricted supply, only ₦780,000 of direct materials will be available during the month.

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.

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**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)

| | | | |
|---|---|---|---|
| 6/12 | 12/12 | 3/12 | 9/12 |

**Step 3:** Labour hours per unit (total labour cost/labour cost per

| | | | |
|---|---|---|---|
| 0.5 | 1 | | 0.25 |

**Step 4: Contribution per hour** (contribution per unit/ labour hours per unit

| | | | |
|---|---|---|---|
| 4.5/0.5 = 9 | 7/1 = 7 | 2.5/0.25 = 10 | 9/0.75 = 12 |

Contribution per hour (₦)

**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 |

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**Solution (continued)** **1**

**Note: The plan is constructed as follows.**

D is ranked first so the company needs to make as many of these as possible. The most it can sell is 4,000 units 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 these that can be sold is 4,000 units. However, this would use 2,000 hours

**Solution** **2**

| | W | X | Y | Z |
|---|---|---|---|---|
| | ₦ | ₦ | ₦ | ₦ |
| Sales price/unit | 5,000 | 3,150 | 5,975 | 5,425 |
| Variable cost/unit | 1,000 | 1,150 | 1,175 | 1,225 |
| Contribution per unit | 4,000 | 2,000 | 4,800 | 4,200 |
| Direct materials per unit (₦) | 500 | 400 | 800 | 600 |
| ₦ 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 | Direct materials | Sales units | Contribution per unit | Total contribution |
|---|---|---|---|---|
| | ₦ | | ₦ | ₦ |
| W (1st) | 200,000 | 400 | 4,000 | 1,600,000 |
| Z (2nd) | 180,000 | 300 | 4,200 | 1,260,000 |
| Y (3rd) - balance | 400,000 | 500 | 4,800 | 2,400,000 |
| | 780,000 | | | 5,260,000 |

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## 12.5 Formulate and solve multiple scarce resources problems using both linear programming , graphs and simultaneous equations as appropriate

### 12.5.1 Linear Programming in decision making

### 12.5.2 Two or more limiting factors

There may be more than one scarce resource or limiting factor. When there is more than one limiting factor (other than sales demand for the products), the contribution-maximising plan cannot be identified simply by ranking products in order of contribution per unit of limiting factor, because the ranking provided by each limiting factor could be different.

The problem is still to decide what mix of products should be made and sold in order to maximise profits. It can be formulated and solved as a linear programming problem.

Linear programming is a mathematical method for determining a way to achieve the best outcome (such as maximum profit or lowest cost) subject to a number of limiting factors (constraints).

(a) A linear programming problem involves maximising or minimising a linear function (the objective function) subject to linear constraints.
(b) Both the constraints and the "best outcome" are represented as linear relationships.

What constitutes the best outcome depends on the objective. The equation constructed to represent the best outcome is known as the objective function.

Typical examples would be to work out the maximum profit from making two sorts of goods when resources needed to make the goods are limited or the minimum cost for which two different projects are completed.

***Overall approach***

Formulate the problem:

(a) **Step 1:** Define variables.
(b) **Step 2:** Formulate the objective function
(c) **Step 3:** Formulate the constraints. Solve the problem
(d) **Step 4:** Plot the constraints on a graph
(e) **Step 5:** Identify the feasible region. This is an area that represents the combinations of x and y that are possible in the light of the constraints.
(f) **Step 6:** Identify the values of ***x*** and ***y*** that lead to the optimum value of the objective function. This might be a maximum or minimum value depending on the objective. There are different methods available to find this combination of values of ***x*** and ***y***.

This chapter will firstly discuss some of the above steps in a little more detail before continuing to demonstrate their full use to solve a problem.

### 12.5.3 Formulating constraints

#### Define variables

The first step in any formulation is to define variables for the outcome that you are trying to optimise. For example, if the question is about which combination of products will maximise profit, a variable must be defined for the number of each type of product in the final solution.

The defined variable can then be sued to formulate the objective function and constraints. This section is going to say a little more about the formulation of constraints.

#### Construct constraints

A separate constraint must be identified for each item that might put a limitation on the objective function.

Each constraint, like the objective function, is expressed as a formula. Each constraint must also specify the amount of the limit or constraint.

(a) For a **maximum limit**, the constraint must be expressed as 'must be equal to or less than'.
(b) For a **minimum limit**, the constraint must be expressed as 'must be equal to or more than'.

**Example: Formulate constraints – maximum demand**

| **Type of constraint** | **Illustration** |
|---|---|
| Maximum limit: | Maximum sales demand for Product X of 5,000 units |
| Define variables | Let x be the number of Product X made. |
| Constraint expressed as: | x ≤ 5,000 |

***Example: Formulate constraints – Constraints with two variables Type of constraint Illustration***

| | |
|---|---|
| Constraints with two variables | A company makes two products, X and Y.<br>It takes 2 hours to make one unit of X and 3 hours to make one unit of Y.<br>Only 18,000 direct labour hours are available. |
| Define variables | Let x be the number of Product X made and let y be the number of Product Y made. |
| Constraint expressed as: | 2x + 3y ≤ 18,000 |

**Example: Formulate constraints – Minimum production allowed**

| Type of constraint | Illustration |
|---|---|
| Minimum limit: | There is a requirement to supply a customer with at least 2,000 units of Product X |
| Define variables | Let x be the number of Product X made. |
| Constraint expressed as: | $x \geq 2{,}000$ |

**Example: Formulate constraints – Non-negativity**

| Type of constraint | Illustration |
|---|---|
| Non-negativity constraints | It is not possible to make a negative number of products. |
| Define variables | Let x be the number of Product X made and let y be the number of Product Y made. |
| Constraint expressed as: | $x, y \geq 0$ are called positive constraints<br>These constraints do not have to be plotted |

## Plotting constraints

The constraints in a linear programming problem can be drawn as straight lines on a graph, provided that there are just two variables in the problem (x and y). One axis of the graph represents values for one of the variables, and the other axis represents values for the second variable.

The straight line for each constraint is the boundary edge of the constraint – its outer limit in the case of maximum amounts (and inner limit, in the case of minimum value constraints).

**Example: Constraints**

| Constraint | Outer limit represented by the line |
|---|---|
| $2x + 3y \leq 600$ | $2x + 3y = 600$<br>Combinations of values of x and y beyond this line on the graph (with higher values for x and y) will have a value in excess of 600. These exceed the limit of the constraint, and so cannot be feasible for a solution to the problem. |

The constraint is drawn as a straight line. Two points are needed to draw a straight line on a graph. The easiest approach to finding the points is to set x to zero and calculate a value for y and then set y to zero and calculate a value for x.

**Example: Plotting a constraint**

$2x + 3y = 600$

when $x = 0$, $y = 200$ (600/3)

when $y = 0$, $x = 300$ (600/2)

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## 12.3 Linear Programming of Business Problems

Decisions about what mix of products should be made and sold in order to maximise profits can be formulated and solved as linear programming problems.

### *12.3.1 Overall approach (repeated here for your convenience)*

(a) **Step 1:** Define variables.
(b) **Step 2:** Formulate the objective function
(c) **Step 3:** Formulate the constraints.
(d) **Step 4:** Plot the constraints on a graph
(e) **Step 5:** Identify the feasible region. This is an area that represents the combinations of x and y that are possible in the light of the constraints.

| | Product X | Product Y |
|---|---|---|
| Direct labour hours per unit | 6 hours | 3 hours |
| Materials per unit | 4 kgs | 8 kgs |
| | | |
| Resource availability (per hour): | | |
| Total direct labour hours available (there being more than one worker) | 36 hrs | |
| Total material available | 48 kg | |

(f) **Step 6:** Identify the values of ***x*** and ***y*** that lead to the optimum value of the objective function. This might be a maximum or minimum value depending on the objective. There are different methods available to find this combination of values of ***x*** and ***y***

**Example: Linear programme**

A company makes and sells two products, Product X and Product Y.

The following information is relevant:

In addition, the company must make at least 2 units of product X and 3 units of Product Y every hour

What combination of Product X and Product Y per hour will maximise contribution per hour?

**Example continued: Linear programme**

**Step 1: Define the variables**

Let x equal the number of units of Product X made Let y equal the number of units of Product Y made

**Step 2: Formulate the objective function**

The objective is to maximise contribution given by: C = 50x + 40y

**Step 3: Formulate the constraints** Constraint:

| | |
|---|---|
| Labour hours | $6x + 3y \leq 36$ |
| | Whatever value is found for x and y, the maximum value that 6x + 3y can have is 36. |
| Material | $4x + 8y \leq 48$ |
| | Whatever value is found for x and y, maximum value that 4x + 8y can have is 48 |

Minimum production: $x \geq 2$ (x must be at least 2)

$y \geq 3$ (y must be at least 3)

**Step 4: Plot the constraints**

6x + 3y = 36 if x = 0 then y = 12 and if y = 0 then x = 6 4x + 8y = 48 if x = 0 then y = 6 and if y = 0 then x = 12

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**Example: Linear programme**

**Step 5: Identify the feasible region**

The feasible area for a solution to the problem is shown as the area ABCD.

Any combinations of values for x and y within this area can be achieved within the limits of the constraints.

Combinations of values of x and y outside this area are not possible, given the constraints that exist.

### 12.3.2 Maximising (or minimising) the objective function

To solve the linear programming problem, we now need to identify the feasible combination of values for x and y (the combination of x and y within the feasible area) that maximises the objective function.

The combination of values for ***x*** and ***y*** that maximises the objective function will be a pair of values that lies somewhere along the outer edge of the feasible area.

The solution is a combination of values for ***x*** and ***y*** that lies at one of the 'corners' of the outer edge of the feasible area. In the graph above, the solution to the problem will be the values of ***x*** and ***y*** at A, B or C. The optimal solution cannot be at D as the objective function is maximisation and values of ***x*** and/or ***y*** are higher than those at D for each of the other points.

The optimal combination of values of ***x*** and ***y*** can be found using one of the following:

(a) corner point theorem;
(b) slope of the objective function: or
(c) simultaneous equations.

Each of these will be demonstrated in turn but the simultaneous equation approach is by far the most commonly used.

### *12.3.3 Corner point theorem.*

The optimum solution lies at a corner of the feasible region. The approach involves calculating the value of ***x*** and ***y*** at each point and then substituting those values into the objective function to identify the optimum solution.

In the previous example, the solution has to be at points A, B, C or D.

Calculate the values of ***x*** and ***y*** at each of these points, using simultaneous equations if necessary to calculate the ***x*** and ***y*** values. Having established the values of ***x*** and ***y*** at each of the points, calculate the value of the objective function for each.

The solution is the combination of values for ***x*** and ***y*** at the point where the total contribution is highest.

**Example: Linear programme – Optimum solution using corner point theorem (continued).**

The maximum value the objective function could take will be at either A or B or C

| | | |
|---|---|---|
| **Point A is at the intersection of:** | x = 2 | 1 |
| | 4x + 8y = 48 | 2 |
| Substitute for x in equation 2 | 4(2) + 8y = 48 | |
| | 8y = 48 □ 8 | |
| | y = 5 | |
| **Point B is at the intersection of:** | 4x + 8y = 48 | 1 |
| | 6x + 3y = 36 | 2 |
| Multiply equation 1 buy 1.5 | 6x + 12y = 72 | 3 |
| Subtract 2 from 3 | 9y = 36 | |
| Therefore | y = 4 | |
| Substitute for y in equation 1 | 4x +8(4) = 48 | |
| | 4x = 16 | |
| | x = 4 | |
| **Point C is at the intersection of:** | y = 3 | 1 |
| | 6x + 3y = 36 | 2 |
| Substitute for y in equation 2 | 6x + 3(3) = 36 | |
| | 6x = 27 | |
| | x = 4.5 | |
| **Substitute coordinates into objective function** Point A (x = 2; y = 5) | C = 50x + 40y | |
| | C = 50(2) + 40(5) | |
| | C = 300 | |
| Point B (x = 4; y = 4) | C = 50(4) + 40(4) | |
| | C = 360 | |
| Point C (x = 4.5; y = 3) | C = 50(4.5) + 40(3) | |
| | C = 345 | |

**Conclusion:** The optimal solution is at point B where x = 4 and y = 4 giving a value for the objective function of 360.

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### 12.3.4 Slope of the objective function

There are two ways of using the slope of the objective line to find the optimum solution.

#### Measuring slopes

This approach involves estimating the slope of each constraint and the objective function and ranking them in order. The slope of the objective function will lie between those of two of the constraints. The optimum solution lies at the intersection of these two lines and the values of x and y at this point can be found as above.

**Example: Optimum solution by measuring slopes**

| Objective function: | Rearranged | Slope |
|---|---|---|
| C = 50x + 40y | $y = C/40 - 1.25x$ | – 1.25 |
| Constraints: | | |
| 6x + 3y = 36 | y = 12 – 2x | – 2 |
| 4x + 8y = 48 | y = 6 – 0.5x | – 0.5 |
| x = 2 | | ∞ |
| y = 3 | | 0 |

The slope of the objective function (– 1.25) lies between the slopes of 6x + 3y = 36 (– 2) and 4x + 8y = 48 (– 0.5). The optimum solution is at the intersection of these two lines.

Values of x and y at this point would then be calculated as above (x = 4

### 12.3.4 Plotting the objective function line and moving it from the source

The example above showed that the objective function (C = 50x + 40y) can be rearranged to the standard form of the equation of a straight line (y = C/40 □ 1.25x).

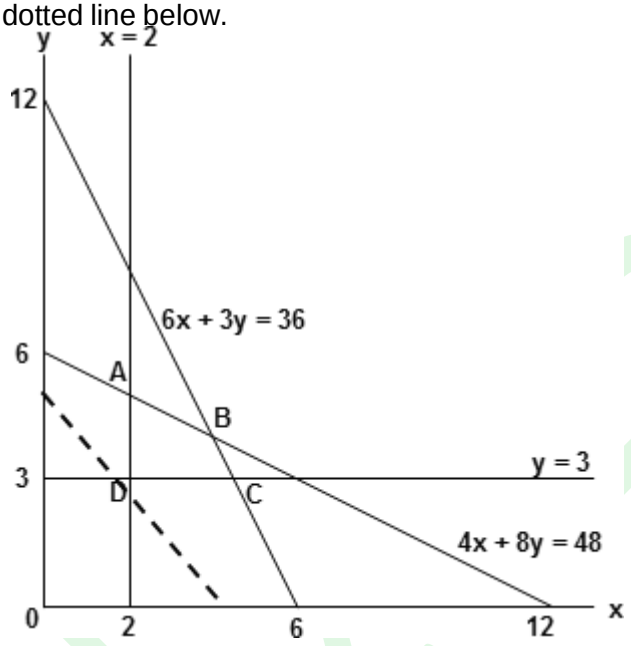
This shows that the slope of the line is not affected by the value of the equation (C). This is useful to know as it means that we can set the equation to any value in order to plot the line of the objective function on the graph.

The first step is to pick a value for the objective function and construct two pairs of coordinates so that the line of the objective function can be plotted. (The total value of the line does not matter as it does not affect the slope and that is what we are interested in).

**Example: Plotting the objective function (C = 50x + 40y)**

Let C = 200

200 = 50x + 40y  if x = 0 then y = 5 and if y = 0 then x = 4 This is plotted as the dotted line below.



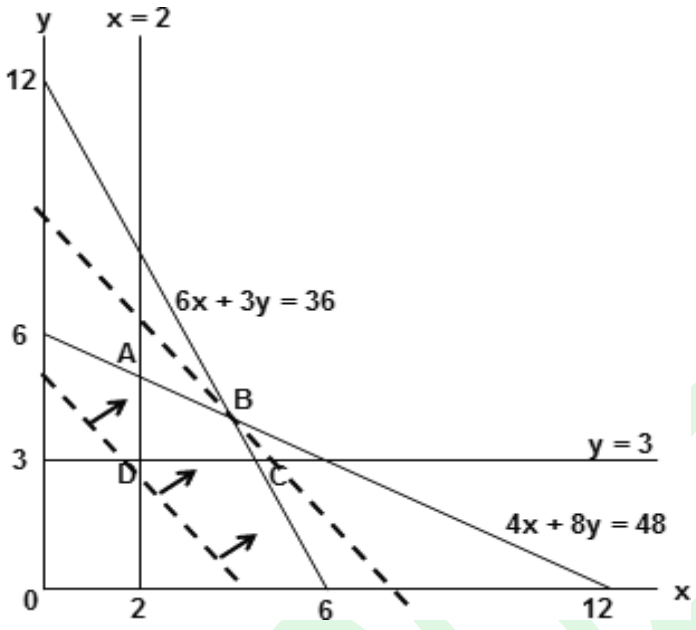

Note that the value of C in the above plot of the objective function is constant (at 200). This means that any pair of values of x and y that fall on the line will result in the same value for the objective function (200). If a value higher than 200 had been used to plot the objective function it would have resulted in a line with the same slope but further out from the source (the intersection of the x and y axes).

We are trying to maximise the value of the objective function so the next step is to identify the point in the feasible area where objective function line can be drawn as far from the origin of the graph as possible.

This can be done by putting a ruler along the objective function line that you have drawn and moving it outwards, parallel to the line drawn, until that point where it just leaves the feasible area. This will be one of the corners of the feasible region. This is the combination of values of x and y that provides the solution to the linear programming problem.

**Example: Finding the optimum solution**

Move a line parallel to the one that you have drawn until that point where it is just about to leave the feasible region.




### 12.3.5 Simultaneous equations

Instead of reading the values of x and y at which the objective function is maximised off a graph they could be found by solving the equations of the lines simultaneously.

You should know how to solve simultaneous equations. However, if you are not sure, the technique is to multiply one or both of the simultaneous equations so that you obtain two equations where the coefficient for either x or y is the same. You can then subtract one equation from the other (or possible add them together, if minus values for coefficients are involved). This will allow you to calculate the value for wither x or y.

Having obtained a value for x or y, you can then substitute this value in any of the simultaneous equations to obtain the value for the other variable.

In this example the simultaneous equations are solved as follows:

**Example: Finding the optimum solution**

Solving for values of x and y at the intersection of two lines. (1)

6x □ 3y = 36

(2) 4x □ 8v = 48

| | | Equation |
|---|---|---|
| | 6x □ 3y = 36 | 1 |
| | 4x □ 8y = 48 | 2 |
| Multiply equation 2 by 1.5 (to make the y coefficients the same) | 6x □ 12y = 72 | 3 |
| Subtract equation 1 from equation 3: | | |
| From above | 6x □ 3y = 36 | 1 |
| Therefore | 9y = 36 | 3 |
| | **y = 4** | |
| Substitute y = 4 into equation 1 | 6x □ 3y = 36 | 1 |
| | 6x □ (3 ´ 4) = 36 | |
| | 6x = 36 □ 12 | |
| | 6x = 24 | |
| | **x = 4** | |

Conclusion: Contribution is maximised at the intersection of line 6x + 3y = 36 and 4x + 8y = 48 giving a solution of x = 4 and y = 4. The value of the objective function at this point is:

C = 50x + 40y

### 12.3.6 Minimising functions

The above illustration is one where the objective is to maximise the objective function. For example, this might relate to the combination of products that maximise profit.

You may also face minimisation problems (for example, where the objective is to minimise costs). In this case the optimal solution is at the point in the feasible region that is closest to the origin. It is found using similar techniques to those above.

**Practice question** **1**

**Solve the following linear programme.**

Objective function: Maximise $C = 5x + 5y$

Subject to the following constraints:

| | | | |
|---|---|---|---|
| Direct labour | $2x + 3y$ | ≤ | 6,000 |
| Machine time | $4x + y$ | ≤ | 4,000 |
| Sales demand, Y | $y$ | ≤ | 1,800 |
| Non-negativity | $x, y$ | ≥ | 0 |

**Practice question** **2**

**Construct the constraints and the objective function taking into account the following information:**

A company makes and sells two products, Product X and Product Y. The contribution per unit is ₦8 for Product X and ₦12 for Product Y. The company wishes to maximise profit.

The expected sales demand is for 6,000 units of Product X and 4,000 units of Product Y.

| | Product X | Product Y |
|---|---|---|
| Machine hours per unit | 3 hours<br>1 hour | 2 hours<br>2.5 hours |

| | **Total hours** |
|---|---|
| Total direct labour hours available | 20,000 |
| Total machine hours available | 12,000 |

**Practice question** **3**

Lagos Manufacturing Limited makes and sells two versions of a product, Mark 1 and Mark 2

Identify the quantities of Mark 1 and Mark 2 that should be made and sold during the year in order to maximise profit and contribution.

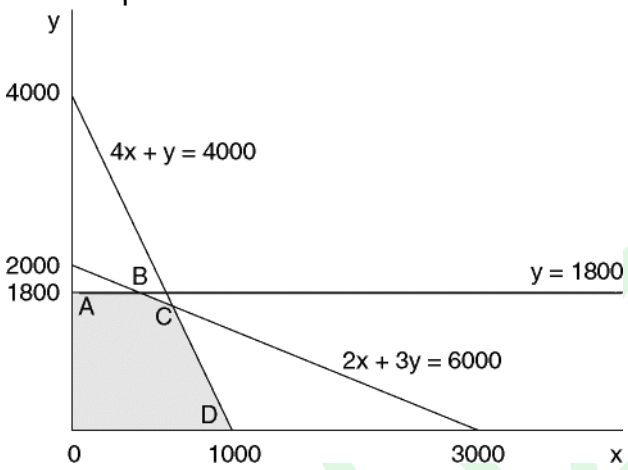
| | **Mark 1** | **Mark 2** |
|---|---|---|
| Direct materials per unit | 2 kgs | 4 kgs |
| Direct labour hours per unit | 3 hours | 2 hours |
| Maximum sales demand | 5,000 units | Unlimited |
| Contribution per unit | 10 per unit | 15 per unit |

| | **Resource available** |
|---|---|
| Direct materials | 24,000 kgs |
| Direct labour hours | 18,000 hours |

**Solution – Plotting the constraints** **1**

The non-negativity constraints are represented by the lines of the x axis and
The other three constraints are drawn as follows, to produce a combination of values for x and y that meet all three constraints.

These combinations of values for x and y represent the 'feasible region' on the graph for a solution to the problem.




**Workings**

(1) Constraint: 2x + 3y = 6,000

(2) Constraint: 4x + y = 4,000

When x = 0, y = 4,000. When y = 0, x =

(3) Constraint : y =

The feasible area for a solution to the problem is shown as the shaded area

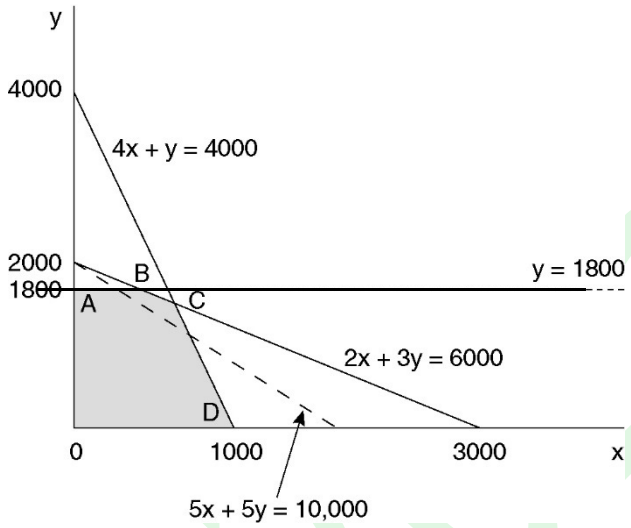
**Solution – Plotting the objective function and identifying the optimum point.** **1**

Plotting the objective function – Let P = 10,000 (The value 10,000 is chosen as a convenient multiple of the values 5 and 5 that can be drawn clearly on the graph.)

5x + 5y = 10,000

x = 0, y = 2,000 and y = 0, x = 2,000.

The combination of values of x and y that will maximise total contribution lies at




Point C is at the intersection of: 2x + 3y = 6,000 and 4x = 4,000
+ y

Solving for x and y:

| | | | | |
|---|---|---|---|---|
| 2x + 3y | | = | 6,000 | 1 |
| 4x + y | | = | 4,000 | 2 |
| Multiply (1) by 2: | 4x + 6y | = | 12,000 | 3 |
| Subtract (2) from (3): | 5y | = | 8,000 | |
| Therefore | **y** | **=** | **1,600** | |
| Substitute in equation (2) | 4x + 1,600 | = | 4,000 | |
| | 4x | = | 2,400 | |
| | **x** | **=** | **600** | |

**Solution – Optimum solution using corner point theorem.** **1**

Maximise C = 5x + 5y

| | | |
|---|---|---|
| Point A is where | y = 1,800 | |
| | x = 0 | |
| Point B is at the intersection of: | y = 1,800 | 1 |
| 2x + 3y = 6,000 | | 2 |
| 2x + 3(1,800) = 6,000 | | 3 |
| x = 300 | | |
| Point C is at the intersection of: | 2x + 3y = 6,000 | 1 |
| 4x + y = 4,000 | | 2 |
| Solved previously at | x = 600 and y = 1,600 | |
| Point D is at the intersection of: | y = 0 | 1 |
| 4x + y = 4,000 | | 2 |
| 4x + 0 = 4,000 | | |
| x = 1,000 | | |

Substitute coordinates into objective function

| | |
|---|---|
| | C = 5x + 5y |
| Point A (x = 0; y = 1,800) | C = 5(0) + 5(1,800) |
| | C = 9,000 |
| Point B (x = 300; y = 1,800) | C = 5(300) + 5(1,800) |
| | C = 10,500 |
| Point C (x = 600; y = 1,600 | C = 5(600) + 5(1,600) |
| | C = 11,000 |
| Point D (x = 1,000; y = 0) | C = 5(1,000) + 5(0) |
| | C = 5,000 |

Conclusion: The optimal solution is at point C where x = 600 and y = 1,600 giving a value for the objective function of 11,000.

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**Solution – Optimum solution by measuring** **1**

| Objective function: | Rearranged | Slope |
|---|---|---|
| C = 5x + 5y | $y = {}^{C}/_{5} - x$ | – 1 |
| Constraints: | | |
| y = 1,800 | | 0 |
| 2x + 3y = 6,000 | $y = 2{,}000 - {}^{2}/_{3}x$ | $-{}^{2}/_{3}$ |
| 4x + y = 4,000 | y = 1,000 – 4x | – 4 |

The slope of the objective function (– 1) lies between the slopes of 2x + 3y = 6,000 ($-{}^{2}/_{3}$) and 4x + y = 4,000 (– 4). The optimum solution is at the intersection of these two lines.

**Solutions** **2**

A linear programming problem can be formulated as follows:

Let the number of units (made and sold) of Product X be x

Let the number of units (made and sold) of Product Y be y

The objective function is to maximise total contribution given as C = 8x + 12y.

| | | | |
|---|---|---|---|
| Direct labour | 3x + 2y | ≤ | 20,000 |
| Machine time | x + 2.5y | ≤ | 12,000 |
| Sales demand, X | x | ≤ | 6,000 |
| Sales demand, Y | y | ≤ | 4,000 |
| Non-negativity | x, y | ≥ | 0 |

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**Solution** **3**

Define the constraints

Let the number of units of Mark 1 be x
Let the number of units of Mark 2 be y.

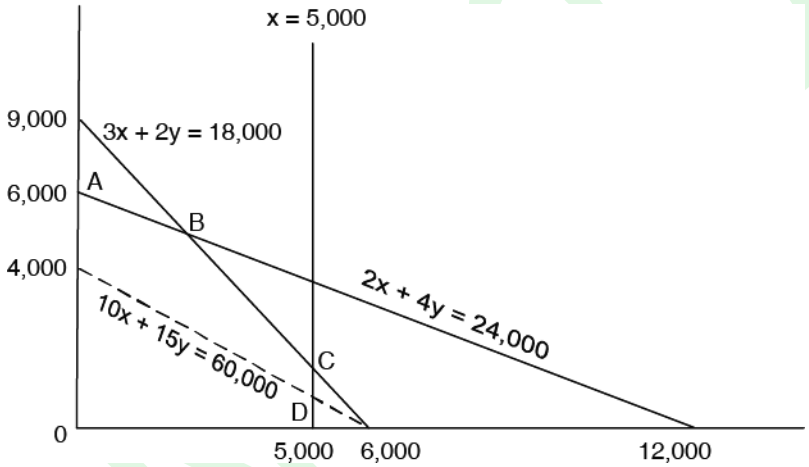
Formulate the objective

Maximise total contribution given by:

$$C = 10x + 15y$$

Formulate constraints:

| | | | |
|---|---|---|---|
| Direct materials | $2x + 4y$ | $\leq$ | 24,000 |
| Direct labour | $3x + 2y$ | $\leq$ | 18,000 |
| Sales demand, Mark 1 | $x$ | $\leq$ | 5,000 |
| Non-negativity | $x, y$ | $\geq$ | 0 |




The feasible solutions are shown by the area 0ABCD in the graph.

**Solution – Solving the values of x and y that maximise the objective function and finding its maximum value.** **3**

The optimum solution is at point B. This can be found be examining the contribution line to see where it leaves the feasible region, using corner point theorem or by comparing the slope of the objective function to the slopes of the constraints (workings given on next page)

Point B is at the intersection of: 2x + 4y = 24,000 and 3x + 2y = 18,000

Solving for x and y:

| | | | | |
|---|---|---|---|---|
| | 2x + 4y | = | 24,000 | 1 |
| | 3x + 2y | = | 18,000 | 2 |
| Multiply (1) by 2: | 6x + 4y | = | 36,000 | 3 |
| Subtract (1) from (3): | 4x | = | 12,000 | |
| Therefore | **x** | **=** | **3,000** | |
| Substitute in equation (1) | 2 (3,000) + 4y | = | 24,000 | |
| | 4y | = | 18,000 | |
| | **y** | **=** | **4,500** | |

The total contribution is maximised by producing 3,000 units of X and 4,500 units of Y.
The objective in this problem is to maximise 10x + 15y giving a maximum value of:

10 (3,000) + 15 (4,500) = 97,500

**Solution – Optimum solution by measuring slopes.** **3**

| | Rearranged | Slope |
|---|---|---|
| Objective function: | | |
| C = 10x + 15y | $y = C/15 - 10/15x$ | $-10/15 = -2/3$ |
| Constraints: | | |
| 2x + 4y = 24,000 | y = 6,000 – 0.5x | – 0.5x |
| 3x + 2y = 18,000 | $y = 9,000 - 3/2x$ | $-3/2$ |
| x = 5,000 | | ∞ |

The slope of the objective function ($-2/3$) lies between the slopes of 2x + 4y = 24,000 (– 0.5) and 3x + 2y = 18,000 ($-3/2$). The optimum solution is at the intersection of these two lines.

Values of x and y at this point would then be calculated as above (x = 3,000 and y = 4,500) and the value of the objective function found.

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**Solution – Optimum solution using corner point theorem.** **3**

Maximise C = 10x + 15y

Point A is where y = 6,000
x = 0

Point B is at the intersection of: 2x + 4y = 24,000
3x + 2y = 18,000
Solved previously at x = 3,000 and y = 4,500

Point C is at the intersection of: x = 5,000 1
3x + 2y = 18,000 2
Substituting 3(5,000) + 2y = 18,000
y = 1500

Point D is where y = 0
x = 5,000

Substitute coordinates into objective function

C = 10x + 15y

Point A (x = 6,000; y = 0) C = 10(0) + 15(6,000)
C = 90,000

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## 12.4 Explain and calculate shadow prices (Dual Prices) and discuss their implication for decision making for performance management:

**Dual prices and slack variables**

### 12.4.1 Introduction to dual prices

Linear programming is a method of solving for the optimum solution of a linear function subject to constraints identified as other linear functions. Some constraints are limiting but others are non-limiting.

Every constraint has a dual price (also known as the shadow price). The dual price of a constraint is the change in the objective function that is brought about if a constraint is changed by a unit.

The dual price of a non-limiting constraint is zero. This should be obvious. If a constraint is non-limiting, a small increase or decrease in its availability will have no impact on the value of the objective function.

Dual prices of limiting resources always have a value. This may be positive or negative depending on whether it is calculated by reducing or increasing availability of a resource and whether a problem is maximising or minimising.

### 12.4.2 Calculating dual prices

Once the solution is found to a linear programme, it is easy to calculate dual prices.

Dual prices are calculated one at a time by taking the following steps:

(a) Increase the limit of the first limiting constraint by one unit.
(b) Recalculate values for the variables.
(c) Recalculate the value of the objective function and compare the new figure to the value of the objective function in the original solution.

The difference is the dual price of the constraint.

This process is then repeated for the other constraint.

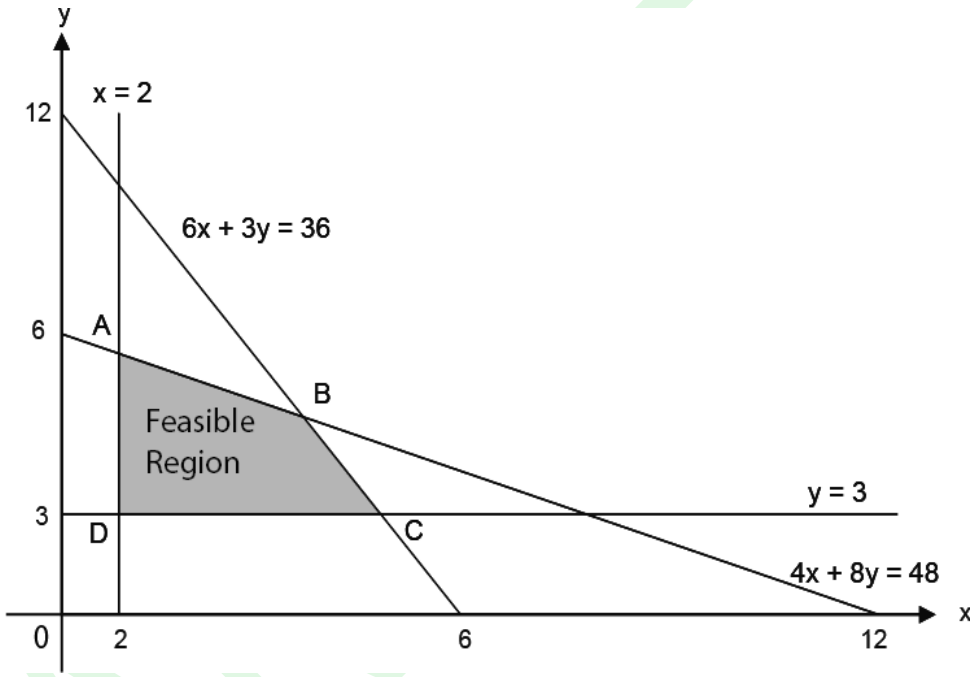
This is illustrated below using information from an earlier example which is repeated here for your convenience.

***Example: Linear programme***

Maximise C = 50x + 40y Subject to the constraints

| | |
|---|---|
| 6x + 3y □ 36 | Constraint 1 |
| 4x + 8y □ 48 | Constraint 2 |
| x ³ 2 | x must be at least 2 |
| y ³ 3 | y must be at least |

3 Plot the constraints




Optimum solution is at point B

Point B is at the intersection of

and

| | | |
|---|---|---|
| 4x + 8y = 48 | | 1 |
| 6x + 3y = 36 | | 2 |
| Multiply equation 1 by 1.5 | 6x + 12y = 72 | 3 |
| Subtract 2 from 3 | 9y = 36 | |
| | y = 4 | |
| Substitute for y in equation 1 | 4x +8(4) = 48 | |
| | 4x = 16 | |
| | x = 4 | |

Conclusion: The optimal solution is at point B where x = 4 and y = 4 giving a value for the objective function of 360.

Point B is where x = 4 and y = 4 □ C = 50(4) + 40(4)

C = 360

***Example: Linear programme – dual price***

**Constraint 1**

**Increase the value of constraint 1 by 1**

| | | | |
|---|---|---|---|
| Point B is at the intersection of | | 4x + 8y = 48 | 1 |
| | and | 6x + 3y = 37 | 2 |
| Multiply equation 1 by 1.5 | | 6x + 12y = 72 | 3 |
| Subtract 2 from 3 | | 9y = 35 | |
| | | y = 3.889 | |
| Substitute for y in equation 1 | | 4x +8(3.889) = 48 | |
| | | 4x +31.11 = 48 | |
| | | 4x = 16.888 | |
| | | x = 4.222 | |

**Change in value of the objective function**

| | | |
|---|---|---|
| New value: | $C^1 = 50(4.222) + 40(3.889)$ | 366.66 |
| Original value (C) | | 360.00 |
| Dual price of constraint 1 = $C^1 – C$ = | | 6.66 |

**Constraint 2**

**Increase the value of constraint 2 by 1**

| | | |
|---|---|---|
| Point B is at the intersection of | 4x + 8y = 49 | 1 |
| | 6x + 3y = 36 | 2 |
| Multiply equation 1 buy 1.5 | 6x + 12y = 73.5 | 3 |
| Subtract 2 from 3 | 9y = 37.5 | |
| | y = 4.167 | |
| Substitute for y in equation 1 | 4x +8(4.167) = 49 | |
| | 4x +33.33 = 49 | |
| | 4x = 14.67 | |
| | x = 3.917 | |

**Change in value of the objective function**

| | | |
|---|---|---|
| New value: | $C^1 = 50(3.917) + 40(4.167)$ | 362.50 |
| Original value (C) | | 360.00 |
| Dual price of constraint 2 = $C^1 – C$ = | | 2.50 |

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### 12.2.3 Dual prices and business problems

The dual price of a constraint is always expressed in terms of the units of that constraint. Thus, the dual price of a labour constraint is expressed in terms of an amount of currency per hour.

What the amount actually means depends on the objective function. If the objective function is expressed in terms of profit (or contribution), the dual price per hour will also be expressed in terms of profit (or contribution) per hour.

A common mistake is to say that the dual price is the maximum amount that a business would pay to acquire one extra unit of resource. This is incorrect as the dual price is expressed in terms of profit which already includes the basic cost of that unit. In fact, the dual price is the maximum premium that a business would pay for an extra unit of resource above and beyond the basic price of that unit.

**Example: Meaning of dual price**

An hour of labour costs ₦100.

The objective function is expressed in terms of contribution. The

dual price of labour is found to be ₦30.

This means that one extra hour of labour increases the contribution by ₦30.

The contribution already includes the cost of labour so this extra ₦30 is after taking the cost of labour into account.

The business would be prepared to pay up to a maximum of ₦30 (₦100 + ₦30) for one extra hour of labour. Beyond this price, contribution would be reduced.

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**Practice question 1**

This is a continuation of a question from the previous chapter.

Lagos Manufacturing Limited makes and sells two versions of a product called Mark 1 and Mark 2.

The company used linear programming based on the following information to calculate the product mix that would maximise profit and contribution:

| | **Mark 1** | **Mark 2** |
|---|---|---|
| Direct materials per unit | 2 kg | 4 kg |
| Direct labour hours per unit | 3 hours | 2 hours |
| Maximum sales demand | 5,000 units | unlimited |
| Contribution per unit | ₦10 per unit | ₦15 per unit |

Resource available

| | |
|---|---|
| Direct materials | 24,000 kg |
| Direct labour hours | 18,000 hours |

The optimal solution was found to be at the intersection of the following constraints.

| | |
|---|---|
| Direct materials | 2x + 4y = 24,000 |
| Direct labour | 3x + 2y = 18,000 |

The contribution resulting from this product mix was obtained as follows:
Solving the above equations showed the optimal product mix to be:

| | |
|---|---|
| Mark 1 (x) | 3,000 units |
| Mark 2 (y) | 4,500 units |

The contribution resulting from this product mix was:

C = 10x + 15y

C = 10 (3,000) + 15 (4,500) = 97,500

Calculate the dual price of direct materials and the dual price of direct labour.

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**Practice question** **2**

A company makes two products B and C. Product B earns a contribution of ₦10 per unit and a unit of Product C earns a contribution of ₦30.

The following resources are used to make one unit of each product:

| | Product B | Product C | Maximum resource available |
|---|---|---|---|
| Machine type 1 | 30 minutes | 10 minutes | 15 hours per day |
| Machine type 2 | 40 minutes | 45 minutes | 30 hours per day |
| Skilled labour | 20 minutes | 30 minutes | 15 hours per day |

The maximum sales demand for C is 20 units per day. The sales demand for Product B is unlimited.

Calculate the optimum production plan for the company and the dual prices of resources. (Hint: Remember that non-limiting constraints have a

### 12.4.3 Limit to the dual price

The dual price of a limiting resource applies only to additional quantities of the resource for as long as it remains a limiting factor.

Eventually, if more and more units of a scarce resource are made available, a point will be reached when it ceases to be an effective limiting factor, and a different constraint becomes a limiting factor instead. When this point is reached, the dual price for additional units of the resource will become zero.

### 12.4.4 Calculate Slack and explain the implications of the existence of slack for decision making and performance management

Slack refers to the amount of a constraint that is not used in the optimal solution to a linear programming problem.

Only non-limiting resources have slack. Limiting resources are fully utilised so never have any slack.

The amount of slack in any non-limiting resources is easily found by substituting the optimum product mix into the equation for that resource. This would show how much of that resource was needed for the optimum solution. This could then be compared to the amount of resource available to give the slack.

Positive slack (+ve) = Constraint or resources not fully utilised

Zero Slack (0 ) = Binding or fully utilized constraint

Negative Slack (-ve) = Not binding constraint or solution is not been achieved.

### 12.5.1 Preliminary information

This section does not explain the simplex method. Instead, it introduces and explains certain ideas which will seem completely unrelated but which you will find useful when you come to try to understand the simplex method.

### 12.5.2 Matrices

A matrix is a rectangular array of numbers consisting of a number of rows and columns. Matrices are an important tool used in solving all kinds of mathematical problems. Matrices are not in your syllabus so very little will be explained here except what you need to know.

An identity matrix is one where the number of rows is the same as the number of columns and the elements in the leading diagonal are all equal to one with all the other elements being equal to zero. (The leading diagonal is the one that slants down from the top left hand corner to the bottom right hand corner).

The following are examples of identity matrices:

**Example: Identity matrices:**

**Matrix A**

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

**Matrix B**

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$$

Identity matrices have several important uses but what has been mentioned above is all you need to know.

### 12.5.3 Basic and non-basic variables

Algebra is used to describe relationships between variables and on some occasions to solve for values of those variables.

Consider the following:

It is easy to find the value of x when it is contained in a single equation with no other unknowns. For example x + 40 = 100

It is not so easy to solve for x in an equation where there are two unknowns. For example, x + y =100.

However, we could solve for x if we assign a value to y. In other words, we could say what the value of x would be given a certain value of y.

As a general statement, if there are more variables than the number of equations that contain those variables the number of variables must be reduced to the number of equations by having values assigned to them. The easiest value to assign is zero.

(a) The variables to which a value (zero) is assigned are called non-basic variables.
(b) The variables which are calculated after values are assigned to others are called the basic variables.

This might be a little difficult to understand. What it means is that if there are four unknowns (say a, b, c and d) which appear in only three equations, a value must be assigned to one of the variables (say a, b, c or d) as a mechanism to allow the calculation of values for the others. Suppose a was set to be equal to zero.

(a) b, c and d are called basic variables.
(b) a is a non-basic variable.

Please do not worry if all of this seems a little mysterious. You probably have never had to do this before and the truth is that you could learn to do simplex without knowing it simply by following a procedure. However, this information will allow you to understand what the starting point of simplex is all about.

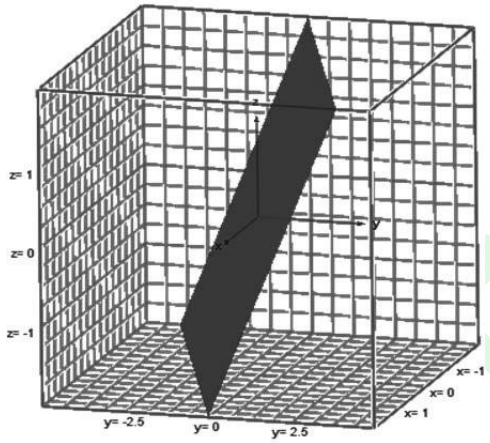
### 12.5.4 Background to simplex method

So far (in the previous chapter) linear programmes were solved for problems where there were two unknowns. In cases like this, the problem can be represented graphically as we need a dimension (y axis and x axis) for each unknown so that constraints containing the two unknowns can be drawn as a straight line.

If there are three or more unknowns things become a little trickier to imagine. If there are three variables then the value of each variable would change in two directions in response to changes in the other two variables. In this case, an equation containing the three unknowns would be drawn as a plane (flat service). The following is a simple example of this:

**Illustration: 3 dimensional (3d) plot of equation with 3 variables**

$$y = x + z$$




It is easy to imagine other equations being drawn in the same way to generate a feasible volume.

When we face problems with 4 or more variables, it becomes impossible to visualise them in a diagrammatic way. A mathematician would not even try, but be happy in the knowledge that he or she can describe the information mathematically.

Simplex is a technique that can be used to solve linear programmes with any number of variables. It is quite tricky to use but it is usually carried out using a computer programme. However, you might be asked to demonstrate an understanding of a simple example.

An example with just two unknowns will be used to illustrate the technique. This is because it becomes progressively more difficult to keep track of what is happening as the number of unknowns increases but the process is just the same for any number of unknowns.

### 12.5.5 Simplex

Simplex is a tabular solution procedure for solving linear programmes.

Simplex works by establishing an initial table that represents a corner of the feasible region and then moves to the next point. The direction of movement is decided by which of the directions has the biggest impact on the objective function.

(a) The starting point (called the initial tableau) is constructed to show the situation at the origin of the feasible area/volume where x and y are both zero and the value of the objective function is therefore zero. This is described as the initial feasible solution. It is the starting point for finding the optimum point in the feasible region.

(b) The table is then transformed to calculate the value of the objective function at the next “corner” of the feasible area/volume.

(c) This continues until the optimum is found

This is best explained with an example. We will use an example based on one that you have already seen in the previous chapter

### 12.5.6 Simplex technique: Constructing the initial tableau

**Example: Simplex (starting data)**

Assume that the following information relates to the profit and constraints of a two product business.

Maximise $Z = 50x + 40y$

Subject to the constraints

$6x + 3y \leq 36$

$4x + 8y \leq 48$

### 12.5.7 Step 1: Inequalities into equalities

The first thing to do is to change the inequalities into equalities. This is done by introducing a slack variable into each equation. A slack variable represents the amount of unused resource in the equation. Of course, this will turn out to be zero in the final solution if the equation is a limiting constraint.

The constraints become as follows:

**Example: Simplex: Inequalities changed to equalities**

$$6x + 3y + S1 = 36$$
$$4x + 8y + S2 = 48$$

The equations are said to be in the standard form. This means (in part) that they now equate to a value.

There are 4 variables (x, y, S1 and S2) but only 2 constraints. It is only possible to solve for the same number of variables as there are constraints. A zero value must be assigned to two of the constraints and then values of the others can be calculated.

Zero value is assigned to ***x*** and to ***y*** (they become the non-basic variables). Note that you do not have to do anything here. This is simply explaining what the first table means. In the above equations if ***x*** and ***y*** are both zero, S1 = 36 and S2 = 48. S1 and S2 are now the basic variables. Just remember this for a minute. We will return to it.

The objective function must also be expressed in the standard form. This is easy to do by rearranging the equation

**Example: Simplex: Rearrange the objective function into the standard form**

$$Z = 50x + 40y$$

Therefore: $Z - 50x - 40y = 0$

If this business did not face any constraints it would make as many items of ***x*** as possible. This is because each item of ***x*** made provides a higher reward (50) than each item of ***y***(40).

Expressing the objective function in the standard form does not change this. However, it does change the sign associated with the profit of each item. The profit from an item of ***x*** is represented as a value of □50 but this is only because we have rearranged the function. Items of ***x*** are still more profitable than items of ***y***.

### 12.5.7 Step 2: Assemble the initial tableau

The resultant equations can then be used to construct a table called the initial tableau.

This table consists of three rows, one for each constraint and one for the objective function. (If there were more constraints there would be more rows).

The table consists of a series of columns. The first column is the variable that each equation solves to and the last column is the value that the equation solves to. In between there is a column for each unknown. The heading for these columns is the unknown variable being solved for. The content of each columns is the coefficient of each unknown.

**Example: Simplex: Initial tableau**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 |
| S2 | 4 | 8 | 0 | 1 | 48 |
| Z | –50 | –40 | 0 | 0 | 0 |

It is worth spending some time to ensure that you understand what this initial tableau means.

Each line represents an equation. The first column highlights what is being solved in the equation set out in the remaining columns. For example the first line means: S1 = 6x + 3y +S1 + 0 = 36

In other words, the tableau shows the values of the basic constraints (S1 and S2) and of the objective function when both ***x*** and ***y*** are equal to zero. This is at the origin of the ***x*** and ***y*** axes.

(a) The first line says that ***S***1 (in the left hand column) = 36 (in the right hand column) when ***x*** = zero (therefore 6x = zero) and ***y*** = zero (therefore 3y = zero). The slack variable is 36 being all of the available resource because no products are being made.

(b) The second line says that ***S2*** (in the left hand column) = 48 (in the right hand column) when ***x*** = zero (therefore 4x = zero) and ***y*** = zero (therefore 8y = zero). The slack variable is 48 being all of the available resource because no products are being made.

(c) The value of the objective function (***Z***) is zero as nothing is being produced.

Note that the rows and columns for the basic variables (***S1*** and ***S2***) form a 2 by 2 identity matrix.

### 12.5.8 Simplex technique: First transformation

The simplex approach involves moving to an adjacent point on the feasible region in order to see the impact on the objective function.

This is done in order of which movement has the biggest positive impact on the objective function. Note that this is shown as the biggest negative value in the ***Z row***.

Moving to an adjacent point involves redrafting the table to represent that point. One of the non-basic variables (i.e. the one with the most negative value on the ***Z row***) becomes basic and replaces an existing basic variable. (The number of rows and columns remains constant.
The basic variable being replaced is called the exit variable.
The non-basic variable replacing the original basic variable is called the entry variable.

**Example: Simplex: Initial tableau**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 |
| S2 | 4 | 8 | 0 | 1 | 48 |
| Z | –50 | –40 | 0 | 0 | 0 |

### 12.5.9 Identifying the entry variable

The largest negative value in the ***Z row*** is –50. This is in the ***x*** column. This column is now called the pivotal column and ***x*** is the entry variable.

**Example: Simplex: First transformation – entry variable**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 |
| S2 | 4 | 8 | 0 | 1 | 48 |
| Z | –50 | –40 | 0 | 0 | 0 |

### 12.5.10 Identifying the exit variable

The quantity of each constraint in the ***Quantity*** column is divided by the value in that line in the pivotal column.

Every number in the quantity column is divided by each equivalent value from the same line in the pivotal column. If a value is negative the answer is ignored and there is no entry made for it.

The row with the lowest figure resulting from this division is the exit variable. It leaves the solution to be replaced by ***x***. This is the S1 row in the example (see below).

**Example: Simplex: First transformation – exit variable**

| Basic variables | x | y | S1 | S2 | Quantity | |
|---|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 | $^{36}/_{6} =$ 6 |
| S2 | 4 | 8 | 0 | 1 | 48 | $^{48}/_{4} =$ 12 |
| Z | –50 | –40 | 0 | 0 | 0 | |

### 12.5.11 Replacing the exit variable with the entry variable.

This is the most difficult part to understand so we will proceed step by step.

The values for entry variable in the pivotal column must be restated to the values that were in the column for the exit variable. They take the exit variable's place as part of the identity matrix. In other words, the ***S1*** column reading from the top was 1, 0 ,0. The values in the ***x*** column must become 1, 0, 0.

However, each row is an equation. If one value in a row changes (as they are due to replacing values in the x column), other figures must be changed in order to keep the equation in balance.

We want to change each equation so that we end up with the table looking as follows:

**Example: Simplex: First transformation – to show how the pivotal column should look after the transformation.**

The value in the pivotal row of the pivotal (x) column must be changed from 6

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | ? | ? | ? | ? |
| S2 | 0 | ? | ? | ? | ? |
| Z | 0 | ? | ? | ? | ? |

to

1. This is achieved by dividing the original value by 6. Therefore, the equation in the first row (now the x row) can be maintained if every other number is also divided by 6.
2.

**Example: Simplex: First transformation to show how the pivotal row looks after the transformation.**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| X | 1 | $^{3}/_{6}$ | $^{1}/_{6}$ | 0 | $^{36}/_{6} = 6$ |
| S2 | 0 | ? | ? | ? | ? |
| Z | 0 | ? | ? | ? | ? |

The value in the second row of the ***x*** column must be changed from 4 to 0. This is achieved by taking the pivotal row (either before or after the transformation), perhaps adjusting it so that the coefficients of ***x*** match and then adding it to or subtracting it from the second row. This is difficult to understand so we will show you in a number of ways.

**Example: Working – Adjusting the second row so that the value in the x column is zero.**

Multiply values in the pivotal row before its transformation by –2/3 and add the resultant row to the second row

.

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 6 | 3 | 1 | 0 | 36 |
| Multiply | ´ 2/3 | ´ 2/3 | ´ 2/3 | ´ 2/3 | ´ 2/3 |
| = | 4 | 2 | 2/3 | 0 | 24 |
| S2 before | 4 | 8 | 0 | 1 | 48 |
| S2 after | 0 | 6 | 2/3 | 1 | 24 |

Or it could have been done as follows:

**Example: Working – Adjusting the second row so that the value in the x column is zero.**

Multiply values in the pivotal row after transformation by –4 and add the resultant row to the second row

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 3/6 = 0.5 | 1/6 | 0 | 36/6 = 6 |
| Multiply | ´4 | ´4 | ´4 | ´4 | ´4 |
| = | 4 | 2 | 2/3 | 0 | 24 |
| S2 before | 4 | 8 | 0 | 1 | 48 |
| S2 after | 0 | 6 | 2/3 | 1 | 24 |

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After the second row is transformed the table will look as follows:

**Example: Simplex: First transformation after the pivotal row and the second row have been transformed**

The same thing must be done for the ***Z row***.

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | $^{3}/_{6}$ | $^{1}/_{6}$ | 0 | 6 |
| S2 | 0 | 6 | $-^{2}/_{3}$ | 1 | 24 |
| Z | 0 | ? | ? | ? | ? |

The value in the x column in the ***Z row*** is −50 but this must be changed to zero. This represents the fact that all possible items of ***x*** are being made at this point so it is not possible to make any further contribution.

The value in the ***x*** column in the ***Z row*** is changed to zero by taking the pivotal row (either before or after the transformation), perhaps adjusting it so that the coefficients of ***x*** match and then adding it to or subtracting it from the ***Z row***.

**Example: Adjusting the Z row so that the value in the x column is zero.**

Multiply values in the pivotal row after transformation by 50 and add the resultant row to the second row.

| Basic variables | x | y | | S1 | S2 | Quantity |
|---|---|---|---|---|---|---|
| x | 1 | $^{3}/_{6}$ = 0.5 | = | $^{1}/_{6}$ | 0 | $^{36}/_{6}$ = 6 |
| Multiply | × 50 | × 50 | | × 50 | × 50 | × 50 |
| = | 50 | 25 | | 8 $^{1}/_{3}$ | 0 | 300 |
| Z before | −50 | − 40 | | 0 | 0 | 0 |
| Z after | 0 | − 15 | | 8 $^{1}/_{3}$ | 0 | 300 |

After the ***Z row*** is transformed the table will look as follows.

**Example: Simplex: After the first transformation**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | $^{3}/_{6}$ | $^{1}/_{6}$ | 0 | 6 |
| S2 | 0 | 6 | $-^{2}/_{3}$ | 1 | 24 |
| Z | 0 | −15 | 8 $^{1}/_{3}$ | 0 | 300 |

This is how the tableau looks at the end of the first transformation. It has moved to a corner of the feasible area where the largest possible number of ***x*** (6) are being made to give a contribution of 300. (Note that this is 6 units as in the right hand column above, at 50 per unit)

The process continues until there is no negative figure in the ***Z row***. As can be seen above there is a negative figure in the ***Z row***. This means that the objective function can take a higher value so this is not the optimal point.

### 12.5.12 Simplex technique: Second transformation

This will be carried out in exactly the same way as before but with less explanation.

**Example: Simplex: Second transformation**

Tableau brought forward after the first transformation

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | $3/6$ | $1/6$ | 0 | 6 |
| S2 | 0 | 6 | $-2/3$ | 1 | 24 |
| Z | 0 | $-15$ | $8\ 1/3$ | 0 | 300 |

Identify the pivotal column by choosing the column with the most negative figure.

**Example: Simplex: Second transformation – Pivotal column**

| Basic variables | x | y | S1 | S2 |
|---|---|---|---|---|
| x | 1 | $^3/_6$ | $^1/_6$ | 0 |
| S2 | 0 | 6 | $-^2/_3$ | 1 |
| Z | 0 | $-15$ | $8\ ^1/_3$ | 0 |

The above shows that ***y*** is the entry variable.

Next, identify the pivotal row by dividing each row in the quantity column by the value in the equivalent row in the pivotal column and identifying the lowest figure

.

**Example: Simplex: Second transformation – Pivotal row**

| Basic variables | x | y | S1 | S2 | Quantity | |
|---|---|---|---|---|---|---|
| x | 1 | $^3/_6$ | $^1/_6$ | 0 | 6 | $6 \div {}^3/_6 = 12$ |
| S2 | 0 | 6 | $-^2/_3$ | 1 | 24 | $^{24}/_6 = 4$ |
| Z | 0 | $-15$ | $8\ ^1/_3$ | 0 | 300 | |

The above shows that ***S2*** is the exit variable

Values in the ***y*** column must complete the identity matrix. That is to say they must look as follows:

**Example: Simplex: Second transformation – Pivotal row**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 0 | ? | ? | ? |
| y | 0 | 1 | ? | ? | ? |
| Z | 0 | 0 | ? | ? | ? |

The value in the pivotal row of the pivotal (y) column must be changed from 6 to 1. This is achieved by dividing the original value by 6. Therefore, the equation in the pivotal row (now the y row) can be maintained if every other number is also divided by 6.

**Example: Simplex: Second transformation – Pivotal row**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 0 | ? | ? | ? |
| y | 0 | 1 | $-1/9$ | $1/6$ | 4 |
| Z | 0 | 0 | ? | ? | ? |

The value in the first row of the pivotal column is 0.5 (3/6) but must become zero. This can be achieved by multiplying the pivotal row by − 0.5 and adding the result to the first row.

**Example: Working – Adjusting the first row so that the value in the y column is zero.**

Multiply values in the pivotal row after transformation by –0.5 and add the resultant row to the second row.

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| y | 0 | 1 | − 1/9 | 1/6 | 4 |
| Multiply | ´ −0.5 | ´ −0.5 | ´ −0.5 | ´ −0.5 | ´ −0.5 |
| = | 0 | ´ −0.5 | 1/18 | − 1/12 | − 2 |
| x before | 1 | 0.5 (3/6) | 1/6 | 0 | 6 |
| | | | 4/18 | | |
| x after | 1 | 0 | = 2/9 | − 1/12 | 4 |

**Example: Simplex: Second transformation – x row**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 0 | $^{2}/_{9}$ | $-\,^{1}/_{12}$ | 4 |
| y | 0 | 1 | $-^{1}/_{9}$ | $^{1}/_{6}$ | 4 |
| Z | 0 | 0 | ? | ? | ? |

The value in the ***Z row*** of the pivotal column is  15 but must become zero. This can be achieved by multiplying the pivotal row by 15 and adding the result to the ***Z row***.

**Example: Working – Adjusting the first row so that the value in the y column is zero.**

Multiply values in the pivotal row after transformation by –0.5 and add the resultant row to the second row.

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| y | 0 | 1 |  $^{1}/_{9}$ | $^{1}/_{6}$ | 4 |
| Multiply | ´ 15 | ´ 15 | ´ 15 | ´ 15 | ´ 15 |
| = | 0 | 15 |  $^{15}/_{9}$ | $^{15}/_{6}$ | 60 |
| Z before | 0 |  15 | $^{75}/_{9}$ (8 $^{1}/_{3}$) | 0 | 300 |
| Z after | 0 | 0 | $^{60}/_{9}$ = $^{20}/_{3}$ = 6$^{2}/_{3}$ | $^{15}/_{6}$ = 2 ½ | 360 |

**Example: Simplex: Second transformation – Final tableau**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 0 | $^{2}/_{9}$ | $-\,^{1}/_{12}$ | 4 |
| y | 0 | 1 | $-^{1}/_{9}$ | $^{1}/_{6}$ | 4 |
| Z | 0 | 0 | 6 $^{2}/_{3}$ | 2 $^{1}/_{2}$ | 360 |

There is no negative figure in the **Z row** so this is an optimal solution.

### 12.5.13 Comment

The above process is complex. You may be forgiven for asking why anyone would use the technique to solve an example like this when it is so much easier using the techniques covered earlier. The answer is that nobody would use this technique to solve this example. The example has been used to explain the process. A more complex example could have been used but would have required further transformations.

Also remember that this is usually carried out using a computer which reduces the effort to formulating the problem and inputting the data and then to interpreting the final tableau.

**Interpretation of the final tableau**

**Example: Simplex: Final tableau brought forward**

| Basic variables | | | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | | | | | 4 |
| y | | | | | 4 |
| Z | 0 | 0 | Dual $6\ ^2/_3$ price | Dual $2\ ^1/_2$ price | 360 |

Optimum product mix

Value of objective function at optimal product mix

## 12.5.13 Summary

The example was worked in far more detail than would normally be used to answer a question.

This section shows what a normal answer wold look like (ignoring the initial formulation of the equations).

**Example: Step 1: Set up the initial tableau**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 |
| S2 | 4 | 8 | 0 | 1 | 48 |
| Z | –50 | –40 | 0 | 0 | 0 |

| Basic variables | x | y | S1 | S2 | Quantity | |
|---|---|---|---|---|---|---|
| S1 | 6 | 3 | 1 | 0 | 36 | $^{36}/_{6} =$ 6 |
| S2 | 4 | 8 | 0 | 1 | 48 | $^{48}/_{4} =$ 12 |
| Z | –50 | –40 | 0 | 0 | 0 | |

**Example: Step 3: First transformation**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | $^{3}/_{6}$ | $^{1}/_{6}$ | 0 | 6 |
| S2 | 0 | 6 | $-^{2}/_{3}$ | 1 | 24 |
| Z | 0 | −15 | $8\ ^{1}/_{3}$ | 0 | 300 |

There is a negative value in the objective function row so the solution is not optimum.

**Example: Step 4: Second transformation**

| Basic variables | x | y | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | 1 | 0 | $^{2}/_{9}$ | $-\ ^{1}/_{12}$ | 4 |
| y | 0 | 1 | $-^{1}/_{9}$ | $^{1}/_{6}$ | 4 |
| Z | 0 | 0 | $6\ ^{2}/_{3}$ | $2\ ^{1}/_{2}$ | 360 |

There is no negative figure in the **Z row** so this is an optimal solution.

**Example: Step 5: Interpret the final tableau**

| Basic variables | | | S1 | S2 | Quantity |
|---|---|---|---|---|---|
| x | | | | | 4 |
| y | | | | | 4 |
| Z | 0 | 0 | $6\ ^{2}/_{3}$ | $2\ ^{1}/_{2}$ | 360 |

Optimum product mix

Dual price | Dual price

Value of objective function at optimal product mix

**Practice question: Simplex** **3**

Maximise:

Z = 5a + 4b + 3c – d
Subject to:

| | | | | |
|---|---|---|---|---|
| 2a | +b | + c | +2d | ≤ 20 |
| a | + 2b | + 5c | + 3d | ≤ 15 |
| -a | +b | | +2d | ≤ 10 |

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## SOLUTIONS TO PRACTICE QUESTIONS

Solution 1

**Dual price of direct materials**

| | | | | |
|---|---|---|---|---|
| | 2x + 4y | = | 24,001 | 1 |
| | 3x + 2y | = | 18,000 | 2 |
| Multiply (2) by 2: | 6x + 4y | = | 36,000 | 3 |
| Subtract (1) from (3): | 4x | = | 11,999 | |
| Therefore | **x** | **=** | **2,999.75** | |
| Substitute in equation (1) | 2 (2,999.75) + 4y | = | 24,001 | |
| | 4y | = | 18,001.5 | |
| | **y** | **=** | **4,500.375** | |

Contribution = 10x + 15y Contribution = 10(2,999.75) + 15(4,500.375) =

| | |
|---|---|
| New contribution | 97,503.1 |
| Original contribution | 97,500.0 |
| Dual price per | 3.1 |

**Dual price of direct labour**

| | | | | |
|---|---|---|---|---|
| | 2x + 4y | = | 24,000 | 1 |
| | 3x + 2y | = | 18,001 | 2 |
| Multiply (2) by 2: | 6x + 4y | = | 36,002 | 3 |
| Subtract (1) from (3): | 4x | = | 12,002 | |
| Therefore | **x** | **=** | **3,000.5** | |
| Substitute in equation (1) | 2 (3,000.5) + 4y | | 24,000 | |
| | 4y | = | 17,999 | |
| | **y** | **=** | **4,499.75** | |

Contribution = 10x + 15y Contribution =10(3,000.5) + 15(4,499.75) =

| | |
|---|---|
| New contribution | 97,503.8 |
| Original contribution | 97,500.0 |
| Dual price per | 3.8 |

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Solution 2

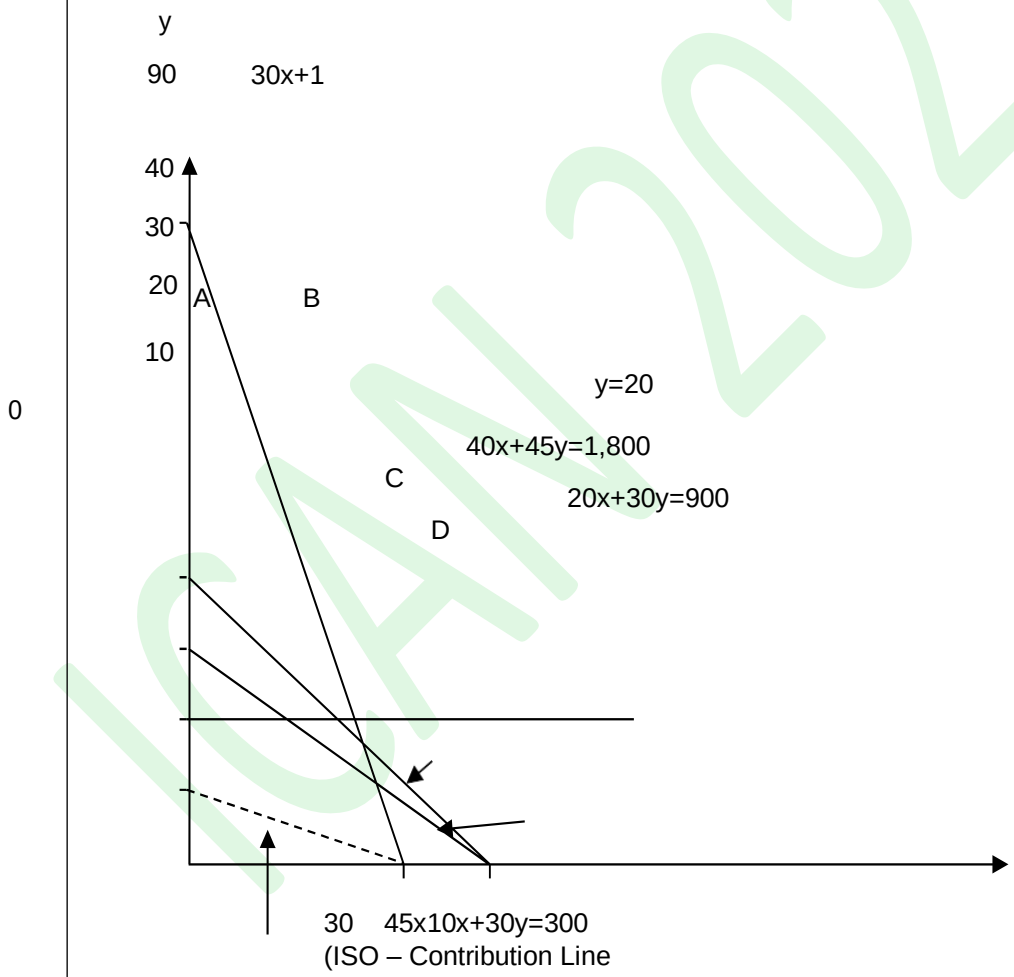
Let x = the number of units of Product B per day Let y

= the number of units of Product C per day

The objective function is to maximise the total contribution given by C = 10x + 30y. Subject to the constraints:

| | |
|---|---|
| Machine type 1 | 30x + 10y ≤ 900 |
| Machine type 2 | 40x + 45y ≤ 1,800 |
| Skilled labour | 20x + 30y ≤ 900 |
| Demand for C | y ≤ 20 |
| Minimum production | x ≥ 0, y ≥0 |

A graph can be drawn as follows to identify the feasible area for a solution. This is shown below. The feasible area is 0ABCD, and the optimal solution is at point A, point B, point C or point D




An iso-co10x + 30y = 300 has been drawn to establish the slope of the objective function. This can be used to identify the optimal solution, which is at point B.

At point B, the effective constraints are sales demand (y = 20) and skilled labour (20x + 30y = 900).

Since y = 20: 20x + (30 □ 20) = 900

Therefore 20x = 300 and x = 15.

Total contribution at the optimal solution is therefore (15 □ ₦10) + (20 □ ₦30) = ₦750 per day.

**Solution (continued)** **2**

**Dual price of skilled labour**

| | | | | | |
|---|---|---|---|---|---|
| | y | | = | 20 | 1 |
| | 20x 30y | + | = | 901 | 2 |
| Multiply (1) by 30 | 30y | | = | 600 | 3 |
| Subtract (3) from (2): | 20x | | = | 301 | |
| Therefore | **x** | | **=** | **15.05** | |

x does not appear in the other limiting constraint. This remains as y = 20.

Contribution = 10x + 30y

Contribution = 10(15.05) + 30(20) = 750.5

| | |
|---|---|
| New contribution | 750.5 |
| Original contribution | 750.0 |
| Dual price per | 0.5 |

The dual price of skilled labour is therefore ₦0.50 per minute, or ₦30 perhour.

**Dual price of sales demand**

| | | | | | |
|---|---|---|---|---|---|
| | y | | = | 21 | 1 |
| | 20x 30y | + | = | 900 | 2 |
| Multiply (1) by 30 | 30y | | = | 630 | 3 |
| Subtract (3) from (2): | 20x | | = | 270 | |
| Therefore | **x** | | **=** | **13.5** | |

x does not appear in the other limiting constraint. This remains as y = 21.

Contribution = 10x + 30y Contribution =10(13.5) + 30(21) = 765

| | |
|---|---|
| New contribution | 765.5 |
| Original contribution | 750.0 |
| Dual price per | 15.0 |

The dual price of sales demand for Product is therefore 15 per unit of demand.

Dual price of non-limiting constraints

In the optimal solution, the total available time on both machine type 1 and machine type 2 is not fully used. This means that there is spare capacity on both types of machine and the dual price for both types of machine is ze

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Solution 3

**Initial tableau**

| Basic variables | A | b | c | d | S1 | S2 | S3 | Quantity |
|---|---|---|---|---|---|---|---|---|
| S1 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 20 |
| S2 | 1 | 2 | 5 | 3 | 0 | 1 | 0 | 15 |
| S3 | -1 | 1 | 0 | 2 | 0 | 0 | 1 | 10 |
| Z | -5 | -4 | -3 | 1 | 0 | 0 | 0 | 0 |

**Pivotal column and row**

| Basic variables | A | b | c | d | S1 | S2 | S3 | Quantity |
|---|---|---|---|---|---|---|---|---|
| S1 | 2 | 1 | 1 | 2 | 1 | 0 | 0 | 20 |
| S2 | 1 | 2 | 5 | 3 | 0 | 1 | 0 | 15 |
| S3 | -1 | 1 | 0 | 2 | 0 | 0 | 1 | 10 |
| Z | -5 | -4 | -3 | 1 | 0 | 0 | 0 | 0 |

**First transformation**

| Basic variables | a | b | c | d | S1 | S2 | S3 | Quantity |
|---|---|---|---|---|---|---|---|---|
| A | 1 | 0.5 | 0.5 | 1 | 0.5 | 0 | 0 | 10 |
| S2 | 0 | 1.5 | 4.5 | 2 | -0.5 | 1 | 0 | 5 |
| S3 | 0 | 1.5 | 0.5 | 3 | 0.5 | 0 | 1 | 20 |
| Z | 0 | -1.5 | -0.5 | 6 | 2.5 | 0 | 0 | 50 |

There are negative values in the Z row so this is not the optimal solution.

**Pivotal column and row**

| Basic variables | a | b | c | d | S1 | S2 | S3 | Quantity |
|---|---|---|---|---|---|---|---|---|
| A | 1 | 0.5 | 0.5 | 1 | 0.5 | 0 | 0 | 10 |
| S2 | 0 | 1.5 | 4.5 | 2 | -0.5 | 1 | 0 | 5 |
| S3 | 0 | 1.5 | 0.5 | 3 | 0.5 | 0 | 1 | 20 |
| Z | 0 | -1.5 | -0.5 | 6 | 2.5 | 0 | 0 | 50 |

**Second transformation**

| Basic variable | a | b | c | d | S1 | S2 | S3 | Quantit |
|---|---|---|---|---|---|---|---|---|

| s | | | | | | | | y |
|---|---|---|---|---|---|---|---|---|
| A | 1 | 0 | -1 | 0.33 | 0.67 | -0.33 | 0 | 8.33 |
| B | 0 | 1 | 3 | 1.33 | -0.33 | 0.67 | 0 | 3.33 |
| S3 | 0 | 0 | -4 | 1 | 1 | -1 | 1 | 15 |
| Z | 0 | 0 | 4 | 8 | 2 | 1 | 0 | 55 |

There are no negative values in the Z row so this is the optimal solution.

## 12.6 CHAPTER REVIEW

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

(a) Explain the issue of limiting factors
(b) Identify limiting factors
(c) Explain the basic concepts of linear programming
(d) Explain the meaning of objective function and constraints in linear programming
(e) Formulate a linear programme and solve Linear programming equation
(f) Solve linear programming problems to identify the optimal solution when there is more than one constraint

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**Skills level**
**Performance management**




# PRICING DECISIONS

## Chapter Contents

13.0 Learning objective
13.1 Learning outcomes
13.2 Factors that influence price
13.3 Price elasticity of demand
13.4 Demand equations, cost functions and maximising profit
13.5 Price strategies
13.6 Chapter review

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# 13 Pricing Decisions

## 13.0 Learning objectives

This chapter introduces candidates to the concept of pricing decisions in Performance management as it affects pricing strategies and determination of optimum pricing mechanism for new products, complementary product and situations of market discrimination

## 13.1 Learning outcome

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

(a) Explain the factors that influence selling prices
(b) Explain and calculate price elasticity
(c) Derive cost and demand functions
(d) Calculate the price (and therefore quantity) that leads to profit maximisation
(e) Explain different types of pricing strategy

## 13.2 FACTORS THAT INFLUENCE PRICE

**Section Overview**

(a) The nature of pricing decisions
(b) Demand and supply
(c) Cost
(d) Income of customers
(e) Product life cycle
(f) Quality

### 13.2.1 The nature of pricing decisions

For many companies, pricing decisions are amongst the most important decisions management must make. The selling price for a company's products or services will affect:

(a) the volume of sales demand; and
(b) the profit margin per unit.

Some pricing decisions are for the longer term; companies have to decide the general price level at which it wants to sell its goods or services. The ability of companies to decide the general level of selling prices differs according to the size of the company relative to the size of the market it operates in.

(a) Companies that dominate their market, and are the largest suppliers to the market, are often able to decide what selling prices should be. They are 'price makers'. Companies that dominate their market might sell their products at low prices to maintain their dominant market share.

(b) Companies that do not dominate their market are usually 'price takers', which means that they have to sell their products at about the same price as other companies in the market. They are unable to sell at lower prices

without incurring a loss; and if they try selling at higher prices, customers will switch to rival suppliers.

(c) In the short term companies might use other pricing strategies, such as temporary price reductions or pricing a special job or contract at a low price in order to win the work and a new customer.

Some of the factors that influence sales pricing decisions are described briefly in the rest of this section.

### 13.3.2 Demand and supply

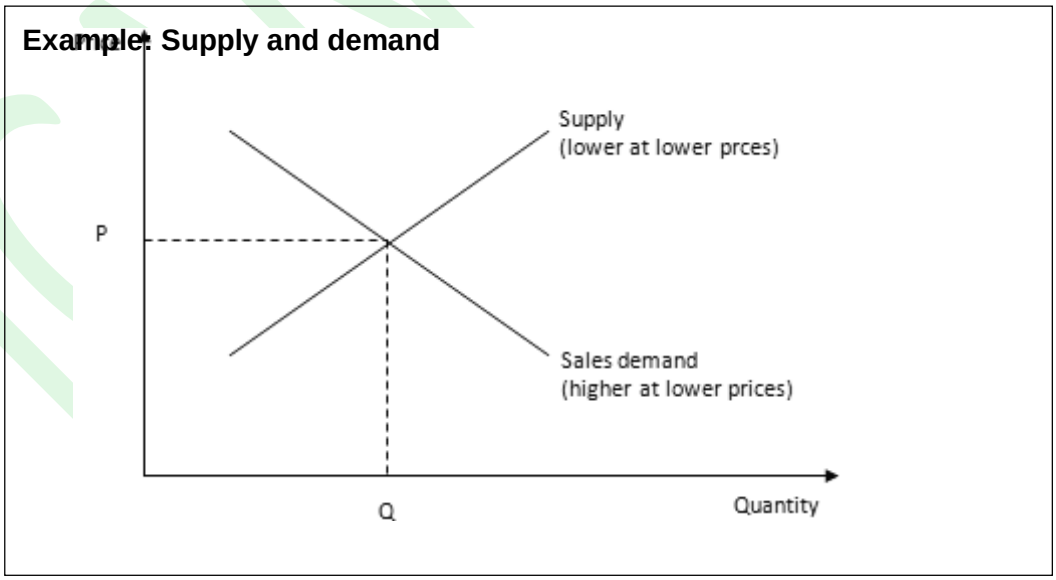
According to basic microeconomic analysis, the sales price for a product in a market is determined by demand and supply.

(a) Demand is the volume of sales demand that will exist for the product at any given price. As a normal rule, sales demand will be higher when the price is lower. If the price rises, total sales demand will fall. If the price falls, sales demand will ris

(b) Supply is the quantity of the product (or service) that suppliers are willing to sell at any given sales price. Higher prices will attract more suppliers into the market and encourage existing suppliers to produce more. Lower prices will deter some suppliers, and might drive some out of business if the price fall results in losses.

A simple graph of supply and demand is shown below. In this diagram, the equilibrium price level is the sales price that would become established in the market if the factors that affect supply or demand did not change. Here the price would be P and the total sales demand for the product would be Q units.

**Example: Supply and demand**




Occasionally, sales demand for a product might rise to such a high level that producers in the market are unable to meet the demand in full. Until production capacity can be increased, this situation could result in very large price rises and very high profit margins for producers.

An example of demand exceeding supply capacity has been the market for oil on occasions in the past. Oil suppliers are unable to alter their output volumes quickly, so a large increase in demand for oil can result in very large price increases, at least in the short term.

### *13.2.3 Monopoly pricing*

Supply and demand in the diagram above is for the market as a whole, and within the market there might be many different suppliers competing with each other to win business.

A similar situation applies to companies that are dominant in their particular market, and supply most of the goods or services sold in the market. In these 'monopoly markets', the individual company has a downward-sloping demand curve, which means that:

(a) as a monopoly supplier to the market, it is in a position to set prices for the market, but
(b) if it raises the prices of its products, the demand for its products will fall

### *13.2.4 Pricing in a competitive market*

In contrast to a monopoly market, companies that sell their products in a highly competitive market will decide their selling prices by comparing them with those of competitors.

In order to compete effectively, companies might use short-term pricing tactics such as price reductions, volume purchase discounts, better credit terms and so on.

### 13.2.5 Cost

In the long run, the sales price must exceed the average cost of sales of the product that a business entity sells. If cost is higher than selling price, the business will make a loss and cannot survive in the long term. Cost is therefore a major determinant of price.

Costs are influenced by factors such as:

(a) suppliers' prices for raw materials and components;
(b) price inflation;
(c) exchange rate movements;
(d) other elements of cost, such as wage rates and general expenses; and
(e) quality: it usually costs more to produce an item to a higher quality standard.

A company may have to decide where it wants to position its product in the market in terms of quality. Premium pricing (higher-than-average prices) prices can be used for higher quality products, but customers may prefer lower quality, lower priced products. A clear understanding of the link between quality and cost will be needed to help management determine the optimum price/quality mix.

If a company is able to reduce its costs, it should be in a position if it wishes to reduce its sales prices and compete more aggressively (on price) for a bigger share of the market.

### 13.2.6 Income of customers

Another microeconomic factor influencing sales demand in any market is the level of income of customers and potential customers for the product.

As the income of customers rises, they are more likely to want to buy more of the product. When demand is growing because income levels are rising, there is a tendency for prices to rise.

(a) In an economy as a whole, rising income occurs when the national economy is growing, and prices will rise. (The authorities might try to prevent excessive inflation, but prices will nevertheless increase.)
(b) When income in an economy is falling, there is an economic recession, and there might even be some price falls.

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### 13.2.6 Product life cycle

The product life cycle is explained in more detail in a later chapter on life cycle costing.

As a product goes through the different stages of its life cycle, sales prices will change.

(a) **Introduction stage**. During the introduction stage of its life cycle, the product is introduced to the market. If the product is new, and there are no rival products on the market, there is a choice between a market skimming policy for pricing or a market penetration policy. These policies are explained later.

(b) **Growth stage**. During the growth stage of its life cycle, demand for the product increases rapidly, but more competitors enter the market. If the market is competitive, each firm might have to lower its prices to win a share of the growing market. However, because sales demand is strong, prices and profit margins are likely to be fairly high (although falling). Some companies might try to identify a specialist 'niche' in the market, where they have more control over pricing of their products. Similarly, companies might try to keep prices higher by differentiating their product from those of competitors on the basis of quality or other distinguishing features (such as design differences).

(c) **Maturity stage**. When a product reaches the maturity stage of its life cycle, total sales demand in the market becomes stable, but the product may become a 'commodity'. Firms must then compete for market share, often by cutting prices. Companies might use product differentiation strategies to keep the price of their product higher than it might otherwise be, but prices generally will be lower than during the growth stage of the life cycle.

(d) **Decline**. Eventually, the market demand for a product declines. When sales demand falls, companies leave the market. Those that remain keep on selling the product as long as they can make a profit. Prices might remain very low. In some cases, however, a product might acquire 'rarity value', allowing companies to raise prices. However, since unit costs will also be higher, it is still difficult to make a profit.

### 13.2.7 Quality

Some customers will often be willing to pay more for better quality and companies may set prices higher than the market average because their products have a better-quality design or more features that provide value to customers.

Quality is often 'real', and can be provided by better-quality materials (for example in clothing products) or by greater reliability of performance or better performance (for example in motor cars).

Quality may also be 'perceived' rather than real, and customers will pay more for a branded product than for a similar or near-identical product with no brand name or a 'cheaper' brand name.

### 13.2.8 Other factors influencing price

There are other influences on pricing decisions and the general level of selling prices in a market.

(a) The price of 'substitute goods'. Substitute goods are goods that customers could buy as an alternative. Companies might set the price for their product in the knowledge that customers could switch to an alternative product if they think that the price is too high. For example, if the price of butter is too high, more customers might switch to margarine or other types of 'spread'.

(b) The price of 'complementary goods'. Complementary goods are items that customers will have to buy in addition to complement the product. The pricing of complementary products is explained in more detail later, as a pricing strategy that companies may use.

(c) Consumer tastes and fashion. High prices might be obtained for 'fashion goods'.

(d) Advertising and marketing. Sales demand can be affected by sales and marketing activities, including public relations activity. Strong consumer interest in a product or service could allow a company to set a higher price.

(e) In addition to general factors influencing price, such as supply and demand, competition and cost, companies will use one or more different pricing strategies to decide the sales prices for their products or services.

A number of different pricing strategies are described in a later section of this chapter.

## 13.3 Calculate and explain price elasticity of demand

**Section Overview**

(a) Price elasticity of demand: its meaning and measurement

(b) Elastic and inelastic demand

(c) Elasticity and setting prices

### 13.3.1 Price elasticity of demand: its meaning and measurement

Within a market as a whole, there is an inverse relationship between selling price and sales demand. At higher prices, total sales demand for a product will be lower. For individual companies in a monopoly position in their market (or niche of the market) the same rule applies: if prices are raised, demand will fall.

The price elasticity of demand (PED) is a measurement of the change in sales demand that would occur for a given change in the selling price.

It is measured as follows:

**Formula: Price elasticity of demand**

$$= \frac{\text{The change in quantity demanded as a percentage of original demand}}{\text{The change in sales price as a percentage of the original price}} \times 100$$

Price elasticity of demand has a negative value, because demand rises (positive) if the price falls (negative), and demand falls if the price rises.

**Example: Price elasticity**

The following estimates have been made of total sales demand for product X:

An increase in the price from ₦90 to ₦100 will result in a fall in daily demand from 2,000 to 1,600 units

The price elasticity of demand for product X at a price of ₦90 is calculated as follows:

If the price is increased from ₦90 to ₦100

The change in quantity demanded as a percentage of original demand

= - 400/2,000 = - 0.20 or - 20%.

The change in price as a percentage of the original price

= ₦10/₦90 = + 0.111 or + 11.1%.

PED = - 0.20/ + 0.111 = - 1.8.

**Practice questions**

The following estimates have been made of total sales demand for product X:

A fall in the price from ₦50 to ₦40 will result in a rise in daily demand from 8,000 to 9,000 units.

**Practice questions** **1**

The following estimates have been made of total sales demand for product X:

A fall in the price from ₦50 to ₦40 will result in a rise in daily demand from 8,000 to 9,000 units.

### 13.3.2 Elastic and inelastic demand

Sales demand for a product could be either elastic or inelastic in response to changes in sales price.

(a) Demand is elastic if its value is above 1. (More accurately, demand is elastic if its elasticity is a figure larger than – 1.)
(b) Demand is inelastic if its value is less than 1. (More accurately, demand is inelastic if its elasticity is a figure below – 1, between 0 and – 1.)

### *13.3.3 The significance of elasticity*

Price elasticity of demand affects the amount by which total sales revenue from a product will change when there is a change in the sales price.

If demand is highly elastic (greater than 1, ignoring the minus sign):

(a) increasing the sales price will lead to a fall in total sales revenue, due to a large fall in sales demand, and
(b) a reduction in the sales price will result in an increase in total sales revenue, due to the large rise in sales demand.

Profit might increase or decrease when the sales price is changed, depending on changes in total costs as well as the change in total revenue.

If demand is inelastic (less than 1, ignoring the minus sign):

(a) increasing the sales price will result in an increase in total sales revenue from the product, because the fall in sales volume is fairly small, and
(b) reducing the sales price will result in lower total sales revenue, because the increase in sales demand will not be enough to offset the effect on revenue of the fall in price.

A product does not necessarily have high or low price elasticity of demand at all price levels. The same product might have a high price elasticity of demand at some sales prices and low price elasticity at other prices.

### 13.3.4 Elasticity and setting prices

An understanding of the price elasticity of demand for products can help managers to make pricing decisions:

(a) If demand is inelastic, raising selling prices will result in higher sales revenue. Since fewer units will be sold, it should be expected that total costs will fall. Higher revenue and lower total costs mean higher profits. If management believe that sales demand for their product is price-inelastic, they might therefore consider raising the sales price.
(b) If demand is inelastic, reducing the sale price will lead to lower total sales revenue. Sales demand will increase, and so the costs of sales are also likely to increase. Profits are therefore likely to fall.

(c) If demand is elastic, an increase in the sales price will lead to a fall in total sales revenue. Sales demand will also fall. If managers are thinking about an increase in the sales price, they will have to consider whether the fall in total costs (due to the lower volume of sales) will exceed the fall in total revenue.
(d) If demand is elastic, reducing the sales price will increase total sales revenue from the product, but total sales volume will increase. The effect, as with raising sales prices for a product with high price elasticity of demand, could be either higher or lower total profits. There is a risk that if one company reduces its sales prices and elasticity of demand is high, this could lead to a 'price war' in which all competitors reduce their prices too. At the end of a price war, all sellers are likely to be worse off.

Companies might try to reduce the price elasticity of demand for their products by using non-price methods, such as improving product quality, improving service and the use of advertising and sales promotions.

## 13.4 Derive and apply a straight line equation on demand and cost function

### 13.4.1 Introduction

Many scenarios faced by businesses can be mathematically modelled in order to aid decision making. One such area is price setting.

Decisions are made to achieve objectives. The pricing model assumes that the objective of a business is to maximise its profits.

**Definitions**

Revenue: The income generated from sale of goods or services. It is the price of a good multiplied by the quantity sold.

Marginal revenue: The change in total revenue as a result of selling one extra item. This is the slope of the revenue curve.

Marginal cost: The change in total cost as a result of making one extra item. This is the slope of the cost curve.

A business should continue to make and sell more units as long as the marginal revenue from selling an item exceeds its marginal cost as this will increase profit. Any unit sold once marginal cost exceeds marginal revenue would reduce profit.

The values of marginal cost and marginal revenue depend on the shape of the total cost and total revenue curves of a business.

### *Revenue curves*

There are two sets of market conditions to consider:

(a) a market in which there is perfect competition; and
(b) a market in which there is imperfect competition.

Perfect competition requires the existence of many different suppliers competing to sell identical products to many different customers and that all market participants have perfect information to help them to make selling and buying decisions. No single supplier can influence the price of goods as this is determined by the market.

A supplier should make and sell more goods as long as the marginal cost of making them is less than the marginal revenue from selling them (this being equal to the price set by the market.

Perfect competition is rare in practice and not very interesting from a mathematical modelling view. Questions are far more likely to be about a company facing imperfect competition.

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### 13.4.1 Demand curves in imperfect competition

Suppliers seek to differentiate their products from those of their competitors. This leads to imperfect competition. When imperfect competition exists a supplier can set his own price. However, this has an effect on demand. The degree of this impact depends on the shape of the demand curve faced by a supplier.

A demand curve is a graph showing the quantity demanded at different sales prices. Usually an increase in price leads to a fall in demand. If the link between price and quantity is assumed to be a straight line relationship it can be represented as follows.

**Formula: Demand curve**

$P = a - bQ$

**Where:**

P = sales price

Q = quantity demanded

a = sales price when the quantity demanded is 0

b = change in sale price/ change in quantity sold

**Example: Deriving a demand curve.**

The sales demand curve for a product is straight-line.

Demand = 80,000 units when the sales price is ₦0.

Demand = 0 units when the sales price is ₦40.

Derive the demand curve

a = ₦40 (given)

b =₦40/80,000 = 0.0005

Demand curve: $P = 40 - 0.0005Q$

This means that if a company increases the selling price then the number of goods sold will fall and vice versa.

Revenue = Price × Quantity

The impact of a price change on the total revenue of a company depends on the interaction between the change in price and the change in quantity. In other words it depends on the slope of the revenue curve. This is the marginal revenue (MR).

### Calculating MR

**Example: Revenue and marginal revenue.**

Demand curve: P = 40 – 0.0005Q

Construct the equation for total revenue and then differentiate it with respect to Q to give an expression for marginal revenue.

Demand curve $P = 40 - 0.0005Q$

Revenue curve:

Multiply the demand curve by Q $P \times Q = 40Q - 0.0005Q^2$

$R = 40Q - 0.0005Q^2$

MR curve by differentiation $\frac{dR}{dQ} = 40 - 0.001Q$

### Calculating MC

Marginal cost is the slope of the total cost curve. An equation for total costs can be constructed (the total cost function) and this can be differentiated with respect to the quantity to find the marginal cost.

**Example: Total cost and marginal cost.**

A business manufactures goods at a variable cost of ₦2 per unit.

Fixed costs are ₦500,000.

Construct the equation for total costs and then differentiate it with respect to Q to give an expression for marginal costs.

Total costs (TC) = Total fixed costs + Total variable costs

Total variable costs = Variable cost per unit (₦2) × Number of units made (Q)

Total costs given by: $TC = 500{,}000 + 2Q$

MC curve by differentiation $\frac{dTC}{dQ} = 2$

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### 13.4.2 Profit-maximisation

A company seeks to maximise its profits. Questions ask for the calculation of the quantity that must be sold to maximise profit (from which a selling price can be calculated).

There are two approaches to measuring the quantity that a business needs to sell to maximise profit using either:

(a) MR = MC; or
(b) the profit function

***MR = MC***

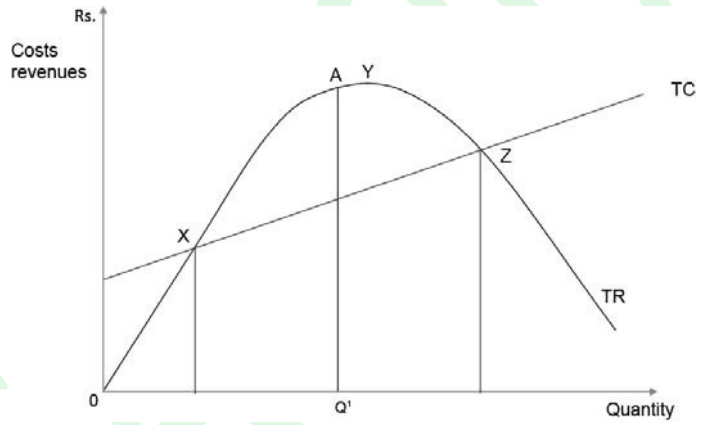
A business should sell an extra unit as long as the marginal revenue (MR) of the sale is greater than its marginal cost (MC).

A company can only sell more and more units by dropping its selling price. Eventually the MR of a sale will become less than its MC.

This implies there is a point where MR = MC at which profit is maximised.

The following diagram shows plots of the revenue curve and cost curve of a product.

**Illustration: Profit and cost curves**




MR = MC approach to finding the selling price and sales quantity at which profit is maximised.

**Step 1:** Derive the demand curve.
**Step 2:** Derive the revenue curve by multiplying the demand curve by Q.
**Step 3:** Derive an expression for MR by differentiating the revenue curve.
**Step 4:** Set MR = MC and solve for the sales quantity that maximises profit.
**Step 5:** Calculate the price at which profits are maximised by substituting the value of Q found at step 4 into the demand curve.

The marginal cost is found by differentiating the total cost line. Usually we assume that the cost function is straight line so marginal cost is simply the slope of this line.

**Example**

**Demand curve: P = 40 – 0.0005Q**

**Total cost line: Total cost = 500,000 + 2Q**

**Step 1**: Demand curve

**Step 2:** Revenue curve:
Multiply the demand curve by Q

$$P = 40 - 0.0005Q$$

$$R = 40Q - 0.0005Q^2$$

**Step 3:** MR curve by differentiation

$$\frac{dR}{dQ} = 40 - 0.001Q$$

**Step 4:** (Set MR = MC)

$$40 - 0.001Q = 2$$

Note that the marginal cost is the slope of the cost line

$$40 - 2 = 0.001Q$$

$$Q = 38{,}000$$

$$P = 40 - 0.0005Q$$

$$P = 40 - 0.0005(38{,}000)$$

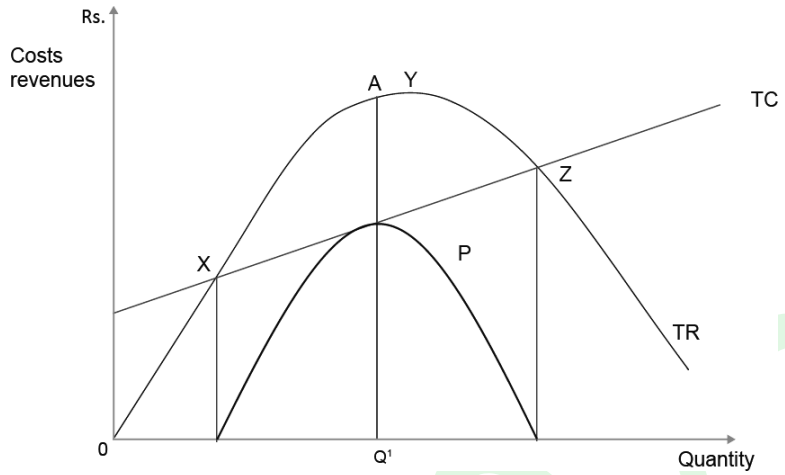
**Conclusion:**
Profit is maximised by selling 38,000 units for ₦21 per unit.

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## Using the profit function

The following illustration shows the curves of the revenue function, total cost function and the profit function.

**Illustration: Profit and cost curves**




The business does not start to make profit until the revenue line crosses the total cost line at point X.

Profit is maximised at $Q^1$. This is where the slope of the revenue curve (MR) equals the slope of the cost curve. Notice that the point A is not the highest point on the revenue curve. $Q^1$ is the quantity that maximises

Profit function approach to finding the selling price and sales quantity at which profit is maximised.

**Step 1:** Derive the demand curve.
**Step 2:** Derive the revenue curve by multiplying the demand curve by Q.
**Step 3:** Derive the total cost curve.
**Step 4:** Derive the profit curve (Profit = Revenue less total costs).
**Step 5:** Differentiate the profit curve to find its slope
**Step 6:** Set the differential coefficient to zero and solve for Q. This is the profit maximising quantity. (You can prove that this is a maximum by checking that the second differential is negative).
**Step 7:** Calculate the price at which profits are maximised by substituting the value of Q found at step 6 into the demand

**Example**

**Demand curve: P = 40 – 0.0005Q**

**A business manufactures goods at a variable cost of ₦2 per unit.**

**Step 1**: Demand curve

$$P = 40 - 0.0005Q$$

**Step 2:** Revenue curve:
Multiply the demand curve by Q

$$R = 40Q - 0.0005Q^2$$

**Step 3:** Derive the total cost curve

$$TC = 500{,}000 + 2Q$$

$$P = R - C$$

$$P = 40Q - 0.0005Q^2 - (500{,}000 + 2Q)$$

**Step 5:** Differentiate the profit curve to find its slope

$$\frac{dP}{dQ} = 38 - 0.001Q$$

$$0 = 38 - 0.001Q$$

**Step 6:** Set the differential coefficient to zero and solve for Q

$$0.001Q = 38$$

$$Q = 38{,}000$$

$$P = 40 - 0.0005Q$$

$$P = 40 - 0.0005(38{,}000)$$

**Conclusion:**
Profit is maximised by selling 38,000 units for ₦21 per unit.

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**Practice question** **2**

**Calculate the profit maximising quantity and price in each of the following scenarios.**

**1** At a price of ₦12 per unit, the expected annual sales demand is 300,000 units

Annual sales demand falls or increases by 2,000 units for every ₦0.50 increase or reduction in price.

Marginal cost is ₦2.

**2** A major hotel is planning a gala dinner, at which there will be up to 800 places available.

The initial idea was to charge ₦1,000 per person and at this price the hotel would expect to sell 600 tickets.

Market research suggests that for every ₦50 increase or reduction in the ticket price, demand will fall or increase by 20.

### 13.4.3 Problems using a demand equation

There are several practical difficulties with using a demand equation to establish a profit-maximising price.

(a) There may be insufficient reliable data to produce an estimate of the demand equation.

(b) The assumption that the demand equation is a straight line may be inaccurate.

(c) A demand equation normally applies to either total market demand for a product or to the demand for a product that is made and sold by a company in a monopoly position in its market. For smaller companies in a competitive market, selling prices might not be the profit-maximising price, but a price at which the company can compete successfully against its rivals.

### 13.4.4 Evaluate a decision to increase production and sales levels, considering incremental costs, incremental revenues and other factors

#### Incremental revenue and incremental cost

Because of the practical problems with deriving a reliable demand equation, decisions about changing the selling price for a product are more likely to be assessed by comparing the incremental revenues and incremental costs that would arise from the price change.

Reducing the selling price of a product by a specific amount should be expected to result in higher sales demand. (If it doesn't, there would be no reason to reduce the price.) Higher sales demand would be met by increasing the volume of output; and at higher volumes of output, costs will change.

(a) There may be no change in variable costs; however variable costs per unit may change. Labour costs per hour will increase if employees are required to work overtime to produce the higher volume of output. On the other hand, direct materials costs per unit might change if volume purchase discounts are available at the new volume of production.

(b) There may be no change in fixed cost expenditure; however fixed cost spending may be higher at higher volumes of output due to a 'step' increase in fixed costs.

To assess the effect of a proposed increase in price on profit, it is necessary to calculate:

(a) the incremental sales revenue, which is the increase in total sales revenue that would occur (or fall in total revenue, if demand is inelastic), and
(b) the incremental costs, which is the net increase in total costs, both fixed and variable that would occur.

A reduction in price would be justified if incremental revenue exceeded incremental costs.

Study the following example carefully.

**Example: Incremental approach**

A company makes and sells a single product. The sales price is ₦20 per unit. Annual sales demand is currently 24,000. Annual fixed costs are ₦250,000, and the variable cost per unit is ₦8, made up as follows:

| **Variable cost per unit** | ₦ |
|---|---|
| Materials | 4 |
| Direct labour | 3 |
| Other variable costs | 1 |
| Total variable cost | 8 |

The company is considering a proposal to reduce the sales price from ₦20 to ₦19. At the lower price, it is expected that annual sales demand would be 30,000 units. The following changes in costs would occur if annual production and sales are increased to 30,000 units:

A favourable volume price discount would be obtained on direct material purchases, and materials costs would fall by 10% for all units produced by the company during the year.

The company's output capacity is 28,000 units during normal working time. At output volumes above this amount, some overtime would have to be worked. The overtime premium is 50% on top of normal hourly rates of pay.

Total fixed cost expenditure would increase to ₦260,000.

**Required**

(a) Calculate the effect on annual profit of the proposed price reduction and recommend (on the basis of change in profit) whether the price should be reduced.
(b) Briefly state any other factors, other than profitability, that might influence the pricing decision.

**Example (continued): Incremental approach**

| | ₦ |
|---|---|
| Sales revenue at new price level: 30,000 × ₦19 | 570,000 |
| Sales revenue at current price level: 24,000 × ₦20 | 480,000 |
| Incremental revenue | 90,000 |
| Total materials cost at new price level: 30,000 × ₦4 × 90% | 108,000 |
| Total materials cost at current price level: 24,000 × ₦4 | 96,000 |
| Incremental cost of materials | (12,000) |
| Incremental cost of labour at basic rate: 6,000 units × ₦3 | 18,000 |
| Overtime premium for 2,000 units: 2,000 × ₦3 × 50% | 3,000 |
| Total incremental cost of labour | (21,000) |
| Other variable costs: incremental costs: 6,000 units × ₦1 | (6,000) |
| Incremental fixed cost expenditure: ₦(260,000 – 250,000) | (10,000) |
| Incremental profit | 41,000 |

**Conclusion**: By reducing the price to ₦19, annual profits would increase by ₦41,000. On the basis of profitability, the sales price should be reduced. **Other factors could affect the decision**:

Profit might be increased even more if the sales price is changed to a different amount, say ₦18.

Management needs to be satisfied that the company has the capacity to produce the larger volume of output without loss of production efficiency or quality.

The recommendation that the price should be reduced assumes that the estimate of sales demand at ₦19 per unit is reliable. If competitors respond by reducing their prices by a similar amount, there might be little or no sales volume increase, and profits might fall rather than increase.

## 13.5 Discuss different pricing strategies

### 13.5.1 The nature of pricing strategies

Although sales prices in a market are determined largely by factors such as supply and demand and competition, companies might use a variety of different pricing strategies, depending on the nature of their business, the nature of the markets in which they operate and the particular circumstances in which a pricing decision is made. For example:

For companies in a jobbing industry or contracting industry, each new job or contract might be different, and this means that a separate price has to be calculated for each individual job or contract. Some form of cost-plus pricing is therefore often used in these industries.

When a company brings an entirely new product to the market, can decide whether to set the price high or low, because there are no rival products on the market.

Several different pricing strategies are described in this section.

### 13.5.2 Full cost plus pricing

Full cost plus pricing involves calculating the full cost of an item (such as a job or contract) – or the expected full cost – and adding a profit margin to arrive at a selling price.

Profit is expressed as either:

(a) a percentage of the full cost (a profit 'mark-up') or
(b) a percentage of the sales price (a 'profit margin').

#### Advantages of full cost plus pricing

A business entity might have an idea of the percentage profit margin it would like to earn on the goods or services that it sells. It might therefore decide the average profit mark-up on cost that it would like to earn from sales, as a general guideline for its pricing decisions. This can be useful for businesses that carry out a large amount of **contract work** or **jobbing work**, for which individual job or contract prices must be quoted regularly to prospective customers and there is no obvious 'fair market' price

The percentage mark-up or profit margin does not have to be a fixed percentage figure. It can be varied to suit the circumstances, such as demand conditions in the market and what the customer is prepared to pay.

There are also other possible advantages in using full cost plus pricing:

(a) If the budgeted sales volume is achieved, sales revenue will cover all costs and there will be a profit.
(b) It is useful for justifying price rises to customers, when an increase in price occurs as a consequence of an increase in costs.

### Disadvantages of full cost plus pricing

The main disadvantage of cost plus pricing is that it is calculated on the basis of cost, without any consideration of market conditions, such as competitors' prices.

(a) Cost plus pricing fails to allow for the fact that when the sales demand for a product is affected by its selling price, there is a profit-maximising combination of price and demand. A cost plus based approach to pricing is unlikely to arrive at the profit-maximising price for the product.
(b) In most markets, prices must be adjusted to market and demand conditions. The pricing decision cannot be made on a cost basis only.

There are also other disadvantages:

(a) The choice of profit margin or mark-up is arbitrary. How is it decided?
(b) When a company makes and sells different types of products, the calculation of a full cost becomes a problem due to the weaknesses of absorption costing. The method of apportioning costs between the different products in absorption costing is largely subjective. This affects the calculation of full cost and the selling price. For example, full cost per unit will differ according to whether a direct labour hour absorption rate or a machine hour absorption rate is used. Full cost will also differ if activity-based costing is used.

**Example: Full cost plus pricing**

Entity Q makes two products, product X and product Y. These products are both made by the same work force and in the same department. The budgeted fixed costs are ₦900,000. Variable costs per unit are as follows:

| | Product X | | | Product Y |
|---|---|---|---|---|
| | ₦ | | | ₦ |
| Direct costs | 60 | | | 60 |
| Materials | | | | |
| Labour | (2 hours) | 120 | (3 hours) | 180 |
| Expenses | (1 machine hour) | 60 | (1 machine hour) | 60 |
| | 240 | | | 300 |

Budgeted production and sales are 1,500 units of product X and 1,000 units of product Y.

The sale prices for each unit of product X and product Y to give a profit margin of 20% on the full cost, if overheads are absorbed on a direct labour hour basis is

**Example (continued): Full cost plus pricing Direct labour hour basis**

Budgeted direct labour hours = (1,500 × 2) + (1,000 × 3) = 6,000 hours.

Overhead absorption rate = ₦900,000/6,000 = ₦150 per direct labour hour.

| | Product X | Product Y |
|---|---|---|
| **Direct costs** | **₦** | **₦** |
| Materials | 60 | 60 |
| Labour | 120 | 180 |
| Expenses | 60 | 60 |
| | 240 | 300 |
| Absorbed overhead | 300 | 450 |
| Full cost | 540 | 750 |
| Mark-up (20%) | 108 | 150 |
| Selling price/unit | 648 | 900 |

The budgeted profit would be (1,500 × ₦108) + (1,000 × ₦150) = ₦312,000.

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**Practice question** **3**

A company makes two products, product A and product B. These products are both made by the same work force and in the same department.

The budgeted fixed costs are ₦2,800,000.

| | Product X | | Product Y | |
|---|---|---|---|---|
| Direct costs | ₦ | | ₦ | |
| Materials | 100 | | 250 | |
| Labour | (4 hours) | 200 | (3 hours) | 150 |
| Expenses | (1 machine hour) | 200 | (1.5 machine hour) | 300 |
| | 500 | | | 700 |

Budgeted production and sales are 2,000 units of each product.

Calculate the sale prices for each unit of product X and product Y which give a profit margin of 15% on the full cost, if overheads are absorbed on a labour hour basis or on a machine hour basis.

### 13.5.3 Marginal cost plus pricing (mark-up pricing)

With marginal cost plus pricing, also called mark-up pricing, a mark-up or profit margin is added to the marginal cost in order to obtain a selling price.

The method of calculating sales price is similar to full-cost pricing, except that marginal cost is used instead of full cost. The mark-up represents contribution.

#### *Advantages of marginal cost plus pricing*

The advantages of a marginal cost plus approach are as follows:

(a) It is useful in some industries such as retailing, where prices might be set by adding a mark-up to the purchase cost of items bought for resale. The size of the mark-up can be varied to reflect demand conditions. For example, in a competitive market, a lower mark-up might be added to high- volume items.

(b) It draws management attention to contribution and the effects of higher or lower sales volumes on profit. This can be particularly useful for short-term pricing decisions, such as pricing decisions for a market penetration policy (described later).

(c) When an organisation has spare capacity, marginal cost plus pricing can be used in the short-term to set a price which covers variable cost. This approach is used by hotels, airlines, railway companies and telephone companies **to price off-peak usage**. As long as fixed costs are covered by peak users and the lower price set does not affect the main market, a marginal cost price can be set off-peak to increase demand and therefore contribution.

(d) It is more appropriate where fixed costs are low and variable costs are high.

### Disadvantages of marginal cost plus pricing

A marginal cost plus approach to pricing also has disadvantages.

(a) Although the size of the mark-up can be varied according to demand conditions, marginal cost plus pricing is a cost-based pricing method, and does not properly take market conditions into consideration.

(b) It ignores fixed overheads in the pricing decision. Prices must be high enough to make a profit after covering all fixed costs. Cost-based pricing decisions therefore cannot ignore fixed costs altogether. A risk with marginal cost plus pricing is that the mark-up on marginal cost might not be sufficient to cover fixed costs and achieve a profit.

## 13.5.3 Return on investment (ROI) pricing

This method of pricing might be used in a decentralised environment where an investment centre within a company is required to meet a target return on capital employed. Prices might be set to achieve a target percentage return on the capital invested.

With return on investment pricing, the selling price per unit may be calculated as:

**Formula: Return on investment (ROI) pricing**

$$= \frac{\text{Budgeted total costs of the division + (target ROI\% } \times \text{ capital employed)}}{\text{Budgeted volume}} \times 100$$

When the investment centre makes and sells a single product, the budgeted volume is sales volume.

When the investment centre makes and sells several different products, budgeted volume might be production volume in hours, and the mark-up added to cost is then a mark-up for the number of hours worked on the product item.

Alternatively, the budgeted volume might be sales revenue, and the mark-up is then calculated as a percentage of the selling price (a form of full cost plus pricing).

### Advantages of ROI pricing

The advantages of an ROI approach to pricing are as follows:

(a) ROI pricing is a method of deciding an appropriate profit margin for cost plus pricing.

(b) The target ROI can be varied to allow for differing levels of business risk.

### Disadvantages of ROI pricing

An ROI approach to pricing also has disadvantages.
Like all cost-based pricing methods, it does not take market conditions into sufficient consideration, and the prices that customers will be willing to pay.

Since it is a form of full cost plus pricing, it shares most of the other disadvantages as full cost plus pricing.

**Practice questions** **4**

A manufacturer is about to launch a new

The non-current assets needed for production will cost ₦4,000,000 and working capital requirements are estimated at ₦800,000.

The expected annual sales volume is 40,000

units. Variable production costs are ₦60 per

unit.

Fixed production costs will be ₦600,000 each year and annual fixed non- production costs will be ₦200,000.

**Required**

(a) Calculate selling price using:

(i) full cost plus 20%

(ii) marginal cost plus 40 %

### 13.5.4 Market skimming prices

When a company introduces a new product to the market for the first time, it might choose a pricing policy based on 'skimming the market'.

When a new product is introduced to the market, a few customers might be prepared to pay a high price to obtain the product, in order to be one of the first people to have it. Buying the new product gives the buyer prestige, so the buyer will pay a high price to get it.

In order to increase sales demand, the price must be gradually reduced, but with a skimming policy, the price is reduced slowly and by small amounts each time. The contribution per unit with a skimming policy is very high, although unit costs of production could also be quite high, since sales volumes are low.

To charge high prices, the firm might have to spend heavily on advertising and other marketing expenditure.

Market skimming will probably be more effective for new 'high technology' products, such as (in the past) flat screen televisions and laptop computers.

Firms using market skimming for a new product will have to reduce prices later as new competitors enter market with rival products. A skimming strategy is therefore a short-term pricing strategy that cannot usually be sustained for a long period of time.

### 13.5.5 Skimming prices and a product differentiation strategy

It is much more difficult to apply a market skimming pricing policy when competitors have already introduced a rival product to the market. Customers in the market will already have a view of the prices to expect, and might not be persuaded to buy a new version of a product in the market unless its price is lower than prices of existing versions.

However, it may be possible to have a policy of market skimming if it is possible to differentiate a new product from its rivals, usually on the basis of quality. This

is commonly found in the market for cars, for example, where some manufacturers succeed in presenting new products as high-quality models. High-quality cars cost more to produce, and sales demand may be fairly low: however, profits are obtained by charging high prices and earning a high contribution for each unit sold.

### 13.5.6 Market penetration prices

Market penetration pricing is an alternative pricing policy to market skimming, when a new product is launched on to the market for the first time.

With market penetration pricing, the aim is to set a low selling price for the new product, in order to create a high sales demand as quickly as possible. With a successful penetration pricing strategy, a company might 'capture the market' before competitors can introduce rival products.

A firm might also use market penetration prices to launch its own version of a product into an established market, with the intention that offering low prices will attract customers and win a substantial share of the market.

### 13.5.7 Penetration pricing and a cost leadership strategy

A cost leadership market strategy is a strategy of trying to become the lowest-cost producer of a product in the market. Low-cost production is usually achieved through economies of scale and large-scale production and sales volumes.

Penetration pricing is consistent with a cost leadership strategy, because low prices help a company to obtain a large market share, and a large market share means high volumes, economies of scale and lower costs.

### 13.5.8 Pricing of complementary products and product line pricing

#### Complementary products

Complementary products are products that 'go together', so that if customers buy one of the products, they are also likely to buy the other. Examples of complementary products are:

(a) computer games consoles and computer games;
(b) mobile telephones (portable phones) and telephone calls from mobile phones.

Occasionally if a company sells two or more complementary products it could sell one product at a very low price in the knowledge that if sales demand for the first product is high, customers will then buy more of the second product (which can be priced to provide a much bigger profit margin).

#### Product lines

A product line is a range of products made by the same manufacturer (or a range of services from the same service provider) where the products have some similarity or connection so that customers see them as belonging to the same 'family'.

Examples of a product line are:

(a) a brand and design of tableware manufactured by the same company (such as a range of tableware items in Dresden china);
(b) a brand and range of sports items (such as rackets or golf equipment) made by the same manufacturer.

When manufacturers produce a line of related items, the pricing strategy for all items in the product line might be the same (for example, a product line might be sold as a high-price, high-quality branded range).

**Volume discounting**

A price strategy of volume discounting involves selling at reduced prices to customers who buy in large volumes over a period of time, or for large-value sales orders.

Volume discounting can have either of the following purposes:

(a) To persuade customers to buy a product, by offering a lower price (on condition that the order is above a given size)
(b) To increase profits by selling in larger volumes, even though the sales price is lower.

### 13.5.7 Price discrimination (differential pricing)

With price discrimination (or differential pricing), a firm sells a single identical product in different segments of the market at different prices.

A market segment is simply a separately-identifiable part of the entire market. Customers in one market segment have different characteristics, buying habits, preferences and needs from the customers in other segments of the same total market.

For price discrimination to work successfully, the different market segments must be kept separate. It might be possible to charge different prices for the same product:

(a) in different geographical areas – for example, it would be possible to sell the same product at very different prices in the US and in China;
(b) at different times of the day – for example, travel tickets might be priced differently at different times of the day or the week;
(c) to customers in different age groups – for example, offering special prices to individuals over a certain age, or to students or to children.

## 13.6 CHAPTER REVIEW

(a) Before moving on to the next chapter check that you now know how to:
(b) Explain the factors that influence selling prices
(c) Explain and calculate price elasticity
(d) Derive cost and demand functions
(e) Calculate the price (and therefore quantity) that leads to profit maximisation
(f) Explain different types of pricing strategy

## SOLUTIONS TO PRACTICE QUESTIONS

**Solutions** **1**

(a) If the price is increased from ₦9 to ₦10

The change in quantity demanded as a percentage of original demand

= - 400/2,000 = - 0.20 or - 20%.

The change in price as a percentage of the original price = ₦1/₦9 = + 0.111 or + 11.1%.

PED = - 0.20/ + 0.111 = - 1.8.

The change in quantity demanded as a percentage of original demand

= + 1,000/8,000 = + 0.125 or + 12.5%.

The change in price as a percentage of the original price = - ₦1/₦5 = - 0.20.

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**Solution** **2**

**1** **Step 1**: Demand curve $P = a - bQ$

**a =**

Demand is 300,000 if the sales price is ₦12.

Number of increases before demand falls to zero = 300,000/2,000 = 150.
150 increases is 150 × ₦0.5 = ₦75.

Therefore the price at which the demand would be zero = ₦12 + ₦75 = ₦87.

**b =** ₦0.5/2000 = 0.00025

Multiply the demand curve by Q $R = 87Q - 0.00025Q^2$

**Step 3:** MR curve by differentiation $\frac{dR}{dQ} = 87 - 0.0005Q$

**Step 4:** (Set MR = MC) $87 - 0.0005Q = 2$

Note that the marginal cost is the slope of the cost line

$87 - 2 = 0.0005Q$

$Q = 170{,}000$

$P = 87 - 0.00025Q$

$P = 87 - 0.00025(170{,}000)$

Conclusion:

Profit is maximised by selling 170,000 units for ₦44.5 per unit.

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**Solutions** **2**

**2** **Step 1**: Demand curve $P = a - bQ$

**a =**

Demand is 600 if the sales price is ₦1,000.

Number of increases before demand falls to zero = 600/20 = 30.
30 increases is 30 × ₦50 = ₦1,500.

Therefore the price at which the demand would be zero = ₦1,000 + ₦1,500 = ₦2,500.

**b =** ₦50/20 = ₦2.5

Demand curve $P = 2,500 - 2.5Q$

Multiply the demand curve by Q $R = 2,500Q - 2.5Q^2$

**Step 3:** MR curve by differentiation $\frac{dR}{dQ} = 2,500 - 5Q$

**Step 4:** (Set MR = MC) $2,500 - 5Q = 250$

Note that the marginal cost is the slope of the cost line

$2,500 - 250 = 5Q$

$Q = 450$

$P = 2,500 - 2.5Q$

$P = 2,500 - 2.5(450)$

Conclusion:
Profit is maximised by selling 450 seats for ₦1,375 per head.

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**Solutions** **3**

**Labour hour basis**

Budgeted labour hours = (2,000 × 4) + (2,000 × 3) = 14,000 hours

| | Product X | Product Y |
|---|---|---|
| **Direct costs** | ₦ | ₦ |
| Materials | 100 | 250 |
| Labour | 200 | 150 |
| Expenses | 200 | 300 |
| | 500 | 500 |
| Absorbed overhead | 800 | 600 |
| Full cost | 1,300 | 1,100 |
| Mark-up (15%) | 195 | 165 |
| Selling price/unit | 1,495 | 1,265 |

The budgeted profit would be (1,000 × ₦195) + (1,000 × ₦165) = ₦360,000.

**Machine hour basis**

Budgeted machine hours = (2,000 × 1) + (2,000 × 1.5) = 5,000 hours.

| | Product X | Product Y |
|---|---|---|
| **Direct costs** | ₦ | ₦ |
| Materials | 100 | 250 |
| Labour | 200 | 150 |
| Expenses | 200 | 300 |
| | 500 | 500 |
| Absorbed overhead | 560 | 840 |
| Full cost | 1,060 | 1,340 |
| Mark-up (15%) | 159 | 201 |
| Selling price/unit | 1,219 | 1,541 |

The budgeted profit would be (1,000 × ₦159) + (1,000 × ₦201) = ₦360,000.

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**Solutions** **4**

| **(i) Full cost plus 20%** | **₦per unit** |
|---|---|
| Variable cost | 60 |
| Fixed costs (₦600,000 + ₦200,000)/40,000 units | 20 |
| Full cost | 80 |
| Mark-up: 20% on cost | 16 |
| Selling price | 96 |

| **(ii) Marginal cost plus 40%** | **₦per unit** |
|---|---|
| Variable cost | 60 |
| Mark-up: 40% on variable cost | 24 |
| Selling price | 84 |

| **(iii) Target ROI pricing** | **₦** |
|---|---|
| Non-current assets | 4,000,000 |
| Working capital | 800,000 |
| Capital employed | 4,800,000 |
| Profit required (₦4,800,000 ´ 10%) | 480,000 |
| Profit required per unit (40,000 units) | ₦12 |

| | ₦ |
|---|---|
| Variable cost | 60 |
| Fixed costs (see above, full cost plus pricing) | 20 |
| Full cost | 80 |
| Profit | 12 |
| Selling price | 92 |

(b) If sales are only 20,000 units (= below budget):

| **Profit for the year** | **₦** |
|---|---|
| Sales (20,000 units ´ ₦96) | 1,920,000 |
| Variable costs (20,000 units ´ ₦60) | (1,200,000) |
| Fixed costs | (800,000) |
| Net loss | (80,000) |

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**PRICING DECISIONS**

**Detailed syllabus**

The detailed syllabus includes the following:

| Decision making | | | |
|---|---|---|---|
| **1** | **Advanced decision-making and decision-support** | | |
| | **e** | Explain different pricing strategies, including: | |
| | | i | Cost-plus; |
| | | ii | Skimming; |
| | | iii | Market penetration; |
| | | iv | Complementary product; |
| | | v | Product-line; |
| | | vi | Volume discounting; and |
| | | vii | Market discrimination. |
| | **f** | Calculate and present numerically and graphically the optimum selling price for a product or service using given data and information by applying relevant cost and economic models and advise management. | |

## Exam context

This chapter explains different approaches that may be used to set prices.

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

(a) Explain the factors that influence selling prices
(b) Explain and calculate price elasticity
(c) Derive cost and demand functions
(d) Calculate the price (and therefore quantity) that leads to profit maximisation
(e) Explain different types of pricing strategy

## 13.7 Determine prices and output levels for profit maximisation using the **demand based approaches to pricing**

## 13.8 Factors that influence Price

### 13.8.1 The nature of pricing decisions

For many companies, pricing decisions are amongst the most important decisions management must make. The selling price for a company's products or services will affect:

(a) the volume of sales demand; and
(b) the profit margin per unit.

Some pricing decisions are for the longer term; companies have to decide the general price level at which it wants to sell its goods or services. The ability of companies to decide the general level of selling prices differs according to the size of the company relative to the size of the market it operates in.

(a) Companies that dominate their market, and are the largest suppliers to the market, are often able to decide what selling prices should be. They are 'price makers'. Companies that dominate their market might sell their products at low prices to maintain their dominant market share.
(b) Companies that do not dominate their market are usually 'price takers', which means that they have to sell their products at about the same price as other companies in the market. They are unable to sell at lower prices without incurring a loss; and if they try selling at higher prices, customers will switch to rival suppliers.

In the short term companies might use other pricing strategies, such as temporary price reductions or pricing a special job or contract at a low price in order to win the work and a new customer.

Some of the factors that influence sales pricing decisions are described briefly in the rest of this section.

### 13.8.2 Demand and supply

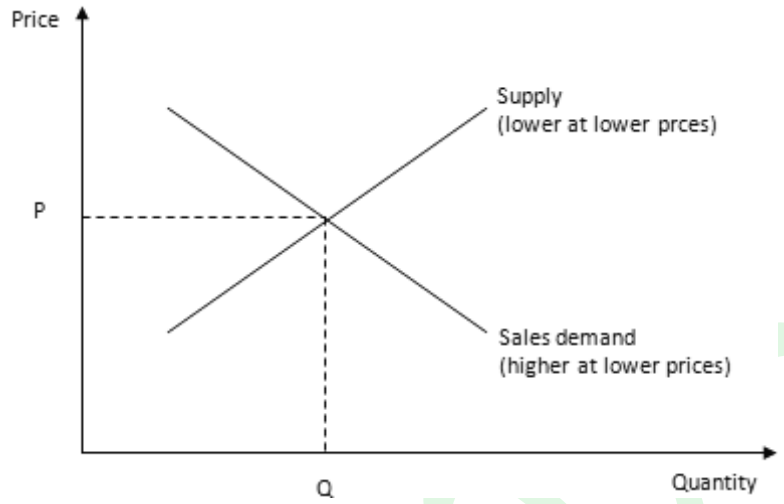
According to basic microeconomic analysis, the sales price for a product in a market is determined by demand and supply.

(a) Demand is the volume of sales demand that will exist for the product at any given price. As a normal rule, sales demand will be higher when the price is lower. If the price rises, total sales demand will fall. If the price falls, sales demand will rise.

(b) Supply is the quantity of the product (or service) that suppliers are willing to ` sell at any given sales price. Higher prices will attract more suppliers into the market and encourage existing suppliers to produce more. Lower prices will deter some suppliers, and might drive some out of business if the price fall results in losses.

A simple graph of supply and demand is shown below. In this diagram, the equilibrium price level is the sales price that would become established in the market if the factors that affect supply or demand did not change. Here the price would be P and the total sales demand for the product would be Q units.

**Example: Supply and demand**




Occasionally, sales demand for a product might rise to such a high level that producers in the market are unable to meet the demand in full. Until production capacity can be increased, this situation could result in very large price rises and very high profit margins for producers.

An example of demand exceeding supply capacity has been the market for oil on occasions in the past. Oil suppliers are unable to alter their output volumes quickly, so a large increase in demand for oil can result in very large price increases, at least in the short term.

### *13.8.2 Monopoly pricing*

Supply and demand in the diagram above is for the market as a whole, and within the market there might be many different suppliers competing with each other to win business.

A similar situation applies to companies that are dominant in their particular market, and supply most of the goods or services sold in the market. In these 'monopoly markets', the individual company has a downward-sloping demand curve, which means that:

(a) as a monopoly supplier to the market, it is in a position to set prices for the market, but
(b) if it raises the prices of its products, the demand for its products will fall.

## 13.8.3 Pricing in a competitive market

In contrast to a monopoly market, companies that sell their products in a highly competitive market will decide their selling prices by comparing them with those of competitors.

In order to compete effectively, companies might use short-term pricing tactics such as price reductions, volume purchase discounts, better credit terms and so on.

### 13.8.4 Cost

In the long run, the sales price must exceed the average cost of sales of the product that a business entity sells. If cost is higher than selling price, the business will make a loss and cannot survive in the long term. Cost is therefore a major determinant of price.

Costs are influenced by factors such as:

(a) suppliers' prices for raw materials and components;
(b) price inflation;
(c) exchange rate movements;
(d) other elements of cost, such as wage rates and general expenses;
(e) quality: it usually costs more to produce an item to a higher quality standard.

A company may have to decide where it wants to position its product in the market in terms of quality. Premium pricing (higher-than-average prices) prices can be used for higher quality products, but customers may prefer lower quality, lower priced products. A clear understanding of the link between quality and cost will be needed to help management determine the optimum price/quality mix.

If a company is able to reduce its costs, it should be in a position if it wishes to reduce its sales prices and compete more aggressively (on price) for a bigger share of the market.

### 13.8.4 Income of customers

Another microeconomic factor influencing sales demand in any market is the level of income of customers and potential customers for the product.

As the income of customers rises, they are more likely to want to buy more of the product. When demand is growing because income levels are rising, there is a tendency for prices to rise.

(a) In an economy as a whole, rising income occurs when the national economy is growing, and prices will rise. (The authorities might try to prevent excessive inflation, but prices will nevertheless increase.)

(b) When income in an economy is falling, there is an economic recession, and there might even be some price falls.

### 13.8.5 Product life cycle

The product life cycle is explained in more detail in a later chapter on life cycle costing.

As a product goes through the different stages of its life cycle, sales prices will change.

(a) **Introduction stage**. During the introduction stage of its life cycle, the product is introduced to the market. If the product is new, and there are no rival products on the market, there is a choice between a market skimming policy for pricing or a market penetration policy. These policies are explained later.

(b) **Growth stage**. During the growth stage of its life cycle, demand for the product increases rapidly, but more competitors enter the market. If the market is competitive, each firm might have to lower its prices to win a share of the growing market. However, because sales demand is strong, prices and profit margins are likely to be fairly high (although falling). Some companies might try to identify a specialist 'niche' in the market, where they have more control over pricing of their products. Similarly, companies might try to keep prices higher by differentiating their product from those of competitors on the basis of quality or other distinguishing features (such as design differences).

(c) **Maturity stage**. When a product reaches the maturity stage of its life cycle, total sales demand in the market becomes stable, but the product may become a 'commodity'. Firms must then compete for market share, often by cutting prices. Companies might use product differentiation strategies to keep the price of their product higher than it might otherwise be, but prices generally will be lower than during the growth stage of the life cycle.

(d) **Decline**. Eventually, the market demand for a product declines. When sales demand falls, companies leave the market. Those that remain keep on selling the product as long as they can make a profit. Prices might remain very low. In some cases, however, a product might acquire 'rarity value', allowing companies to raise prices. However, since unit costs will also be higher, it is still difficult to make a profit.

### 13.8.6 Quality

Some customers will often be willing to pay more for better quality and companies may set prices higher than the market average because their products have a better-quality design or more features that provide value to customers.

Quality is often 'real', and can be provided by better-quality materials (for example in clothing products) or by greater reliability of performance or better performance (for example in motor cars).

Quality may also be 'perceived' rather than real, and customers will pay more for a branded product than for a similar or near-identical product with no brand name or a 'cheaper' brand name

### 13.8.7 Other factors influencing price

There are other influences on pricing decisions and the general level of selling prices in a market.

(a) The price of 'substitute goods'. Substitute goods are goods that customers

could buy as an alternative. Companies might set the price for their product in the knowledge that customers could switch to an alternative product if they think that the price is too high. For example, if the price of butter is too high, more customers might switch to margarine or other types of 'spread'.

(b) The price of 'complementary goods'. Complementary goods are items that customers will have to buy in addition to complement the product. The pricing of complementary products is explained in more detail later, as a pricing strategy that companies may use.

(c) Consumer tastes and fashion. High prices might be obtained for 'fashion goods'.

(d) Advertising and marketing. Sales demand can be affected by sales and marketing activities, including public relations activity. Strong consumer interest in a product or service could allow a company to set a higher price.

In addition to general factors influencing price, such as supply and demand, competition and cost, companies will use one or more different pricing strategies to decide the sales prices for their products or services.

A number of different pricing strategies are described in a later section of this chapter.

## Chapter Review

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

(a) Explain the factors that influence selling prices

(b) Explain and calculate price elasticity

(c) Derive cost and demand functions

(d) Calculate the price (and therefore quantity) that leads to profit maximisation

(e) Explain different types of pricing strategy

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**Skills level**
**Performance management**




# MAKE OR BUY AND OTHER SHORT TERM DECISIONS

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# 14 Make or Buy and Other Short Term Decisions

## 14.0 Learning Objectives

This chapter introduces candidates to further side of relevant costs as it applies to both short-term and long-term decisions.

(a) 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.
(b) 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.

Other 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
(d) Joint product further processing decisions.

## 14.1 Learning outcome

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

(a) application of relevant costing approach in make or buy decision, shut down;
(b) explain the factors that influence selling prices;
(c) explain and calculate price elasticity;
(d) derive cost and demand functions;
(e) calculate the price (and therefore quantity) that leads to profit maximisation; and
(f) explain different types of pricing strategy.

## 14.2 Make-or-buy decisions:

### 14.2.1 Calculate the prices from given strategies

**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 outsourcing the work

**Example: Make-or-buy decisions**

A company manufactures a component that is included in a final product that it also manufactures. 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?

| | |
|---|---|
| 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 |

### 14.2.2 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:

(a) the additional costs of outsourcing production of an item with
(b) 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 | | | ₦140 |
| Priority for outsourcing | 3rd | 2nd | 1st |
| Priority for doing work with own | | | |

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) | | | |
| Maximum labour hours available | 8,000 | | 1,342,400 |
| Sub-contract: | | 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** **1**

A company makes four products, W, X, Y and Z. All four products are made on the same machines, and the machine capacity for the year at the company's factory is 3,500 hours.

The company is able to obtain any of these products in unlimited quantities from a sub-contractor.

Budgeted data is as follows.

| **Product** | **W** | **X** | **Y** | **Z** |
|---|---|---|---|---|
| Annual sales demand (units) | 4,000 | 6,000 | 3,000 | 5,000 |
| | ₦ | ₦ | ₦ | ₦ |
| Sales price per unit | 150 | 200 | 180 | 170 |
| Variable cost per unit, in-house manufacture | 50 | 70 | 60 | 70 |
| Cost of external purchase (outsourcing) | 80 | 118 | 105 | 110 |
| Machine hours per unit, in- house production | 0.25 | 0.5 | 0.3 | 0.4 |

Which items should be produced in-house and which should be outsourced?
Calculate the total cost associated with the optimal plan.

### 14.2.3 Non-financial considerations

When relevant costs are used to make a decision, it is assumed that the decision should be based on financial considerations and whether the decision will add to profit (cash flows).

In reality, however, managers are likely to think about non-financial issues as well as financial issues when making their decisions. The non-financial considerations in any decision will depend on the circumstances, and will vary from one decision to another. Non-financial considerations can influence a decision. In your examination, be prepared to identify relevant non-financial issues in a particular situation, and discuss their potential implications.

Non-financial considerations that will often be relevant to a make-or-buy decision include the following.

(a) When work is outsourced, the entity loses some control over the work. It will rely on the external supplier to produce and supply the outsourced items. There may be some risk that the external supplier will:
(b) produce the outsourced items to a lower standard of quality, or
(c) fail to meet delivery dates on schedule, so that production of the end- product may be held up by a lack of components.
(d) The entity will also lose some flexibility. If it needs to increase or reduce

supply of the outsourced item at short notice, it may be unable to do so because of the terms of the agreement with the external supplier. For example, the terms of the agreement may provide for the supply of a fixed quantity of the outsourced item each month.

(e) A decision to outsource work may have implications for employment within the entity, and it may be necessary to make some employees redundant. This will have cost implications, and could also adversely affect relations between management and other employees.

(f) It might be appropriate to think about the longer-term consequences of a decision to outsource work. What might happen if the entity changes its mind at some time in the future and decides either (a) to bring the work back in-house or (b) to give the work to a different external supplier? The problem might be that taking the work from the initial external provider and placing it somewhere else might not be easy in practice, since the external supplier might not be co-operative in helping with the removal of its work.

The non-financial factors listed above are all reasons against outsourcing work. There might also be non-financial **benefits** from outsourcing work to an external supplier.

(a) If the work that is outsourced is not specialised, or is outside the entity's main area of expertise, outsourcing work will enable management to focus their efforts on those aspects of operations that the entity does best. For example, it could be argued that activities such as the management of an entity's fleet of delivery vehicles, or the monthly payroll work, should be outsourced because the entity itself has no special expertise on these areas.

(b) The external supplier, on the other hand, may have specialist expertise which enables it to provide the outsourced products or services more efficiently and effectively. For example a company might outsource all its IT support operations, because it cannot recruit and retain IT specialists. An external service provider, on the other hand, will employ IT specialists.

## 14.3 Application of relevant costing on one-off contract , shutdown and further product processing:

### 14.3.1 Applications of relevant costing

The principles of relevant costing were explained in the previous chapter.

These principles 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 are:

(a) One-off contract decisions
(b) Shutdown decisions
(c) Joint product further processing decisions.

### 14.3.2 One-off contract decisions

Management might have an opportunity to carry out a contract or job for a customer, where the job is 'once only' and will not be repeated in the future. The decision is therefore to decide whether to agree to do the job at the price offered by the customer, or to decide a selling price at which an incremental profit would be made.

If it is a one-off contract, rather than regular production work, it would be worthwhile

undertaking the contract if the extra revenue from the contract is higher than the relevant costs of doing the work (including any opportunity costs).

The incremental profit from the one-off contract is the revenue that would be obtained minus the relevant costs.

One-off contract decisions might occur when a company has spare capacity, and an opportunity arises to earn some extra profit. This type of analysis should not be applied to most contract decisions, however, because a company must earn sufficient profits in total to cover its fixed costs and make a profit. Relevant costs do not help management to decide what the size of the profit margin should be, in order to ensure that the company makes an overall profit from all its activities

**Practice question 2**

Contractor Ltd. 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 Contractor Ltd. but are currently idle due to a recent downturn in business.

(b) Materials X and Y will be used. 100 tonnes 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 tonne but it would cost ₦180 per tonne to replace it 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 B is toxic and if not used in this contract Contractor Ltd. must pay ₦24,000 to have it disposed.

(c) The contract will require the use of a storage unit for three months. Contractor 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 Contractor Ltd. 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 performed the following calculation which shows that the contract will cost ₦359,000 to deliver and concluded that the contract should therefore not be accepted for ₦200,000.

| Description | Relevant cost |
|---|---|
| | ₦120,000 |
| Labour: 200 hours x ₦600 | |
| Material X: 100 tonnes 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 |

Calculate the relevant cost of the contract and advise whether the contract should be accepted or not on financial grounds.

### 14.3.3 Shutdown decisions

A shutdown decision is a decision about whether or not to shut down a part of the operations of a company. From a financial viewpoint, an operation should be shut down if the benefits of shutdown exceed the relevant costs.

A shutdown decision may be a long-term decision when there are large initial expenditures involved (for example, costs of making the work force redundant). For the purpose of the examination, however, any shutdown decision will be a short-term decision.

**Example: Shutdown decisions**

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.

| **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) |

Product S makes a loss of ₦350,000 after allocation of general fixed overhead. However, this is misleading as the allocation of general fixed overhead is not a relevant cost. Stopping making product S 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.

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### 14.3.3 Joint product further processing decisions

Joint products are products manufactured from a common process. In some instances, a company might have a choice between:

(a) selling the joint product as soon as it is output from the common process, or
(b) processing the joint product further before selling it (at a higher price).

This is a short-term decision, and the financial assessment should be made using relevant costs and revenues. The financial assessment should compare:

(a) the revenue that will be obtained (less any selling costs) from selling the joint product as soon as it is output from the common process, and
(b) the revenue that will be obtained if the joint product is processed further, less the incremental costs of further processing and then selling the product.

Applying relevant costing, the costs of the common process are irrelevant to the decision, because these costs will be incurred anyway, whatever the decision. The decision should be to further process the joint product if the extra revenue from further processing exceeds the extra (relevant) costs of the further processing.

**Example: Joint product further processing decisions**

A company produces two joint products from a common process. The costs of the common process are ₦4,000 per 100 kilograms of input.

For every 100 kilograms of input to the common process, output consists of 40 kilograms of J1 and 60 kilograms of J2.

J1 can be sold for ₦100 per kilogram and J2 can be sold for ₦160 per kilogram.

Alternatively, J1 can be processed to make a finished product, F1.

Costs of further processing consist of variable costs of ₦60 per kilogram and fixed costs of ₦1,200,000 per year.

Of these fixed costs, ₦960,000 would be directly attributable to the further processing operations, and the remaining ₦240,000 would be an apportionment of general fixed overhead costs.

The further processed product (F1) would have a selling price of ₦280 per kilogram.

It is estimated that 15,000 kilograms of J1 will be produced each year. There are no losses in any process.

The decision as to whether J1 be sold as soon as it is produced from the common process, or further processed into Product F1 is made as follows.

**Example (continued) : Joint product further processing decisions**

The common processing costs are irrelevant to the further processing decision. The annual relevant costs and benefits of further processing JP1 are as follows:

| | |
|---|---|
| Revenue from selling FP1 (per kilogram) | 280 |
| Variable further processing cost | (60) |
| | 220 |
| Additional variable revenue from further processing | (100) |
| Opportunity cost: sales of JP1 forgone | 120 |
| Benefit per kilogram from further processing | ₦1,800,000 |
| Number of kilograms produced each year | ₦(960,000) |
| | ₦840,000 |

**Recommendation**: J1 should be processed to make F1, because this will increase annual profit by ₦840,000.

## 14.4 CHAPTER REVIEW

**Chapter review**

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

(b) Analyse relevant costs to decide whether to make or buy a good

(c) Analyse relevant costs to price contracts

(d) Analyse relevant costs to make shutdown decisions

(e) Analyse relevant costs to make further processing decisions

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**Solutions** **1**

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 in-house production | 3rd | 1st | 4th | 2nd |

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 |

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Solutions 2

(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 tonne 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 Contractor 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 Contractor 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 ₦82,000 as follows:

| Description | Relevant cost ₦ |
|---|---|
| Labour | 0 |
| 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 Contractor of ₦123,000 (revenue of ₦200,000 less relevant

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**Skills level**
**Performance management**




# DEALING WITH RISK AND UNCERTAINTY IN DECISION MAKING

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# 15 Dealing With Risk And Uncertainty In Decision Making

## 15.0 Learning objective

This chapter introduces candidates to aspect of performance management that deals with risk and uncertainty in decision making

## 15.1 Learning outcomes

At the conclusion of this chapter, candidates are expected to understand the nature of risk and uncertainty, be in a position to evaluate research techniques to reduce uncertainty and risks as well as be able to calculate expected values, value of perfect and imperfect information and can determine maximax, maximin and minimax regret values.

## 15.2 The nature of risk and uncertainty

A lot of decision-making in business involves some risk or uncertainty. Decisions might be based on what the decision-maker thinks will happen, but there is some possibility that the actual outcome will be different – possibly better or possibly worse than expected.

(a) **Uncertainty** occurs when there is insufficient information about what will happen, or what will probably happen, in the future. It is therefore likely that estimates of future values (estimates of future sales, future costs, and so on) will be inaccurate.

(b) **Risk** occurs when the future outcome from a decision could be any of several different possibilities. However, it might be possible to assess with reasonable accuracy the probability of each possible outcome. When there are reliable estimates of the probability for each possible outcome, risk can be assessed or analysed statistically.

### 15.2.1 Reducing uncertainty

Uncertainty occurs when there is a lack of reliable information. It can therefore be reduced by obtaining more information on which some reliance can be placed. However, it is doubtful whether uncertainty can be eliminated altogether.

There is often uncertainty about the likely volume of sales demand for a product.

(a) For established products, it might be possible to estimate future sales by taking historical sales figures, and making adjustments for sales growth or decline, and planned changes in the sales price.

(b) For new products, however, estimating sales demand can be very difficult because there is no benchmark on which to base the estimate.

Uncertainty about future sales demand for a product can be reduced through the use of market research or focus groups.

Market research is research into a particular market, such as the market for a product, for the purpose of obtaining information about the market – such as attitudes and buying intentions of customers in the market.

(a) Market research might be carried out, for example, to test the attitudes of

target customers to a prototype of a new product.

(b) In some cases, market research might attempt to obtain an estimate of the likely sales demand for a product.

A focus group is a group of participants who are invited to give their views, opinions and ideas about a product or market to a market research team. The members of a focus group will be selected so as to represent a target audience or target market, and the information provided by the group will therefore be representative of the views of the target market as a whole.

By analysing data obtained from market research surveys or focus groups, an entity might expect to obtain more reliable estimates of the likely sales demand for a product.

### 15.2.2 Dealing with risk and uncertainty in decision making

When there is uncertainty or risk in a business decision, management should consider both:

(a) the expected incremental costs, revenues and profits, and also
(b) the risk or uncertainty.

There are several different ways of allowing for risk and uncertainty in decision-making. The approach taken by management will depend to a large extent on their attitude to risk. In other words, to what extent will a management decision be affected by the risk or uncertainty in the situation?

Risk cannot be removed from a decision, because risk exists in the situation itself. A decision-maker can try to analyse the risk, and must make a decision on the basis of whether the risk is justified or acceptable.

### 15.2.3 Risk preference

Risk preference describes the attitude of a decision-maker towards risk. Decision-makers might be described as risk averse, risk-seeking or possibly risk neutral.

(a) A **risk averse decision maker** considers risk in making a decision, and will not select a course of action that is more risky unless the expected return is higher and so justifies the extra risk. A risk-averse decision maker does not try to avoid risk as much as possible; however he might want a substantially higher expected return to make any extra risk worth taking.
(b) A **risk neutral decision maker** ignores risk entirely in making a decision. The decision of a risk neutral decision maker is to select the course of action with the highest expected return, regardless of risk.
(c) A **risk-seeking decision maker** also considers risk in making a decision. A risk seeker, unlike a risk-averse decision-maker, will take extra risks in the hope of earning a higher return.

It is often assumed that managers are risk averse, and so will not select a course of action that has higher risk unless it offers a higher expected return sufficient to justify the risk that is taken.

15.3 Explain the use and application of simulation, expected values and sensitivity to decision making.

### 15.3.1 Expected values

One technique for comparing risk and return of different decision options is the use of expected values.

Expected values can be used to analyse information where risk can be assessed in terms of probabilities of different outcomes. Where probabilities are assigned to different outcomes, we can evaluate the worth of a decision as the expected value or weighted average of these outcomes.

Expected value (EV) = weighted average of possible outcomes.

The weighted average value is calculated by applying the probability of each possible outcome to the value of the outcome.

**Formula: Expected value**

$$Expected\ value = \sum px$$

**Where:**

p = the probability of each outcome

x = the value of each outcome

An EV is a measurement of weighted average value.

A decision might be based on selecting the course of action that offers the highest EV of profit, or the lowest EV of cost. In other words, the 'decision rule' is to select the course of action with the highest EV of profit or the lowest EV of cost.

The main advantage of using EVs to make a decision is that it takes into consideration the probability or likelihood of each different possible outcome, as well as its value (profit or cost

**Example: Expected value**

A business entity has to decide which of three projects to select for investment. The three projects are mutually exclusive.

The projects do not involve any initial capital expenditures.

The expected annual profits from investing in each of the projects depend on the state of the market. The following estimates of annual profits (operational cash flows) have been prepared

| State of market | Declining | Static | Expanding |
|---|---|---|---|
| Probability | 0.4 | 0.3 | 0.3 |
| Project 1 | 100 | 200 | 900 |
| Project 2 | 0 | 500 | 600 |
| Project 3 | 180 | 190 | 200 |

This type of table is called a 'pay-off table' or a 'pay-off matrix'. It shows all the possible 'pay-offs' or results from different possible decisions or strategies.

| **Project 1** | Profit | Probability | Profit ´ probability |
|---|---|---|---|
| Declining | 100 | 0.4 | 40 |
| Static | 200 | 0.3 | 60 |
| Expanding | 900 | 0.3 | 270 |
| | | | 370 |

| **Project 2** | Profit | Probability | Profit ´ probability |
|---|---|---|---|
| Declining | 0 | 0.4 | 0 |
| Static | 500 | 0.3 | 150 |
| Expanding | 600 | 0.3 | 180 |
| | | | 330 |

| **Project 3** | Profit | Probability | Profit ´ probability |
|---|---|---|---|
| Declining | 180 | 0.4 | 72 |
| Static | 190 | 0.3 | 57 |
| Expanding | 200 | 0.3 | 60 |
| | | | 189 |

Based on expected values, project 1 should be selected because it has the highest EV of annual profit.

### Advantages of using expected values

An EV is a weighted average value, that is based on all the different possible outcomes and the probability that each will occur.

It recognises the risk in decisions, based on the probabilities of different possible results or outcomes.

It expresses risk in a single figure, which makes it easy to compare different options and reach a decision.

### Disadvantages of using expected values

The probabilities of the different possible outcomes may be difficult to estimate. If the probabilities are unreliable, expected values will also be unreliable.

The EV is unlikely to be an actual outcome that could occur. In the example above, the EVs for projects 1, 2 and 3 (₦370,000, ₦330,000 and ₦189,000 respectively) are not expected to occur. They are simply weighted average

values.

Unless the same decision has to be made many times, the average will not be achieved. It is therefore not a valid way of making a decision about the future when the outcome w ill happen only once.

An EV is an average value. It gives no indication of the range or spread of possible outcomes. It is therefore an inadequate measurement of risk.

### 15.3.2 Expected values and decision making

Expected values should be reliable for decision-making when:

(a) Probabilities can be estimated with reasonable accuracy, and
(b) The outcome from the decision will happen many times, and will not be a 'one-off' event.

In the following example, the estimate of monthly repair costs using expected value is likely to be very reliable, since the probabilities are based on historical records and the outcome happens many times over (10,000 times each month).

**Example: Expected value**

A company makes and sells 10,000 units of Product K each month.

Currently, when customers complain that there is one or more defects in a product the company repairs the product at its own cost.

Management is now considering selling the product for ₦6 less but no longer accepting liability for any defects.

The decision as to whether to change the policy is to be made by comparing the expected monthly cost of the new policy to the expected monthly cost of the current policy.

Expected monthly cost of new policy:

10,000 units × ₦6 = ₦60,000

**Expected cost of existing policy**

The estimates of defects in each product with a calculation of expected defects are given as follows:

| Number of defects per product | Probability | Number of defects × probability |
|---|---|---|
| 0 | 0.99 | 0 |
| 1 | 0.07 | 0.07 |
| 2 | 0.02 | 0.04 |
| 3 | 0.01 | 0.03 |
| | | 0.14 |
| Number of products sold per month | | 10,000 |
| Expected number of defects per month | | 1,400 |

The estimate of the cost of repairing a defect with a calculation of expected cost is given as follows:

**Cost of repairing one**

| Cost of repairing one defect (₦) | Probability | defect (₦) ´ probability |
|---|---|---|
| 20 | 0.2 | 4 |
| 30 | 0.5 | 15 |
| 40 | 0.3 | 12 |
| Expected cost of each repair | | 31 |
| Expected number of defects per month | | 1,400 |
| Expected cost of all repairs | | ₦43,400 |

The policy should not be changed.

## 15.4 Explain and calculate the value of perfect band imperfect information

### 15.4.1 Value of perfect information

Sometimes a question might go on to ask how much a company would be willing to pay to be absolutely certain of an outcome. In other words what is the value of perfect information?

The answer to this question can be simply expressed as:

**Illustration: Value of perfect information**

| | ₦ |
|---|---|
| Expected value without perfect information | X |
| Expected value with perfect information | X |
| Value of perfect information | Y |

**Example: Value of perfect information**

An organisation has offered to provide a perfect forecast of whether the future economic conditions will be good or bad.

What is the maximum amount that the company would pay for this forecast?

At point C – If the company knew that future economic conditions were good it would proceed but if it knew they were poor it would not proceed (thus avoiding the loss of ₦20,000).

The chance of the forecast being good is 60%.

Therefore: Expected value at point C (EVC)

= (0.6 ×50,000) = 30,000

Expected value at point B (EVB)

= (0.8 × EVC) + (0.2 × zero) = (0.8 × 30,000) + (0.2 × zero) = 24,000

Decision at point A (EVA)

Proceed at a cost of ₦12,000 to earn profits with an expected value of ₦24,000 would give a gain of ₦12,000.

The value of the perfect information is then calculated as follows:

| | ₦ |
|---|---|
| Expected value with perfect information | 12,000 |
| Expected value without perfect information | 5,600 |
| Value of perfect information | 6,400 |

### 15.4.2 Value of imperfect information

It might be possible to reduce uncertainty but not to remove it entirely. An expert might be able to make a forecast about the future but that expert might be wrong.

The approach to valuing imperfect information same as before but the calculations can be quite tricky.

**Illustration: Value of imperfect information**

| | ₦ |
|---|---|
| Expected value without imperfect information | X |
| Expected value with imperfect information | X |
| Value of imperfect information | X |

**Example: Value of imperfect information**

An organisation has offered to provide a perfect forecast of whether the future economic conditions will be good or bad.

The organisation normally achieves 85% accuracy (in other words they are wrong 15% of the time). This means that when the say the economy will be strong it may well be bad and vice versa. (Assume that the company will not proceed if a poor economy is forecast).

It is necessary to build a table of possible outcomes before solving the question.

| | Economic conditions are good (60) | Economic conditions are poor (404) | |
|---|---|---|---|
| Expert forecasts the economy will be good | 0.85 ´ 0.6 = 0.51 | 0.15 ´ 0.4 = 0.06 | 0.57 |
| Expert forecasts the economy will be good | 0.15 ´ 0.6 = 0.09 | 0.85 ´ 0.4 = 0.34 | 0.43 |
| | 0.6 | 0.4 | 1 |

Therefore there is a 57% (0.57) chance that the expert will forecast that the economy will be good.

When the expert says the economy is good he is correct 0.51 out of 0.57 times = 89.5% (0.895 times = 0.51/0.57) within that forecast. Therefore, he will be incorrect 10.5% (0,105 times) within that forecast.

The calculation of the value of imperfect information is as follows:

| | ₦ |
|---|---|
| **Expected value at point C (EVC)** | |
| 0.895 ´ 50,000 | 44,750 |
| 0.105 ´ (20,000) | (2,100) |
| | 42,650 |
| Probability of good verdict | 0.57 |
| | 24,311 |
| Probability of successful development | 0.8 |
| **Expected value at point B** | 19,448 |
| | (12,000) |
| **Expected value at point A** | 7,448 |

The value of the imperfect information is then calculated as follows:

| | ₦ |
|---|---|
| Expected value with imperfect information | 7,448 |
| Expected value with imperfect information | 5,600 |
| Value of imperfect information | 1,848 |

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## 15.5 Interpret a decision tree and use it to solve a multi-staged decision problem

### 15.5.1 Decision trees

Sometimes a decision might need to be taken in two or more stages, with the second-stage decision depending on what is the outcome from the first-stage decision.

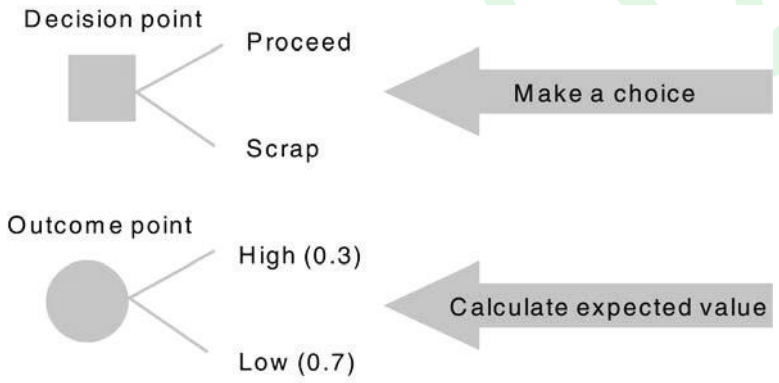
A decision tree can be drawn to provide a methodical approach to calculating the expected value. A decision tree is built to show all possible outcomes and associated probabilities. A decision tree is drawn from its "root" up to its "branches" and then, once drawn, analysed from its "branches" back to its "root".

There are two different types of branching point in the tree:

(a) Decision points – as the name suggests this is a point where a decision is made
(b) Outcome points – an expected value is calculated here.

The following symbols are used for decision points and outcome points:

**Illustration: Symbols**



Example: Expected value

A company is considering whether to invest in a new project costing ₦12,000, which has an 80% chance of being successfully developed.

If it is developed successfully, the profits from the project will depend on whether the economic conditions are good or poor.

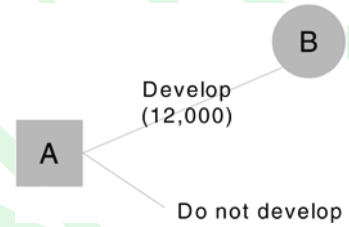
The profits expected depend on the economic conditions which are forecast as follows:

Economic

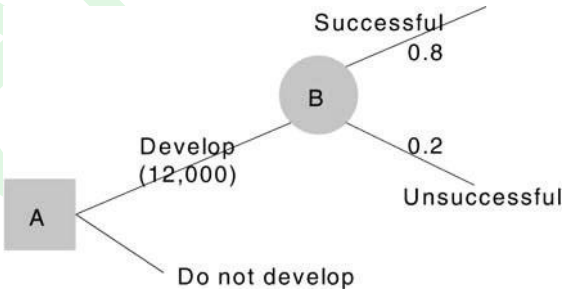
| **conditions** | **Profit (loss)** | **Probability** |
|---|---|---|
| Good | 50,000 | 0.6 |
| Poor | (20,000) | 0.4 |

Should the company undertake the project? Step 1: Build the tree (in this direction□)

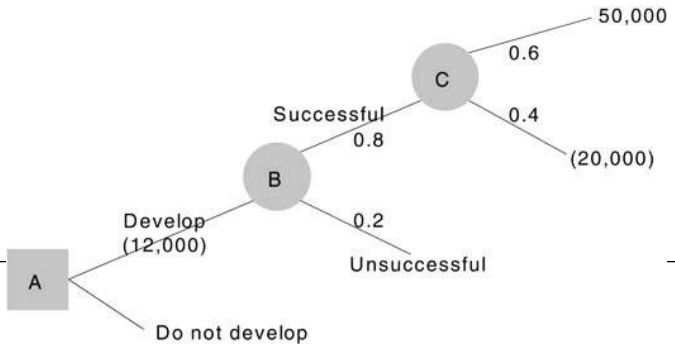
Start with the decision that is being made:




Then at point B draw the possibilities of the success or failure of the project together with the associated probabilities.




Then draw the possibilities of the different economic prospects together with the associated probabilities:




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**Example: Expected value (continued)**

Step 2: Analyse the tree (in this direction←)

Expected value at point C:

= (0.6 ×50,000) + (0.4 ×(20,000)) = 22,000

Expected value at point B (EVB)

= (0.8 × EVC) + (0.2 × zero)

= (0.8 × 22,000) + (0.2 × zero) = 17,600

**Decision at point A (EVA)**

Proceed at a cost of 12,000 to earn profits with an expected value of 17,600 giving a gain of 5,600 or do not proceed for zero

The EV of the decision to invest (+ 5,600) is better than the EV of the decision not to invest (0) therefore proceed with the project

## 15.6 Simulation and its application

### 15.6.1 Introduction

Simulation is the imitation of the operation of a real-world process or system over time.

An earlier chapter showed how decision trees can be used to provide a structure to allow computations of probabilities based on a series of interrelated variables. This is fine for simple situations but real life can be far more complex. Simulation is a versatile tool for providing information about the operation of complex systems.

The act of simulating something first requires that a model be developed. The model must represent the key characteristics of the selected system or process. These characteristics can be identified by observing the actual process being modelled. Once the model is built a researcher can then run it over different time frames and also introduce different variables to see what would happen.

**Example: Simulation**

In general, mortgage lenders run simulation models to provide insight into the state of the housing market.

The models incorporate key macroeconomic variables.

The lenders could run the model to find out what would happen to house prices if the interest rates changed by a given percentage or if incomes increased at a slower rate of inflation and so on.

The model is built to represent the system itself and a simulation represents the operation of the system over a given time period.

Running a single simulation is unlikely to provide useful information.

Once the model is set up a series of simulations can be run and the results can be used to identify an average outcome.

### Uses of simulation

Simulation can be used to show the impact of alternative conditions and courses of action.

Simulation is useful in shedding light on problems where outcomes are uncertain but can be represented by known probability distribution, e.g. queues, inventory control, capital investment, replacement problems, etc.

Simulation modelling can be used to assess probabilities when there are many different variables in the situation, each with different probable outcomes and where the relationship between these variables might be complex.

## 15.6.2 Monte Carlo simulation

A Monte Carlo simulation is one that employs a random device for identifying what happens at a different point in a simulation.

A simulation model contains a large number of inter-related variables (for example sales volumes of each product, sales prices of each product, availability of constraining resources, resources per unit of product, costs of materials and labour, and so on).

For each variable, there are estimated probabilities of different possible values. These probabilities are used to assign a range of random numbers to each variable. (The random number allocation should reflect the probability distribution).

**Example: Assigning random numbers**

A company is considering launching a new product. Market research has indicated that there is a 75% chance of high sales and a 25% chance of low sales.

A random number range can be assigned to each outcome as follows:

| Outcome | Probability | Cumulative probability | Random number |
|---|---|---|---|
| Low sales | 25% | 25% | 01 to 25 |
| High sales | 75% | 100% | 26 to 00 |

It is easier to assign the random number range if a cumulative probability column is constructed first.

Once random numbers have been allocated a random number generator can be used to provide a string of numbers which in turn are used to model the outcomes.

Example: Monte Carlo simulation

Demand for inventory follows the following distribution:

| Demand per day | Probability |
|---|---|
| 0 – 4 | 32% |
| 5 – 9 | 47% |

| | | |
|---|---|---|
| 10 – 14 | 21% | |

The company wishes to model demand.

Step 1: Allocate random numbers to each level of demand.

| Demand per day | Probability | Cumulative probability | Random numbers |
|---|---|---|---|
| 0 – 4 | 32% | 32% | 01 to 32 |
| 5 – 9 | 47% | 79% | 33 to 79 |
| 10 – 14 | 21% | 100% | 80 to 00 |

Step 2: Assign a value to each demand level so that it can be represented as a single number (say the mid-point)

| Demand per day | Assigned value (mid-point) | Random numbers |
|---|---|---|
| 0 – 4 | 2 | 01 to 32 |
| 5 – 9 | 7 | 33 to 79 |
| 10 – 14 | 12 | 80 to 00 |

Step 3: Generate a list of random numbers and select the demand level that corresponds to each number

For example the number 27 corresponds to a demand of 2 in the above table.

Step 4: Repeat for as many simulations as required. In practice this will be until the random effects of small numbers of observations have been smoothed out.

Step 5: Use the simulated values as though they are the actual values occurring in the real system, e.g. to calculate daily inventory movements.

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Often more than one event will require simulation, e.g. in a purchase system both demand and supply lead times will be simulated.

**Practice question 1**

A company makes 4 styles of one of its products.

The demand for these products is as follows:

| Type | Probability |
|---|---|
| Economy | 0.15 |
| Normal | 0.42 |
| Super | 0.28 |
| De-luxe | 0.15 |

### 15.6.2 Multiple variables

Simulation can deal with multiple variables.

**Example: Simulation**

A company wishes to use simulation to provide forecasts of possible profit levels under different circumstances.

The company identifies four variables (sales volume, sales price, variable cost per unit and fixed costs) and believes that the value of each of these variables is independent of the other three variables. (Note that this would be very unlikely for sales volume and sales price).

The company has identified the possible values for each variable with their associated probability, and assigned a range of random numbers to these values as follows:

Sales volume

| Units | Probability | Random number range |
|---|---|---|
| 10,000 | 20% | 01 – 20 |
| 20,000 | 50% | 21 – 70 |
| 30,000 | 30% | 71 – 00 |

Variable cost per unit

| ₦ | Probability | Random number range |
|---|---|---|
| 2 | 10% | 01 – 10 |
| 3 | 30% | 11 – 40 |
| 4 | 40% | 41 – 80 |
| 5 | 20% | 81 – 00 |

Sales price per unit

| | | |
|---|---|---|
| ₦14 | 15% | 01 – 15 |
| ₦15 | 40% | 16 – 55 |

Fixed costs

| | | |
|---|---|---|
| ₦200,000 | 85% | 01 – 85 |
| ₦220,000 | 10% | 86 – 95 |

| | | | | | |
|---|---|---|---|---|---|
| ₦16 | 35% | 56 – 90 | ₦240,000 | 5% | 96 – 00 |
| ₦17 | 10% | 91 – 00 | | | |

The model is then used to calculate the value of the outcome or result, for a given set of values for each variable.

This simple model can be used to calculate the expected profit, given a combination of sales volume, sales price, variable cost and fixed costs.

The values for each variable are determined by generating random numbers for each variable.

For example: If random numbers 14856327 are generated these become 14, 85, 63, 27 and are assigned as follows:

Random

| | Units | Probability | number range | Random number |
|---|---|---|---|---|
| Sales volume | 10,000 | 20% | 00 – 19 | 14 |
| Sales price | ₦16 | 35% | 55 – 89 | 85 |
| Variable cost per unit | 4 | 40% | 40 – 79 | 63 |
| Fixed cost | ₦200,000 | 85% | 00 – 84 | 27 |

**Example (continued): Simulation**

This run gives the following result and associated probability (by multiplication):

| | | | Probability |
|---|---|---|---|
| Sales volume | 10,000 | | 20% |
| Sales price | ₦16 | 160,000 | 35% |
| Revenue | | | |
| Variable cost per unit | 4 | (40,000) | 40% |
| Fixed cost | | (200,000) | 85% |
| | | (80,000) | 2.4% |

The model is then run again and again with different sets of values for each variable obtained by generating another set of random numbers.

This generates a large number of different possible outcomes together with associated probabilities.

Repeating the simulation many times produces a probability distribution of the possible outcomes and this probability distribution can be analysed statistically.

**Practice question** **2**

Using the above information calculate the profit (loss) using the following set of random numbers

32841072

### 15.7.1 Carrying out sensitivity analysis

The starting point for sensitivity analysis is the original plan or estimate. For example this might be a plan which estimates the expected profit in a budget, or the expected profit from a particular project or transaction.

Key variables are identified (such as sales price, sales volume material cost, labour cost, completion time, and so on). The value of the selected key variable is then altered by a percentage amount (typically a reasonable estimate of possible variations in the value of this variable) and the expected profit is re-calculated.

In this way, the sensitivity of a decision or plan to changes in the value of the key items or key factors can be measured.

An advantage of sensitivity analysis is that if a spreadsheet model is used for analysing the original plan or decision, sensitivity analysis can be carried out quickly and easily, by changing one value at a time in the spreadsheet model. Forexample, cash budgets on a spreadsheet are used extensively with 'what-if analysis' to analyse the possible future cash position in a business.

### 15.7.2 Identifying the key variables with sensitivity analysis

Sensitivity analysis can be used to calculate by how much the value of an item (or 'variable') must change before the expected profit or outcome becomes unacceptable. For example, sensitivity analysis can be used to estimate by how much expected sales volume would have to fall short of the estimate before a product became unprofitable.

By applying sensitivity analysis to each variable, it should be possible to identify those that are the most critical, where an error in the estimate could have a large impact on the actual outcome.

Example: Sensitivity analysis

A company is considering launching a new product in the market.
Profit estimates are as follows:

| | ₦ | ₦ |
|---|---|---|
| Sales (10,000 units) | | 200,000 |
| Variable costs: | | |
| Materials | 120,000 | |
| Labour | 20,000 | |
| | | 140,000 |
| Contribution | | 60,000 |
| Fixed costs (all directly attributable) | | 50,000 |
| Profit | | 10,000 |

The estimates of sales volume, sales price, variable costs and fixed costs are uncertain.

Sensitivity analysis can be used to calculate by how much each of these

variables would have to be 'worse' than estimated before the product became loss-making.

Profit can fall by ₦10,000 before the product ceases to be profitable.

Profit would fall by ₦10,000 if any one of the following occurred:

1 Sales volume is ₦10,000/₦60,000 = 16.7% less than expected
2 Sales price is ₦10,000/₦200,000 = 5% less than expected
3 Material costs are ₦10,000/₦120,000 = 8.3% more than expected
4 Labour costs are ₦10,000/₦20,000 = 50% more than expected
5 Fixed costs are ₦10,000/₦50,000 = 20% more than expected.

The product would cease to be profitable if a combination of variables turned out worse than expected. In the example above, for instance, the product would cease to be profitable if fixed costs were 20% more than expected and sales volume was also 16.7% less than expected.

Management can use sensitivity analysis to decide whether they have sufficient confidence in the estimates so that they can go ahead with their planned decision (for example, a decision to launch a new product), or whether the uncertainty is so great that it would be too risky to go ahead.

Assessing the uncertainty is a matter of judgement.

## 15.8 Explanation and application of Maximax, Maximin And Minimax Regret

### 15.8.1 Worst, most likely and best possible outcomes

When a choice has to be made between two or more mutually exclusive options, the choice might be affected by the different possible outcomes that might occur with each option.

For example, a book publisher might need to decide how many copies of a new book to print. He might be considering three options – to print 1,000 copies, 5,000 copies or 10,000 copies. The most profitable choice of print quantity will depend on the sales demand for the book, which is uncertain. Sales demand might depend on the publicity that the book receives from book reviewers. The decision about the print quantity must be taken before it is known what the publicity and expected sales for the book will be.

The choice between two or more alternative courses of action might be based on the worst, most likely or best expected outcomes from each course of action. A **pay-off table** can be produced which records all possible pay-offs (e.g. profit values) that would result from different courses of action and different outcomes.

The example below shows:

(a) the different decision options in the first column (in the example below the decision relates to the size of the print run);
(b) the different outcomes in the top row (type of review and estimated sales in consequence); and
(c) the different pay-offs that result from each decision with each outcome shown in the cells.

**Example: Worst, most likely and best possible outcomes**

The following pay off table shows the profit or loss that would be obtained from print runs of different sizes if a book review is bad, reasonable or excellent

| Course of action: | Bad review (estimated sales of 1,000) | Reasonable review (estimated sales of 5,000) | Excellent review (estimated sales of 10,000) |
|---|---|---|---|
| Print 1,000 copies | -+ ₦2,000 | + ₦2,000 | + ₦2,000 |
| Print 5,000 copies | - ₦8,000 | + ₦10,000 | + ₦10,000 |
| Print 10,000 copies | - ₦12,000 | + ₦1,000 | + ₦35,000 |

This pay-off table or profit table can then be analysed, and a choice can be made between the different decision options under consideration.

### 15.7.3 Constructing a pay-off table or profit table

A pay-off table can be constructed as follows.

(a) One side of the table (rows or columns) should list the different mutually exclusive options, from which a choice will be made

(b) The other side of the table should list the different possible results or outcomes that might occur.

(c) For each option and possible outcome, the value of the expected outcome (for example, the expected profit) should be entered in the appropriate box.

Example: Constructing a pay-off table

A shopkeeper must decide how many boxes of apples to buy each day. A box of apples earns revenue of ₦400 and costs ₦250.

Demand is uncertain and could vary from 30 boxes to 10 boxes.

Any apples that are purchased but not sold will be thrown away at the end of the day.

The shopkeeper has decided that he will buy 10 boxes, 20 boxes or 30 boxes each day, and these are the only three options he wants to consider.

A pay-off table can be constructed as follows to show the pay-offs associated with different numbers of boxes bought and different demand levels:

| **Course of action** | **Demand = 10 boxes** | **Demand = 20 boxes** | **Demand = 30 boxes** |
|---|---|---|---|
| | ₦ | ₦ | ₦ |
| Buy 10 boxes | 1,500 | 1,500 | 1,500 |
| Buy 20 boxes | (1,000) | 3,000 | 3,000 |
| Buy 30 boxes | (3,500) | 500 | 4,500 |

Entries in the pay-off table are calculated as follows:

| **Buy 10 boxes** | **If demand = 10** | **If demand = 20** | **If demand = 30** |
|---|---|---|---|
| Revenue (400 per box) | 4,000 | 4,000 | 4,000 |
| Costs (250 per box) | (2,500) | (2,500) | (2,500) |
| Profit | 1,500 | 1,500 | 1,500 |

Demand greater than 10 cannot be met so the profit does not change.

**Example (continued)ng a pay-off table**

| **Buy 20 boxes** | **If demand = 10** | **If demand = 20** | **If demand = 30** |
|---|---|---|---|
| Revenue (400 per box) | 4,000 | 8,000 | 8,000 |
| Costs (250 per box) | (5,000) | (5,000) | (5,000) |
| Profit | (1,000) | 3,000 | 3,000 |

Demand greater than 20 cannot be met so the profit does not change.

| **Buy 30 boxes** | **If demand = 10** | **If demand = 20** | **If demand = 30** |
|---|---|---|---|
| Revenue (400 per box) | 4,000 | 8,000 | 12,000 |
| Costs (250 per box) | (7,500) | (7,500) | (7,500) |
| Profit | (3,500) | 500 | 4,500 |

The pay-off table or profit table does not identify the 'best' option. It simply shows what the outcome will be for each decision option, given different possible circumstances that might actually occur.

Management need to use their judgement, in using this information, to decide which option to select. The course of action chosen by the company will depend on the attitude to risk of its decision-maker.

### 15.7.4 Maximax, maximin and minimax regret decision rules

Choosing between mutually-exclusive courses of action can be stated as 'decision rules'. A decision rule is simply the basis or 'rule' which a decision-maker uses to select between mutually exclusive options.

As suggested earlier in this chapter, the choice between different options might be based on an assessment of probabilities, and the preferred option might be the one that offers the highest expected value of profit. Alternatively, simulation or sensitivity analysis may be used to compare expected profits with the risk or uncertainty, and a choice between the different options based on an assessment of risk and return.

The choice between mutually exclusive options might also be based on any of the following decision rules:

(a) Maximax rule
(b) Maximin rule
(c) Minimax regret rule

To use any of these decision rules, it is helpful to construct a pay-off table.

### Maximax decision rule

This is a decision rule based on the view that the decision-maker should select the course of action with the best possible pay-off, such as the highest possible profit. This approach is based on the view that the decision-maker should seek the highest return, assuming that events turn out in the best way possible. The maximax decision rule can be described as a decision rule for the 'risk seeker'.

**Example: Maximax decision rule**

A business entity has to decide which of three projects to select for investment. The three projects are mutually exclusive, and only one of them can be selected.

The expected annual profits from investing in each of the projects will depend on the state of the market, but the state of the market will not be known until after the choice of project has been made. The following estimates of annual profit have been prepared:

| State of market | Declining | Static | Expanding |
|---|---|---|---|
| | ₦000 | ₦000 | ₦000 |
| Project 1 | (100) | 120 | 950 |
| Project 2 | 50 | 500 | 600 |
| Project 3 | 180 | 190 | 200 |

Which project would be selected if the decision is based on ) the maximax decision rule?

The decision should be to select the option that offers the prospect of the highest profit. This is Project 1 where the annual profit would be ₦950,000 if there is an expanding market.

It does not matter that this project would make a loss of ₦100,000 if the market turns out to be in decline. The decision rule is to select the option offering the best possible return.

### 15.8.2 Maximin decision rule

This decision rule is based on the view that the decision-maker will identify the course of action with the highest expected return under the worst outcome. The choice is based on trying to maximise the minimum possible profit.

This decision rule might be associated with a risk-averse decision maker.

**Example: Maximin decision rule**

A business entity has to decide which of three projects to select for investment. The three projects are mutually exclusive, and only one of them can be selected.

The expected annual profits from investing in each of the projects will depend on the state of the market, but the state of the market will not be known until after the choice of project has been made. The following estimates of annual profit have been prepared:

| State of market | Declining | Static | Expanding |
|---|---|---|---|
| | ₦000 | ₦000 | ₦000 |
| Project 1 | (100) | 120 | 950 |
| Project 2 | 50 | 500 | 600 |
| Project 3 | 180 | 190 | 200 |

Which project would be selected if the decision is based on the maximin decision rule?

The decision rule is based on the returns that would be obtained if the worst possible outcome occurs.

The worst outcome is a declining market.

If the market turns out to be in decline, the most profitable option would be Project 3, for which the profit would be ₦180,000.

### 15.8.3 Minimax regret decision rule

This decision rule is based on the concept of 'regret'.

'Regret' is the difference between the profit that will be earned by choosing one option, and the profit that would have been earned if the most profitable option had been selected, given a particular outcome.

For example suppose that a company has to choose between options 1, 2 and 3, and the profit from each option depends on whether sales demand is weak, average or strong. For each option (1, 2 and 3) and each possible outcome (weak, average or strong sales demand), there is 'regret'. This is the amount by which the profit earned by choosing the option would be worse than 'the best possible profit' from choosing either of the other two options, given the nature of the sales demand.

Regret is the opportunity cost of having made the wrong decision, given the actual conditions that apply in the future.

In order to use this rule a regret table must be constructed from the pay-off table. A fourth column can then be added to show the maximum regret for each course of action.

The decision rule is to select the course of action with the lowest possible 'regret'.

Example: Minimax regret decision rule

A business entity has to decide which of three projects to select for investment. The three projects are mutually exclusive, and only one of them can be selected.

The expected annual profits from investing in each of the projects will depend on the state of the market, but the state of the market will not be known until after the choice of project has been made. The following estimates of annual profit have been prepared:

| **State of market** | **Declining** | **Static** | **Expanding** |
|---|---|---|---|
| | ₦000 | ₦000 | ₦000 |
| Project 1 | (100) | 120 | 950 |
| Project 2 | 50 | 500 | 600 |
| Project 3 | 180 | 190 | 200 |

Which project would be selected if the decision is based on the minimax regret decision rule?

A regret table must be constructed.

**Step 1:** Draft a table with the same column and row headings as the pay-off table but add another column to identify the maximum regret shown with each course of action.

| State of market | Declining | Static | Expanding | Maximum regret |
|---|---|---|---|---|
| | ₦000 | ₦000 | ₦000 | |

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Project 1

Project 2

Project 3

**Step 2:** Identify the cell in each column from the pay-off that has the best pay – off (e.g. highest profit). Write a zero in the corresponding cell in the regret table.

Maximum

| **State of market** | **Declining** | **Static** | **Expanding** | **regret** |
|---|---|---|---|---|
| | ₦000 | ₦000 | ₦000 | |
| Project 1 | | | 0 | |
| Project 2 | | 0 | | |
| Project 3 | 0 | | | |

**Interpretation:**

The company would have no regret if project 3 was undertaken and the market turned out to be declining.

The company would have no regret if project 2 was undertaken and the market turned out to be static.

The company would have no regret if project 1 was undertaken and the market turned out to be expanding.

Example (continued): Minimax regret decision rule

**Step 3:** Compare the pay-off in each cell to best pay-off in that column. Write the difference in the corresponding cell in the regret table. These are the regret values.

Maximum

| **State of market** | **Declining** | **Static** | **Expanding** | **regret** |
|---|---|---|---|---|
| | ₦000 | ₦000 | ₦000 | |
| Project 1 | 280 | 380 | 0 | |
| Project 2 | 130 | 0 | 350 | |
| Project 3 | 0 | 310 | 750 | |

**Interpretation:**

The company would have no regret if project 3 was undertaken and the market turned out to be declining but if Project 1 was selected the company would be worse off by ₦280,000, which is the difference between the loss that would be made from Project 1 and the profit that would have been made if the best option (Project 3) had been selected.

Similarly, if Project 2 is selected and the market is in decline the regret will be
₦130,000, which is the difference between the profit that would be made from Project 2 and the profit that would have been made if the best option (Project 3) had been selected.

Similarly, suppose that the market turns out to be static. The most profitable option would be Project 2, for which the profit would be ₦500,000. The company would have no regret if project 2 was undertaken but If Project 1 is selected the regret will be ₦380,000 (the difference between the profit that would be made from Project 1 and the profit that would have been made if the best option (Project 2) had been selected.

Similar comments could be made in respect of the expanding market.

A table of 'regrets', once completed, shows the amount of the regret for each possible course of action (projects 1, 2 or 3), given each possible outcome (declining, static or expanding market).

**Step 4:** Write the maximum regret for each option in the right-hand column and select the option where the maximum regret is the lowest. In this example, this is Project 2, for which the maximum regret is ₦350,000.

Maximum

| **State of market** | **Diminishing** | **Static** | **Expanding** | **regret** |
|---|---|---|---|---|
| | ₦000 | ₦000 | ₦000 | ₦000 |
| Project 1 | 280 | 380 | 0 | 380 |
| Project 2 | 130 | 0 | 350 | 350 |
| Project 3 | 0 | 310 | 750 | 750 |

The maximax, maximin and minimax regret decision rules provide a logical basis for making a choice between mutually exclusive options, where the future

conditions are uncertain and there are no probability estimates of what the future conditions might be.

The main disadvantage of choosing between mutually-exclusive courses of action on the basis of the worst, most likely or best possible outcome is that the choice **ignores the likelihood or probability** of the worst, most likely or best outcomes actually happening.

If probability estimates had been available in the previous example for future market conditions (declining, static or expanding market), a different decision rule such as the expected value rule might be more appropriate – because it takes the probabilities of the different outcomes into consideration.

Practice questions 3

A shopkeeper must decide how many boxes of apples to buy each day. A box of apples earns contribution of ₦400 and costs ₦250.

Demand is uncertain and could vary from 30 boxes to 10 boxes.

Any apples that are purchased but not sold will be thrown away at the end of the day.

The shopkeeper has decided that he will buy 10 boxes, 20 boxes or 30 boxes each day, and these are the only three options he wants to consider.

The following pay-off table has been constructed:

| Course of action | Demand = 10 boxes | Demand = 20 boxes | Demand = 30 boxes |
|---|---|---|---|
| | ₦ | ₦ | ₦ |
| Buy 10 boxes | 1,500 | 1,500 | 1,500 |
| Buy 20 boxes | (1,000) | 3,000 | 3,000 |
| Buy 30 boxes | (3,500) | 500 | 4,500 |

How many boxes should the storekeeper purchase if the decision is based on:

**a)** the maximax decision rule?
**b)** the maximin decision rule?
**c)** the minimax regret decision rule

## 15.9 Chapter review

### Chapter review

(a) Before moving on to the next chapter check that you now know how to:
(b) Explain the nature of risk
(c) Calculate expected values
(d) Construct decision trees and use them to solve problems
(e) Estimate the value of perfect information
(f) Explain simulation
(g) Carry out a simple simulation from data provided
(h) Perform sensitivity analysis
(i) Apply maximax, maximin and minimax regret criteria to make decisions

**Solutions** **1**

Assign random numbers to categories

| Category | Probability | Cumulative probability | Random number range |
|---|---|---|---|
| Economy | 0.15 | 0.15 | 00-14 |
| Normal | 0.42 | 0.57 | 15-56 |
| Super | 0.28 | 0.85 | 57-84 |
| De-luxe | 0.15 | 1.00 | 85-99 |

Simulation of next seven demands

| Run | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Random number | 25 | 95 | 32 | 84 | 10 | 72 | 66 |
| Category | N | D | N | S | E | S | S |

| | | | Probability |
|---|---|---|---|
| Sales volume | 30,000 | | 30% |
| Sales price | ₦16 | 480,000 | 35% |
| Revenue | | | |
| Variable cost per unit | ₦2 | (60,000) | 10% |
| Fixed cost | | (220,000) | 10% |
| Profit | | 20,000 | 0. 105% |

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**Solutions** **3**

| **Pay off table** | **Demand = 10 boxes** | **Demand = 20 boxes** | **Demand = 30 boxes** |
|---|---|---|---|
| **Course of action** | **₦** | **₦** | **₦** |
| Buy 10 boxes | 1,500 | 1,500 | 1,500 |
| Buy 20 boxes | (1,000) | 3,000 | 3,000 |
| Buy 30 boxes | (3,500) | 500 | 4,500 |

| **Regret table** | **Demand = 10 boxes** | **Demand = 20 boxes** | **Demand = 30 boxes** | **Maximum regret** |
|---|---|---|---|---|
| **Course of action** | **₦** | **₦** | **₦** | **₦** |
| Buy 10 boxes | 0 | 1,500 | 3,000 | 3,000 |
| Buy 20 boxes | 2,500 | 0 | 1,500 | 2,500 |
| Buy 30 boxes | 5,000 | 2,500 | 0 | 5,000 |

**a)** Maximax decision rule:

30 boxes would be bought as this allows for the biggest possible pay off.

**b)** Maximin decision rule:

10 boxes would be bought as this would maximise the lowest possible pay-offs associated with each course of action at the lowest demand level.

**c)** Minimax regret decision rule

20 boxes should be bought.

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**PART D**

**BUDGETING AND CONTROL TECHNIQUES**

1. **Budgetary systems and types of budgets**
2. **Analytical techniques in budgeting and forecasting**
3. **Standard costing**
4. **Material mix and yield variances**
5. **Sales mix and quantity variances**
6. **Planning and operational variances**
7. **Performance analysis**

## INTRODUCTION

### Aim

Performance management develops and deepens candidates' capability to provide information and decision support to management in operational and strategic contexts with a focus on linking costing, management accounting and quantitative methods to critical success factors and operational strategic objectives whether financial, operational or with a social purpose. Candidates are expected to be capable of analysing financial and non- financial data and information to support management decisions.

### Detailed syllabus

The detailed syllabus includes the following:

| B | Planning and control | | |
|---|---|---|---|
| | 1 | Budgetary system, planning and control | |
| | | A | Discuss and apply forecasting techniques to planning and control. |
| | | B | Discuss budgetary system in an organisation as an aid to performance management. |
| | | C | Evaluate the information used in budgetary system. |
| | | D | Discuss the behavioural aspects of budgeting. |
| | | E | Discuss the usefulness and problems associated with different types of budget. |
| | | F | Explain ***beyond budgeting*** models. |

### Exam context

This chapters 16 to 22 explains the purpose of budgetary control systems and continues by explaining different types of approaches to budgeting. Standard costing

is of particular importance as it is the foundation of variance analysis (covered in the next two chapters). The concluding section of the chapter covers the behavioural aspects of budgeting.

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

(a) Explain the purposes of budgeting and the budgeting process

(b) Describe the main features of, and explain the differences between bottom-up and top- down budgeting

(c) Explain incremental and zero-based budgeting

(d) Explain activity based budgeting (ABB)

(e) Recognise and explain the importance of the behavioural aspects of budgeting

(f) Discuss beyond budgeting as a concept

(g) Explain and apply forecasting techniques

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**Skills level**

**Performance management**




# Budgetary systems and types of budgets

Chapter Content

16.0 Learning Objectives
16.1 Learning Outcome
16.2 Select and explain the appropriate budgetary system and types of budgeting
16.3 Preparation of Fixed budget, flexed budget, rolling budget, activity -based budget , zero based, rolling, bottom-up, top-down, incremental, feed forward control, functional and Master budgets and their uses.
16.4 Explain the beyond budgeting model showing benefits and problems
16.5 Explain the benefits and difficulties in employee participation in budgeting process and negotiations of targets.
16.6 Discuss ethical and sustainability considerations when setting budgets.

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# 16 Budgetary systems and types of budgets

## 16.0 Learning objective

This chapter introduces candidates to the concept of budgets and budgeting system, preparation of budgets, the nature of beyond budgeting as well as the benefits and difficulties of budgeting.

## 16.1 Learning outcomes

At the completion of the chapter, candidates should acquire the needed knowledge in budgeting, types of budgeting, benefits and difficulties of budgeting and other ethical and sustainability issues that affect budget

## 16.2 Select and explain the appropriate budgetary system and types of budgeting

16.2.1 The Budgeting Process

**Section overview**

(a) Introduction to budgeting
(b) Preparing the budget
(c) Principal budget factor
(d) Stages in the budgeting process

### 16.2.2 Introduction to budgeting

### 16.2.3 Planning framework

A business entity should plan over the long term, medium term and short term.

Long term planning, or strategic planning, focuses on how to achieve the entity's long-term objectives.

Medium-term or tactical planning focuses on the next year or two.

Short-term or operational planning focuses on day-to-day and week-to- week plans.

Budgets are medium-term plans for the business, expressed in financial terms. A typical budget is prepared annually, and the overall budget is divided into control periods for the purpose of control reporting.

### 16.2.4 The nature of budgets

**Definition: Budget**

A budget is a financial and/or quantitative statement prepared and approved prior to a defined period of time for the purpose of attaining a set of given objectives

A budget is a formal plan, expressed mainly in financial terms and covering all the activities of the entity. It is for a specific period of time, typically one year. When budgets are prepared annually, they are for the next financial year.

The total budget period (one year) may be sub-divided into shorter control periods of one month or one quarter (three months).

### 16.2 5 Purposes of budgeting

Budgets have several purposes.

(a) To convert long-term plans (strategic plans) into more detailed shorter-term (annual) plans.

(b) To ensure that planning is linked to the long-term objectives and strategies of the organisation.

(c) To co-ordinate the actions of all the different parts of the organisation, so that they all work towards the same goals. (This is known as 'goal congruence'). One of the benefits of budgeting is that is covers all activities, so the plan should try to ensure that all the different activities are properly co-ordinated and working towards the same objective.

(d) To communicate the company's plans to the individuals (managers and other employees) who have to put the plans into action.

(e) To motivate managers and employees, by setting targets for achievement, and possibly motivating them with the incentive of bonuses or other rewards if the targets are met.

(f) To provide guidelines for authorising expenditure. Expenditure might not be permitted unless it has been planned in the budget or unless it is within the budgeted expenditure limits for the department.

(g) To identify areas of responsibility for implementing the plans. For each part of the budget, an individual manager should be made responsible for achieving the budget targets for performance.

(h) To provide a benchmark against which actual performance can be measured.

(i) To control costs. Costs can be controlled by comparing budgets with actual results and investigating any differences (or variances) between the two. This is known as **budgetary control**.

### 16.2.6 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 budgeting 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 budgeting process, the functional budgets are usually prepared by the managers with responsibility for the particular aspect of operations covered by that functional budget.

### 16.2.7 Budget manual

There should be a budget manual or budget handbook to guide everyone involved in the budgeting process. This should set out:

(a) the key objectives of the budget;

(b) budget planning procedures and budget timetables;

(c) the budget details that must be included in the functional budgets;

(d) responsibilities for preparing the functional budgets; and

(e) details of the budget approval process. The budget must be approved by the budget committee and then by the board of directors.

### 16.2.8 The master budget

The 'master budget' is the final approved budget. It is usually presented in the form of financial statements - a budgeted statement of profit or loss 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.

### 16.2.9 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 purchasing budget; and
(e) an expenditure budgets for every overhead cost centre and general overhead costs.

### 16.2.10 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.

### 16.2.11 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.

### 16.2.12 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.

### 16.2.13 Stages in the budgeting 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.

**(a)** **Stage 1**: The provision and communication of budget guidelines to relevant managers

**(b)** **Stage 2**: Identify the principal budget factor (or key budget factor). The principal budget factor is often sales volume.

**(c)** **Stage 3**: Prepare the functional budget or plan for the principal budget factor. Usually, this means that the first functional budget to prepare is the sales budget.All the other functional budgets should be prepared within the limitation of the principal budget factor. For example, even if the company has the capacity to produce more output, it should not produce more than it can sell (unless it formally decides to increase the size of the finished goods inventory, in which case the production volume will be higher than the sales volume).

**(d)** **Stage 4**: Prepare the other functional budgets, in logical sequence where necessary. When the sales budget has been prepared, a manufacturing

organisation can then prepare budgets for inventories (= plans to increase or reduce the size of its inventories), a production budget, labour usage budgets and materials usage and purchasing budgets. Expenditure budgets should also be prepared for overhead costs (production overheads, administration overheads and sales and distribution overheads). Overhead costs budgets are usually prepared for each cost centre individually.

**(e)** **Stage 5**: Submit the functional budgets to the budget committee for review and approval. The functional budgets are co-ordinated by the budget committee, which must make sure that they are both realistic and consistent with each other.

**(f)** **Stage 6**: Prepare the 'master budget'. This is the budget statement that summarises the plans for the budget period. The master budget might be presented in the form of:

i. a budgeted statement of profit or loss for the next financial year
ii. a budgeted statement of financial position as at the end of the next financial year
iii. a cash budget or cash flow forecast for the next financial year.

It should be possible to prepare the master budget statements from the functional budgets.

**(g)** **Stage 7**: The master budget and the supporting functional budgets should be submitted to the board of directors for approval. The board approves and authorises the budget.

**(h)** **Stage 8**: The detailed budgets are communicated to the managers responsible for their implementation.

**(i)** **Stage 9**: Control process. After the budget has been approved, actual performance should be monitored by comparing it with the budget. Actual results for the period should be recorded and reported to management. These results should be compared with the budget, and significant differences should be investigated. The reasons for the differences ('variances') should be established, and where appropriate control measures should be taken. Comparing actual results with the budget therefore provides a system of control. The managers responsible for activities where actual results differ significantly from the budget will be held responsible and accountable.

The planning process (budgeting) should therefore lead on to a management monitoring and control process (budgetary control).

The next section describes the approach that can normally be used to prepare functional budgets for a manufacturing organisation. In practice, budgets are usually prepared with a computer model, such as a **spreadsheet**. However, you need to understand the logic of budget preparation.

Practice question 1

X Limited makes and sells two products, Product X and Product Y.

Its sales budget for next year is to sell 2,500 units of Product X at a sales price of ₦410 per unit and 3,200 units of Product Y at a sales price of ₦400 per unit.

The following cost information is expected to apply in the next year:

| | Product X | | Product Y | |
|---|---|---|---|---|
| **Direct materials** | Usage (kgs) | Cost per unit of X (₦) | Usage (kgs) | Cost per unit of Y (₦) |
| Material A (₦30 per kg) | 1.00 | 30 | 1.00 | 30 |
| Material B (₦80 per kg) | 0.75 | 60 | 0.50 | 40 |
| Material C (₦30 per kg) | 2.00 | 60 | 3.00 | 90 |
| | | 150 | | 160 |
| Usage | | | Usage | |
| Direct labour | (hrs) | | (hrs) | |
| Grade I (₦100 per hr.) | 1.00 | | | 80 |
| Grade II (₦80 per hr.) | 1.50 | | | 80 |
| Unit cost | | | | |

The following opening and closing inventories are budgeted:

| | Opening | | | Closing | |
|---|---|---|---|---|---|
| Finished goods: | Cost (₦) | Units | Total (₦) | Units | Total (₦) |
| X | 370 | 300 | 111,000 | 200 | 74,000 |
| Y | 320 | 150 | 48,000 | 100 | 32,000 |
| | | | 159,000 | | 106,000 |
| Materials: | Cost | kgs | | kgs | |
| A | 30 | 400 | 12,000 | 380 | 11,400 |
| B | 80 | 450 | 36,000 | 400 | 32,000 |
| C | 30 | 150 | 4,500 | 120 | 3,600 |
| | | | 52,500 | | 47,000 |
| Total Inventory: | | | 211,500 | | 153,000 |

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**Required**

a) Prepare functional budgets for sales, production units, material usage, material purchases and labour usage.

b) Prepare a budgeted profit or loss account for the period.

## 16.3 Budgetary Systems

**Section overview**

(a) Top-down budgeting and bottom-up budgeting
(b) Periodic budgets and rolling budgets (continuous budgets)
(c) Incremental budgeting and zero-based budgeting (ZBB)
(d) Activity based budgeting (ABB)
(e) Feed-forward control
(f) Difficulties in changing a budgetary system

A budgetary system is a system for preparing budgets (and producing control reports for the purpose of budgetary control). There are several budgetary systems, and entities will choose a system that is appropriate for their needs and circumstances.

### 16.3.1 Top-down budgeting and bottom-up budgeting

**Top-down budgeting**

In a system of **top-down budgeting**, the budget targets for the year are set at senior management level, perhaps by the board of directors or by the budget committee. Top-level decisions might be made, for example, about the amount of budgeted profit that will be achieved, the growth in sales, reductions in production costs and other functional department costs, and so on.

Divisions and departments are then required to prepare a budget for their own operations that is consistent with the budget imposed on them from above.

For example, the board of directors might state that in the budget for the next financial year, sales revenue will grow by 5% and profits by 8%. The sales director would then be required to prepare a more detailed sales budget in which the end result is a 5% growth in annual sales revenue. A production budget and other functional budgets will then be prepared that is consistent with the sales budget. The target for 8% growth in profits cannot be checked until all the functional budgets have been prepared in draft form. If the initial draft budgets fail to achieve 8% growth in profits, some re-drafting of the budgets will be required.

This process is called top-down budgeting because it starts at the top with senior management and works its way down to the most detailed level of budgeting within the management hierarchy. This might be departmental level or possibly an even smaller unit level, such as budgets for each work section within each department. A system of top-down budgeting would normally be associated with an entity where management control is highly centralised.

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### 16.3.2 Bottom-up budgeting

In a system of **bottom-up budgeting**, budgeting starts at the lowest level in the management hierarchy where budgets are prepared. This may be at work section level or departmental level. The draft lower-level budgets are then submitted to the next level of management in the hierarchy, which combines them into a co-ordinated budget, for example a departmental budget. Departmental budgets might then be submitted up to the next level of management, which might be at divisional level, where they will be combined and co-ordinated into a divisional budget. Eventually budgets for each division will be submitted up to the budget committee or board of directors.

The budget committee or board of directors will consider the draft budgets they receive, and ask for changes to be made if the overall master budget is unsatisfactory. Re-drafting of budgets will then go on until the master budget is eventually approved.
In a system of bottom-up budgeting, lower levels of management are likely to have more input to budget decision-making than in a top-down budgeting system, and it is associated with budgeting in entities where management authority is largely decentralised.

### 16.3.3 Periodic budgets and rolling budgets (continuous budgets)

### 16.3.4 Periodic budgets

A **periodic budget** is a budget for a particular time period, typically the financial year. The budget is not changed or revised during the year, and it is a fixed budget for the period. A company might therefore prepare a periodic budget for its financial year 2010, which will then be replaced the next year by the periodic budget for 2011, which will then be replaced the year afterwards by the periodic budget for 2012, and so on.

Traditional budgeting systems are periodic budgeting systems. When periodic budgets are used, an underlying assumption is that revenues and expenditure within the financial year should be fairly predictable and that it is unlikely that any unexpected events will occur during the year that will make the budget unrealistic or irrelevant.

Periodic budgets are much less useful, however, when future events are unpredictable and big changes might happen unexpectedly during the course of the financial year. When events change rapidly, the original budget loses its relevance because of the extent of the changes that have occurred. For example an entity might operate in a country where the annual rate of inflation might be anywhere between 200% and 400% during the year. Given the difficulty in forecasting what the actual rate of inflation will be, but the probability that it will be very high, it would make sense to review the budget regularly, and adjust it to allow for revised estimates of what the rate of inflation will be.

When unexpected changes are likely to occur, or when future events are difficult to predict with accuracy, it might be advisable for an entity to prepare revised budgets much more frequently, as a matter of routine.

### 16.3.5 Rolling budgets

A **rolling budget**, also called a **continuous budget**, is a budget that is continuously being updated. Each updated budget is for a given length of time, typically 12 months. For example a new rolling budget may be prepared every three months so that as one quarter of a 12-month budget ends, a new 12-month budget is prepared

with an additional quarter added at the end. In this way a new 12-month budget is prepared every three months.

A rolling budget can therefore be defined as 'a budget continuously updated by adding a further period, say a month or a quarter, and deducting the earliest period'.

Rolling budgets are most useful where future costs or activities cannot be forecast reliably, so that it makes much more sense for planning purposes to review the budget regularly, but to plan ahead for a full planning period each time.

**Example:**

A company might prepare rolling annual budgets every three months. It will prepare four annual budgets each year. If its year-end is 31st December, its preparation of rolling budgets would be as follows:

| Date of budget preparation | Period covered by the budget |
|---|---|
| December Year 1 | 1st January – 31st December Year 2 |
| March Year 2 | 1st April Year 2 – 31st March Year 3 |
| June Year 2 | 1st July Year 2 – 30th June Year 3 |
| September Year 2 | 1st October Year 2 – 30th September Year 3 |

Rolling budgets might be particularly useful for cash budgeting. An organisation must ensure that it will always have sufficient cash to meet its requirements, but actual cash flows often differ considerably from the budget. It might therefore be appropriate to prepare a new annual cash budget every month, and so have 12 rolling cash budgets every year.

The main **advantages** of rolling budgets are as follows:

**(a)** Budgets are continually reviewed and revised in response to changes in business conditions. The entity is not committed to a fixed annual budget that is no longer relevant.

**(b)** Control can be exercised through comparisons between current forecasts and strategic targets. This is a form of **feedforward control**. When the business environment is continually changing, this may be a more effective method of budgetary control than comparing actual results with the fixed budget or standard costs.

The main **disadvantages** of rolling budgets are as follows:

**(a)** They can be **time-consuming**, and divert management attention from the task of managing actual operations.

**(b)** Whenever a new rolling budget is prepared, the new plans must be communicated to all managers affected by the changes. There is a risk that some managers will not be informed about changes to plans and targets.

### 16.3.6 Incremental budgeting and zero-based budgeting (ZBB)

Incremental budgeting and zero-based budgeting are two different approaches to estimating budgeted expenditure. The difference between them is most obvious in budgeting for administrative activities (and other overhead activities) and overhead costs.

With **incremental budgeting**, the budgeted expenditure for the next financial period is estimated by taking expenditure in the current period as a starting point. An incremental amount is then added for:

**(a)** inflation in costs next year; and
**(b)** possibly, the cost of additional activities that will be carried out next year.

In its simplest form, incremental budgets for a financial period are prepared by taking the expenditure in the current year, and adding a percentage to allow for inflation next year.

This approach to budgeting is very common in practice because of its relative simplicity. For example in order to prepare a labour cost budget, it might be sufficient for the manager to make assumptions about (1) changes in staffing levels and (2) the general level of pay rises, and apply these assumptions to the actual labour costs for the current year that is just ending. If labour costs in the current year are ₦2.4 million, and if it is assumed that the work force will increase by 2% next year and that wages and salaries will increase by an average of 4%, a labour cost budget can be prepared simply as: ₦2.4 million ´ 102% ´ 104% = ₦2.546 million.

A serious weakness of incremental budgeting, however, is that there is no incentive to eliminate wasteful or unnecessary spending from the budget. For example suppose that next year's budget is based on this year's actual spending plus an allowance for inflation. If there has been wasteful spending in the current year, next year's budget will include an allowance for the wasteful spending, plus inflation.

Incremental budgeting can also encourage more waste (sometimes called 'budget slack'), because managers will try to spend up to their budget limit, so that in the next financial year their budgeted spending allowance will not be reduced.

### 16.3.7 Zero-based budgeting (ZBB)

Zero-based budgeting (ZBB) has a completely different approach to budgeting. It aims to eliminate all wasteful spending ('**budget slack**') and only to budget for activities that are worth carrying out and that the organisation can afford.
Planning starts from 'zero' and all spending must be justified.

> **Definition: Zero-based budgeting**
>
> A budget prepared from the "basement" or the "ground up" as if the budget were being prepared for the first time.

ZBB can be particularly useful in budgeting for activities that are prone to wasteful spending and budget slack, such as activities in a bureaucracy. ZBB might be usefully applied, for example, to the budgets of government departments.

The approach used in ZBB is as follows:

**(a)** The minimum level of operations in a department or budget centre is identified. These are the essential things that the department will have to do. A budget is prepared for this minimum essential level.

**(b)** All other activities are optional additional activities that need to be justified, in terms of the benefits obtained in return for the costs. Each additional activity is called a **decision package**.

A decision package is a program of activities that will achieve a specific purpose during the budget period. Each decision package must have a clearly-stated purpose that contributes to the goals and objectives of the entity.

There are two types of decision package.

**(a) Decision packages for a minimum level of operation**. For example, there may be a minimum acceptable level of training for a group of employees. There may be several alternative decision packages for providing the training – internal courses, external courses, or computer- based training programmes. An expenditure estimate should be prepared for each alternative basic decision package.

**(b) Incremental decision packages**. These are programmes for conducting a more extensive operation than the minimum acceptable level. For example, there may be incremental decision packages for providing some employees with more training than the essential minimum, or for having more extensive supervision, or more extensive quality control checks. For incremental decision packages, an estimate should be made of the cost of the incremental operation, and the expected benefits. Incremental decision packages are optional activities: the entity need not include them in the budget.

For each decision package, a budget decision must be made about whether to include it in the budget and the following should be considered:

**(a)** Purpose of the activity (decision package)
**(b)** The likely results and benefits from the activity
**(c)** The resources required for the activity, and their cost
**(d)** Alternative ways of achieving the same purpose, but perhaps at a l lower cost
**(e)** A comparison of the costs and benefits of the activity.

A zero-based budget is then prepared as follows:

**(a)** A decision must be taken to provide for a minimum level of operation. This means deciding for each basic operation:
**(b)** Whether or not to perform the operation at all – do the benefits justify the costs?
**(c)** If the operation is performed at a basic level, which of the alternative basic decision packages should be selected?
**(d)** Having decided on as basic level of operations, a basic expenditure budget can be prepared.
**(e)** The next step is to consider each incremental decision package, and decide whether this additional operation, or additional level of operations, is justified. An incremental decision package is justified if the expected benefits exceed the estimated costs.
**(f)** A budget can then be prepared consisting of all the selected basic decision packages and incremental decision packages.
**(g)** If the total expenditure budget is too high, when all these decision packages are included, some incremental decision packages should be eliminated from the budget. One method of doing this is to rank the incremental decision packages in an order of priority (typically in order of net expected benefits, which are the expected benefits minus the

estimated incremental costs). The decision packages at the bottom of the priority list can then be eliminated from the budget, until total budgeted expenditure comes within the maximum permitted spending limit.

Extensive use of value judgements by managers will be needed to rank decision packages in a priority order. This is because the expected benefits from incremental activities or incremental programmes are often based on guesswork and opinion, or on forecasts that might be difficult to justify.

### The advantages of zero-based budgeting

There are some obvious benefits from zero based budgeting

**(a)** All activities are reviewed and evaluated, and no activity is included in the budget unless it appears to be worthwhile.
**(b)** Inefficiency in using resources and inefficiency in spending should be identified and eliminated.
**(c)** A ZBB approach helps managers to question the reason for doing things rather than simply accepting the current position.
**(d)** When total expenditure has to be reduced, ZBB provides a priority list for activities and expenditures.
**(e)** ZBB encourages greater involvement by managers and might motivate them to eliminate wasteful spending.

### The disadvantages of zero-based budgeting

However, there are also some severe disadvantages to ZBB

**(a)** ZBB is a very time-consuming process, particularly if undertaken every year.
**(b)** It is also costly, because it takes more time.
**(c)** Planners need to understand the principles of relevant costing and decision-making, in order to compare properly the incremental costs and incremental benefits of activities (decision packages).
**(d)** Managers might see ZBB as a threat, and an attempt by senior management to cut back their expenditure allowances in the next budget year.
**(e)** When incremental decision packages are ranked in priority order, there may be disputes between managers of different decision units (budget cost centres), as each tries to protect his own spending levels and argue that budget cuts should fall on other cost centres.

In view of the large amount of management time that is required to prepare a zero based budget, an entity may decide to produce a zero based budget periodically, say every three years, and to prepare incremental budgets in the intervening years.

In order to maintain the support of budget cost centre managers for a system of ZBB, it is also necessary to make sure that any system of performance-based rewards (such as annual bonuses for keeping spending within budget limits) is

not affected by the use of ZBB. If managers feel that their rewards will be threatened – for example because it will be difficult to keep spending within the ZBB limits – they are unlikely to give their support to the ZBB system.

### ZBB and performance monitoring

A successful system of ZBB requires methods for monitoring actual

performance and comparing actual performance with the budget.

**(a)** Each decision package must therefore have one or more measurable performance objectives. The package must specify the objective or objectives, and the activities or operations that will be required to achieve those objectives.

**(b)** Actual performance should be measured and compared with the objectives. Management must be informed whether or not the performance objectives are achieved.

### 16.5.7 Activity based budgeting (ABB)

#### Background

Activity-based budgeting is a planning system under which costs are associated with activities, and budgeted expenditures are then compiled based on the expected activity level.

Activity based budgeting (ABB) is an extension of activity based costing (ABC) which is an alternative approach to traditional absorption costing.

Traditional absorption accounting identifies overheads and absorbs them into units of production or services using a volume based approach. For example, overheads might be absorbed as an amount per direct labour hour or an amount per unit of material used when making a product.

Traditional absorption costing has many weaknesses, especially in a 'modern' manufacturing environment where production overhead costs are often high relative to direct production costs. Therefore, a system of adding overhead costs to product costs by using time spent in production (direct labour hours or machine hours) is difficult to justify.

Activity based costing assumes that overhead costs are caused by activities, and the costs of activities are driven by factors other than production volume. For each activity, there should be a cost driver. A cost driver is the factor that determines the cost of the activity. It is something that will cause the costs for an activity to increase as more of the activity is performed.

When an entity uses activity based costing, it should be able to prepare activity based budgets. These are budgets prepared using activity based costing methods, and budgets for overheads are therefore prepared as activity costs.

> **Definition: Activity-based budgeting**
>
> Activity-based budgeting (ABB) is a method of budgeting based on an activity framework, using cost driver data in the budget setting and variance feedback processes.
>
> *CIMA Official Terminology*

The preparation of an activity based budget requires the following steps:

| Step | Description |
|---|---|
| 1 | Identify activities and their cost drivers |
| 2 | Forecast the number of units of cost driver for the required activity level |

**3** Calculate the cost driver rate (cost per unit of activity). for the coming period

**Example: Activity based budgeting**

A company expects to process 50,000 sales orders in the coming budget period. (NB this is not to sell 50,000 units but to make 50,000 sales with each sales comprising a different number of units).

The forecast cost of processing a single sales order is ₦10 regardless of the number of units to be sold in that order.

The budgeted cost of selling overhead is calculated as follows:

| | |
|---|---|
| **Step 1** | |
| Activity | Sales |
| Cost driver | Making a sale |
| **Step 2:** Number of units of cost driver | 50,000 |
| **Step 3:** Calculate the cost driver rate | ₦10 |

The above example provided a cost driver rate (₦10 per sale). It is important to realise that the cost of an activity would have to be calculated and that might be quite difficult to do.

The company would have to analyses its costs and identify those which related to processing sales orders. This might be a little tricky. For example, part of the cost of processing the order might involve the accounts department raising an invoice. However, the person who raises the invoice will have other duties so not all of the salary costs would necessarily relate to sales.

### Advantages of activity-based budgeting

**(a)** It gives managers a much better understanding of the link between costs and output of the business.
**(b)** It focuses attention on expensive activities and management might be able to reduce the cost of these to increase profit.
**(c)** It might allow management to increase resource to eliminate bottlenecks associated with an activity and allow business functions to run more smoothly.
**(d)** It might also be possible to identify activities that do not add value, and their associated costs. These activities can then be eliminated from the budget.
**(e)** Activities drive costs. By identifying cost drivers, it might be assumed that Resources are clearly matched to its service provision

### Disadvantages of activity-based budgeting

**(a)** It is complex in nature and very difficult to set up.
**(b)** it requires a great deal of preliminary analysis and research to trace costs back to activities; and
**(c)** accounting information systems would have to be modified to track costs that relate to activities.
**(d)** As a result of the work necessary before it can be used it is expensive to

set up. (it is most useful to companies that have already introduced activity based costing because they already have a strong insight into what is needed to introduce activity-based budgeting).

**(e)** It is complex to operate.

**(f)** It is not practical for services where a flexible approach is required and/or where resources need to be moved between activities in response to demand.

### 16.3.7 Feed-forward control

Budgetary systems are systems of control as well as planning systems. In a normal budgetary control system, actual results in each control period (month) are compared with the budgeted results for the period. (Sometimes, cumulative actual results for the year to date are also compared with budgeted results for the year to date.)

Information that provides a comparison between budgeted results (planned results) and actual results is called **feedback**.

Instead of basing budgetary control on feedback, there might be a system of feed-forward control. With feed-forward control, control information is based on a comparison with a revised up-to-date forecast of what is now expected to happen in the budget year.

Feed-forward control involves a comparison between:

**(a)** a revised up-to-date forecast, and

**(b)** the original budget.

Within a budgetary control system, it should be possible in each control period to compare:

**(a)** budgeted and actual results for the most recent control period (feedback control)

**(b)** cumulative budgeted and actual results for the financial year to date (feedback control)

**(c)** forecast results and the original budgeted results for the financial year ( feed-forward control).

A problem with feed-forward control, however, is that up-to-date forecasts of what will happen in the rest of the financial year might not be reliable. The quality of the control system depends on the quality (reliability) of the forecast information.

#### Difficulties in changing a budgetary system

Each of the budgetary systems described in this section offers some benefits, and one system is not necessarily better than another. The senior management of an entity may decide that the budgetary system should be changed, and a new system of budgeting (such as rolling budgets, zero-based budgets, or activity-based budgets) should be introduced.

However, the practical difficulties of switching from one budgetary system to another should be understood, and the benefits of using a new system might not be sufficient to justify the problems in changing over. Difficulties that could arise with the introduction of a new budgetary system include:

**(a)** Resistance of the managers responsible for budgeting: managers might be reluctant to change to a new system from a system they understand and are familiar with.

**(b)** Suspicion about the motives of senior management for wanting to make the

change.

**(c)** The time required to prepare the new system of budgeting, including the time required to train managers in how to operate the new system.

**(d)** Practical difficulties with implementing the new system, such as difficulties in calculating the relevant costs for a decision package (ZBB) or difficulties in preparing reliable up-to-date forecasts (feed-forward control).

## 16.4 Preparation of Fixed budget, flexible budget, rolling budget, activity -based budget, functional and master budgets

### 16.4.1 Preparation of a fixed budget

Fixed budget otherwise referred to as static budget are budgets that are prepared in advance and do not change regardless of changes in the activity level. They are prepared for a specific period. It can be prepared using the following techniques:

**(a)** Historical analysis
**(b)** Topdown approach
**(c)** Bottom up approach
**(d)** Zero based Budgeting
**(e)** Activity Based budgeting

In preparing fixed budget, the following steps are utilized:

**(a)** Define the Period
**(b)** Set the goals and target
**(c)** Estimate both revenue and Expenses
**(d)** Allocate Expenses
**(e)** Monitor actual Performance
**(f)** Review set budget and actual and revise

It can be used in preparing Sales budget, production budget, overhead budget, personnel budget, capital expenditure budget, marketing budget et

Advantages :

**(a)** Useful for planning purposes
**(b)** Useful in setting goals and targets
**(c)** Useful in controlling costs and management of resources
**(d)** Source of motivation
**(e)** Used in accountability

Disadvantages:

**(a)** Do not change with activity level (Inflexibility)
**(b)** Can display unrealistic goal
**(c)** Lacking in motivation
**(d)** Lacking in creativity

### 16.4 .2 Preparation of a flexible budget

A flexible budget is prepared by first identifying fixed and variable costs, then calculating the budgeted variable cost per unit. Next, a flexible budget formula is created and applied to different activity levels. This process allows for adjustments based on varying production or sales levels.

The steps for preparing flexible budget include:

(a) identify fixed and variable costs;

(b) calculate budgeted variable cost per unit;

(c) prepare the flexible budget formula; and

(d) apply the formula to different activity levels.

Benefits of Flexible budgets:

(a) improved cost control;

(b) performance evaluation;

(c) scenario planning; and

(d) resource allocation.

### 16.4.3 Preparation of a rolling budget

A rolling budget is prepared by initially creating a budget for a specific period (e.g., a year), then regularly updating it by adding a new period at the end while removing the period that has just passed. This ensures the budget always covers a set period in the future, like a year. The steps for preparing rolling budget include:

(a) define the budget period and update frequency like monthly, quarterly;

(b) initial budget creation;

(c) regular updates;

(d) data collection and analysis;

(e) adjustments and refinements; and

(f) communication and monitoring.

Benefits of a rolling budget:

(a) improved budget accuracy;

(b) enhanced budget flexibility;

(c) better control of activity; and

(d) increased efficiency budgeting.

### 16.4.3 Preparation of activity based budget

Activity-based budgeting (ABB) involves analysing each activity within a business to determine its cost drivers and then using this information to create a more accurate budget. It's a method that goes beyond simply tracking expenses; it aims to understand how activities consume resources and how to optimise them. This approach helps in cost management and decision-making by providing a more granular view of resource utilisation. The process for preparing ABB include:

(a) identify activities and cost drivers;

(b) determine activity levels;

(c) calculate cost per unit;

(d) build the budget; and

(e) monitor and evaluate.

Benefits of activity-based budgeting:

**(a) improved accuracy**;

**(b) better cost control**;

**(c) enhanced decision-making**; and

**(d) increased efficiency.**

### 16.4.3 Preparation of sales budget

The sales budget as a type of operating budget, is a forecast of the expected units a company intends to sell over a period of time and the revenue it should generate from it. Example of sales budget include:

| Quantity | Sales price | Sales value |
|---|---|---|
| 10,000 | ₦12 | ₦120,000 |
| 14,000 | ₦13 | ₦182,000 |

It is the basis for preparing the income statement for the business. The management prepares a sales budget based on its business environment, overall economic condition, the intensity of competition in the market, production capacity, available funds, etc.

### 16.4.5 Preparation of cash budget

To prepare a cash budget, businesses should first define the time period, estimate cash inflows (income from sales, investments, etc.), and estimate cash outflows (expenses like payroll, rent, etc.). Then calculate the net cash flow (inflows minus outflows) to project the ending cash balance for each period. This helps businesses plan for potential cash shortages or surpluses, and make informed financial decisions. Basis of preparing cash budget include:

(a) define the time period;

(b) estimate cash inflows;

(c) estimate cash outflows;

(d) calculate net cash flow;

(e) project ending cash balance; and

(f) analyse and adjust.

### 16.4.6 Preparation of production budget

A production budget is prepared by first forecasting sales, determining desired inventory levels, and then calculating the number of units to produce. This budget is crucial for aligning production with sales needs and managing inventory, ensuring a company has enough stock on hand without overstocking. The procedure for preparing production budget include:

(a) **develop a sales budget**;

(b) **determine desired closing inventory**;

(c) **calculate units to produce**;

(d) **prepare the production budget**; and

(e) **consider costs**.

## 16.5 Explain the beyond budgeting model showing benefits and problems

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### 16.5.1 Beyond Budgeting

**Section overview**

(a) Origins of 'beyond budgeting'
(b) Weaknesses in traditional budgeting
(c) The 'beyond budgeting model'
(d) Performance management in the 'beyond budgeting' model
(e) Beyond budgeting: concluding comments

### 16.5.1 Origins of 'beyond budgeting'

The Beyond Budgeting Round Table (BBRT) was set up in 1998. It is a European-wide research project investigating whether entities would benefit from the abolition of budgets and budgeting. The BBRT claims that several successful European companies have stopped preparing budgets. Instead, they use a 'responsibility model' for decision-making and performance measurement. As a result, their performance has improved.

In the UK, the ideas of 'beyond budgeting' are associated with the writing of Jeremy Hope and Robin Fraser.

### 16.5.2 Weaknesses in traditional budgeting

Hope and Fraser have argued that the traditional budgeting system is inefficient and inadequate for the needs of modern businesses. In a continually-changing business world, traditional budgeting systems can have the effect of making business organisations fixed and rigid in their thinking, and unable to adapt. As a result, business organisations may be much too slow and inflexible in reacting to business developments.

The budgeting system establishes 'last year's reality' as the framework for the current year's activities. When the business environment is changing rapidly, this approach is inadequate. Managers should respond quickly to changes in the environment, but traditional budgeting and budgetary control systems act as a restraint on innovation and initiative.

Consequences of the inadequacy of the traditional budgeting system are that:

**(a)** operational managers regard the budgeting process as a waste of their time and resent having to prepare and then continually revise budget plans
**(b)** management accountants are involved in the budgetary planning and control system, but their work adds little or no value to the business. As a result, it may be difficult to justify the existence of the management accounting function.

According to the Beyond Budgeting Round Table, there are ten major problems with the traditional budgeting and budgetary control system.

**(a)** Budgets are **time-consuming and expensive**. In spite of computer technology and the use of budget models, it can take four to five months in a large company to prepare the annual budget for next year. The work on budget preparation has been found to use over 20% of the time of senior managers and financial controllers.
**(b)** **Traditional budgeting adds little value** and uses up valuable management time that could be used better in other ways. Preparing a

budget does nothing, or very little, to add value to the entity. Budgets 'are bureaucratic, time-consuming exercises, and the time taken would be better deployed in more value-creating activities' (Hope and Fraser).

**(c)** **Fails to consider shareholder value**. The traditional budgeting process focuses too much on **internal matters** and not enough on external factors and the business environment, and it fails to focus on shareholder value.

**(d)** **Rigid and inflexible: budgeting systems prevent fast response**. Managers concentrate on achieving 'agreed' budget targets, which may not be in the best interests of the organisation as a whole, particularly when circumstances change after the budget has been agreed. Budgets are therefore 'rigid' and prevent fast and flexible responses to changing circumstances and unexpected events.

**(e)** **Budgets 'protect' spending and fail to reduce costs**. In many entities, managers are expected to spend their entire budget allowance. If they don't, money will be taken away from their budget allowance next year. This is certainly no incentive to cut costs.

**(f)** Traditional budgeting and budgetary control **discourages innovation**. Managers are required to achieve fixed budget targets, and the fixed budget does not encourage continuous improvement. Managers will be reluctant to exceed their budgeted spending limits, even though extra spending would be necessary to react to events, possibly because spending above budget will put their bonus at risk. In a dynamic business environment, business organisations should be seeking continuous improvement and innovation.

**(g)** Budgets **focus on sales targets, not customer satisfaction**. This will possibly increase sales in the short-term, even if the products are not as good as they should be, but long-term success depends on satisfying customers.

**(h)** In practice, it has been found that although most companies have a budgeting system, they are poor at executing strategy. This suggests that budgeting systems are not effective systems for implementing strategy.

**(i)** Budgeting systems encourage a **culture of 'dependency'**, in which junior managers do what they are told by their boss, and do not argue. 'They reinforce the "command and control" management model and … undermine attempts at organisational change, such as team working, delegation and empowerment' (Hope and Fraser).

**(j)** Budgets can lead to 'unethical' behaviour, such as including 'slack' within the budgeted spending allowance.

There are other major criticisms of budgeting systems.

**(a)** Traditional budgeting is seen as a method of imposing financial control, by comparing actual results with budget. Budgeting should be a system for communicating corporate goals – setting objectives and improving performance.

**(b)** Budgets are also plans that focus on financial numbers. 'They fail to deal with the most important drivers of shareholder value … - knowledge or intellectual capital. Strong brands, skilled people, excellent management processes, strong leadership and loyal customers are assets that are outside the … accounting system' (Hope and Fraser).

**(c)** In many cases, budget plans are not the result of a rational decision- making process. Often, budgets are a political compromise between different departments and managers, and budgeted spending limits for each manager are the outcome of a bargaining process.

**(d)** Traditional budgetary control encourages managers to achieve fixed budget targets, but does not encourage continuous improvement. Managers will be reluctant to exceed their budgeted spending limits, even though extra spending would be necessary to react to events, possibly because spending above budget will put their bonus at risk. In a dynamic business environment, business organisations should be seeking continuous improvement and innovation.

**(e)** Traditional budgeting shows the costs of departments and functions, but not the costs of activities that are performed by employees. The traditional budget figures do not give managers information about the cost drivers in their business. In addition, traditional budgets do not help managers to identify costs that do not add value.

### 16.5.3 The 'beyond budgeting model'

The Beyond Budgeting view is that budgeting, as practised by most companies, should be abolished. The traditional hierarchical form of management structure should also be abolished. In its place, there should be a system in which authority and responsibility is given to operational managers, who should work together to achieve the strategic objectives of the entity.

Traditional budgeting is based on a 'dependency model' of management and organisation culture. It is a system for centralised control by senior management. Control is exercised by requiring operational managers to meet (or exceed) budget targets.

The 'Beyond Budgeting' alternative is a 'responsibility model' in which decision-making and performance management are delegated to 'line managers' (operating managers). Instead of having fixed annual plans, these managers agree performance targets: these targets are reviewed regularly and amended as necessary in response to changing circumstances and unexpected events.

A solution to the lack of flexibility in traditional budgeting may be **continuous rolling forecasting** (or even continuous budgets), so that the business organisation can adapt much more quickly to changes in its environment and to new events.

Responsibility should be delegated to operational managers, who should be empowered to take decisions in response to changing circumstances, that the managers believe would be in the best interests of the organisation.

**(a)** Goals should be agreed by reference to external benchmarks (such as increasing market share, or beating the competition in other ways) and targets should not be fixed and internally-negotiated.

**(b)** Operational managers should be motivated by the challenges they are given and by the delegation of responsibility.

**(c)** Operational managers can use their direct knowledge of operations to adapt much more quickly to changing circumstances and new events.

**(d)** Operational managers may be expected to work within agreed parameters, but they are not restricted in their spending by detailed line-by-line budgets.

**(e)** Delegated decision-making should encourage more transparent and open communication systems within the organisation. Managers need continuous rolling forecasts to make decisions and apply control. Efficient IT systems are therefore an important element in the 'beyond budgeting' model.

In the Beyond Budgeting model of performance management, there are 12 basic principles.

(a) **Governance**. The basis for taking action should be a set of clear values. Mission statements and plans should not be used to guide action.
(b) **Responsibility for performance**. Managers should be responsible for achieving competitive results, not for meeting the budget target.
(c) **Delegation**. People should be given the ability and the freedom to act. They should not be controlled and constrained by senior managers.
(d) **Structure**. Operations should be organised around processes and networks, and should not be organised on the basis of departments and functions.
(e) **Co-ordination**. There should be effective co-ordination between people within the company, and this should be achieved by process design and fast information systems.
(f) **Leadership**. Senior managers should challenge and 'coach'. They should not command and control.
(g) **Setting goals**. The goal should be to beat competitors, not meet budget.
(h) **Formulating strategy**. Formulating and implementing strategy should be a continuous process, not an annual event imposed by senior management.
(i) **Anticipatory management**. Management should use anticipatory systems for managing strategy. (Anticipatory systems are systems that provide information about events that are anticipated in the future.)
(j) **Resource management**. Resources should be made available to operational managers at a fair cost, when they are required. Resources should not be allocated to departments in a fixed budget.
(k) **Measurement and control**. Performance measurement and control should be based on a small number of key performance indicators, not a large number of detailed reports.
(l) **Motivation and rewards**. Rewards, at a company level and a business unit level, should be based on competitive performance, not meeting predetermined budget targets.

Principles (1) to (6) are concerned with establishing an effective organisation and culture of behaviour. Principles (7) to (12) are concerned with establishing an effective system of performance measurement.

'Beyond Budgeting entails a shift from a performance emphasis based on numbers to one based on people. It assumes that performance improvement is more likely to come from giving capable people control over decisions (and making them accountable for results), than simply from adopting different measures and incentives' (Hope and Fraser).

Hope and Fraser set out the 12 principles, and their effect, as follows:

| | | |
|---|---|---|
| Effective organisation and behaviour | Effective performance competitive success | Management of |

| | | | | |
|---|---|---|---|---|
| Clear values<br>Responsibility for results<br>Freedom and capability to act<br>Fast networks and processes<br>Co-ordination<br>Challenge and stretch | × | Relative targets<br>Adaptive strategies<br>Anticipatory management<br>Internal market for resources<br>Fast, distributed controls<br>Relative team rewards | = | Fast response<br>Best people<br>Innovative strategies<br>Low costs<br>Loyal customers<br>Satisfied customers |

To compete successfully, management have to be very good at the six issues in the box on the right-hand side of this diagram.

**(a)** They must create a climate and culture for fast response. An ability to respond quickly to unexpected changes and events will mean that the company can deal with uncertainty successfully. Change should be seen as an opportunity, not a threat.

**(b)** Managers must be given responsibility for strategy, and they should monitor strategy continuously, not just once a year (as in the traditional budget model).

**(c)** If new initiatives are needed, managers should be able to obtain the resources they need quickly. 'They need, for example, the authority to acquire key people when they are available (not when there is room in the budget); to react to competitive threats and opportunities as they arise (not as predicted in an outdated plan); and to acquire and deploy resources when necessary (not as allocated by head office)' (Hope and Fraser).

**(d)** They must employ the best people. A challenging environment to work in is likely to attract and retain top-quality employees.

**(e)** They must innovate and generate new business ideas. Bureaucracy does not encourage innovation and creativity. The 'Beyond Budgeting' model does.

**(f)** They must operate with low costs. Competitive pressures in markets are forcing down prices. In the 'Beyond Budgeting' model managers will adapt strategies to the requirements of the competitive environment, and will find ways to reduce costs if this is appropriate. The traditional budgeting model does not encourage effective cost reduction.

**(g)** They must create and retain loyal customers. The 'Beyond Budgeting' model encourages managers to focus on satisfying customer needs. Satisfied customers are likely to be loyal customers.

**(h)** They must create value for shareholders. The 'Beyond Budgeting' model should help a company to improve its profitability and create additional value for its shareholders

### 16.5.5 Beyond budgeting: concluding comments

Hope and Fraser have argued that traditional budgeting systems are weak and should not be used. However, in practice most companies and other organisations continue to use them.

It has been argued that the 'beyond budgeting' model is much more easily applied in the private sector than in the public sector. Government activity is managed through expenditure budgets and spending controls, and there is

accountability for spending to politicians (government ministers and elected representatives) and to the general public. There may also be uncertainty about the objectives of particular government activities or departments. In such circumstances, it is difficult to apply a flexible system of decision-making or to devolve decision-making to lower levels of management.

There have been attempts to improve traditional budgeting systems: for example, zero based budgeting, continuous budgets and activity based budgeting are all attempts to improve the budgeting system. Hope and Fraser argue, however, that these are 'valiant efforts to update the process, but they only deal with part of the [problem] and are both time-consuming and complicated to manage.'

## 16.6 Explain the benefits and difficulties in employee participation in budgeting process and negotiations of targets.

**Section overview**

(a) Introduction
(b) Misunderstanding and worries about cost-cutting
(c) Opposition to unfair targets set by senior management
(d) Sub-optimisation
(e) Budget slack (budget bias)
(f) Participation in budget setting
(g) Other behavioural issues
(h) Management styles

### 16.6.1` Introduction

The effectiveness of budgeting and budgetary control depends largely on the behaviour and attitudes of managers and (possibly) other employees.

**(a)** Budgets provide performance targets for individual managers. If managers are rewarded for achieving or exceeding their target, budgets could provide them with an incentive and motivation to perform well.
**(b)** It has also been suggested that budgets can motivate individuals if they are able to participate in the planning process. Individuals who feel a part of the planning and decision-making process are more likely to identify with the plans that are eventually decided. By identifying with the targets, they might have a powerful motivation to succeed in achieving them.

When budgeting helps to create motivation in individuals, the human aspect of budgeting is positive and good for the organisation.

Unfortunately, in practice human behaviour in the budgeting process often has a negative effect. There are several possible reasons why behavioural factors can be harmful:

**(a)** misunderstanding and worries about cost-cutting;
**(b)** opposition to unfair targets set by senior management;
**(c)** sub-optimisation; or

**(d)** budget slack or budget bias.

### 16.6.2 Misunderstanding and worries about cost-cutting

Budgeting is often considered by the managers affected to be an excuse for cutting back on expenditure and finding ways to reduce costs. Individuals often resent having to reduce their spending, and so have a hostile attitude to the entire budgeting process. This fear and hostility can exist even when senior management do not have a cost-cutting strategy.

### 16.6.3 Opposition to unfair targets set by senior management

When senior managers use the budgeting process to set unrealistic and unfair targets for the year, their subordinates may unite in opposition to what the senior managers are trying to achieve. Senior managers should communicate and consult with the individuals affected by target-setting, and try to win their agreement to the targets they are trying to set. Targets need to be reasonable.

A distinction can be made between:

**(a)** **aspirational budgets**, which are budgets based on performance levels and targets that senior managers would like to achieve, and
**(b)** **expectational budgets**, which are budgets based on performance levels and targets that senior managers would realistically expect to achieve.

Aspirational budgets might be considered unfair, especially if the individuals affected have not been consulted. Expectational budgets, based on current performance levels, do not provide for any improvements in performance.

Ideally perhaps, budgets might be set with realistic targets that provide for some improvements in performance.

### 16.6.4 Sub-optimisation

There may be a risk that the planning targets for individual managers are not in the best interests of the organisation as a whole. For example, a production manager might try to budget for production targets that fully utilise production capacity. However, working at full capacity is not in the best interests of the company as a whole if sales demand is lower. It would result in a build-up of unwanted finished goods inventories. The planning process must be co-ordinated in order to avoid sub-optimal planning. In practice, however, effective co-ordination is not always achieved.

### 16.6.5 Budget slack (budget bias)

Budget slack has been defined as 'the intentional overestimation of expenses and/or underestimation of revenue in the budgeting process' (CIMA *Official Terminology*). Managers who prepare budgets may try to overestimate costs so that it will be much easier to keep actual spending within the budget limit. Similarly, managers may try to underestimate revenue in their budget so that it will be easier for them to achieve their budget revenue targets. As a result of slack, budget targets are lower than they should be.

When managers are rewarded for achieving their budget targets, the motivation to include some slack in the budget is even stronger.

An additional problem with budget slack is that when a manager has slack in his spending budget, he may try to make sure that actual spending is up to the budget limit. There are two reasons for this:

**(a)** If there is significant under-spending, the manager responsible might be required to explain why.
**(b)** Actual spending needs to be close to the budget limit in order to keep the budget slack in the budget for the next year.

The problem of budget slack is particularly associated with spending on 'overhead' activities and **incremental budgeting**. One of the advantages of **zero based budgeting** is that it should eliminate a large amount of slack from budgets.

In some cases, budget bias operates the other way. Some managers might prepare budgets that are too optimistic. For example, a sales manager might budget for sales in the next financial year that are unrealistic and unachievable, simply to win the approval of senior management.

### 16.6.6 Participation in budget setting

Rewards for performance are intended to motivate individuals to achieve the targets they have been set.

Another view is that individuals can be motivated to improve their performance and to set challenging budgets through their commitment to the work that they do. If individuals enjoy their work and feel committed to performing as well as possible, challenging budget targets can be agreed and better levels of actual performance should be achieved.

Personal motivation to improve performance, it may be argued, can be achieved if individuals are allowed to:

**(a)** participate meaningfully in the budget-setting or target-setting process; and
**(b)** be directly involved in negotiating performance targets for the budget period.

**Advantages and disadvantages of participation**

The **advantages** of participative budgeting are as follows:

(a) Stronger motivation to achieve budget targets, because individuals are involved in setting or negotiating the targets.

(b) There should be much better communication of goals and budget targets to the individuals involved, and a better understanding of the target-setting process.

(c) Involvement by junior managers in budgeting provides excellent experience for personal development

(d) Better planning decisions – participation might lead to better planning decisions, because 'local' managers often have a much better detailed knowledge of operations and local conditions than senior managers.

However, there are significant **disadvantages** with participation.

(a) It might be difficult for junior managers to understand the overall objectives of the organisation that budgets should be designed to meet.

(b) The quality of planning with participation depends on the skills, knowledge and experience of the individuals involved. Participation is not necessarily beneficial in all circumstances, particularly when individuals lack experience.

(c) There might be a danger that budget targets will be set at a level that is not ambitious. Participation on its own is not necessarily a sufficient incentive to raise standards and targets for achievement. Individuals might try to argue

that performance targets should be set at current levels of achievement.

(d) Senior managers might pretend to be encouraging participation, but in practice they might disregard all the proposals and ideas of their subordinates. To be effective, participation must be 'real'.

(e) It is generally considered that participation is a good thing but need to be strictly and carefully managed by senior management to ensure optimum decision are taken that are in line with the company goals.

### 16.6.7 Factors affecting the impact of participation

The effect of participation on the motivation of subordinates will also depend on circumstances. Hopwood suggested that the effectiveness of participation on employee motivation depends on three key factors.

| Factor | Comments |
|---|---|
| The nature of the task | The effectiveness of participation will depend on the nature of the work, and the extent to which employees have control over the way in which the work is done.<br>*'In highly-programmed … and technically constrained areas, where speed and detailed control are essential for efficiency, participative approaches have less to offer…. In contrast, in areas where flexibility, innovation and the capacity to deal with un-anticipated problems are important, participation in decision-making may offer a more immediate … payoff….'* (Hopwood). |
| Organisation structure | Participation is likely to be more effective in an organisation where management responsibilities are decentralised, and local managers have more influence over their own budgets. |
| Personality of the employees | Some types of individual are more likely than others to be motivated by participation in the budgeting process. |

### 16.6.8 Imposed budgets

The opposite of a participative budget is an imposed budget, where senior management dictates what the budget targets should be. Imposed budgets have certain advantages:

**(a)** Less time consuming. Line managers do not have to spend time on budgeting and so are not distracted from the task of running the business.

**(b)** Senior managers may have a greater appreciation of the constraints faced by the business, such as restrictions on cash and other resources, and shareholder expectations of profits and dividends.

**(c)** It may be easier to co-ordinate departmental budgets if they are prepared together by senior management.

However the disadvantages of imposed budgets are that:

**(a)** Targets may be set at a challenging level and so are unachievable. If unachievable targets are imposed, this will lead to de-motivation.

**(b)** Opportunities for exploiting the specialist knowledge of more junior

managers may be lost if they are excluded from the budget-setting process.

### 16.6.8 Other behavioural issues

Performance of operational managers may be measured by comparing actual performance with the budget. The manager might be rewarded for achieving budget targets but criticised for failing to meet the budget.

This tendency to 'blame' managers for failing to meet the budget targets will have an adverse effect on the motivation and attitude of the operational managers in the following circumstances:

(a) The budget might not make any distinction between costs that are controllable and costs outside the manager's control. The manager might therefore be criticised for excess spending on items over which he has no control.

(b) Circumstances might change and events might occur that make the original budget unrealistic. Even so, the manager might be criticised for failing to meet the budget targets, even when changed circumstances have made the budget targets unrealistic.

If budgeting is used as a 'performance contract' between the company and its managers, and provides a basis on which the actions by management are assessed, this could lead to a number of problems. Managers will want to avoid criticism, and so meet targets, but they have no obvious incentive to do better than the targets in the budget plan.

| Factor | Possible means of dealing with the problem |
|---|---|
| **Meeting only the lowest targets**<br><br>Once a manager has agreed his budget targets for the year, his only incentive is to achieve the budget target, and not to exceed it. | whatever they can to make the target – even if this means ignoring other aspects of performance for which there is no bonus and even if it means 'bending the rules' to make the target. |
| **Using more resources than necessary**<br><br>Once the budgeted utilisation of resources has been agreed (materials, labour time, machine time and so on) a manager will be satisfied with using the full budgeted quantity of resources permitted. There is no incentive to improve on performance and use fewer resources. | Earning the bonus – whatever it takes to do this. |
| Managers and employees who are incentivised by a bonus to achieve a budget target will do | |

It may be appropriate to introduce an incentive scheme, in which higher bonuses are paid according to the amount by which the budget target is exceeded. Higher bonuses can be paid for better (budget-beating) performance.

One possibility is to train management and staff in the application of Total Quality Management techniques, so that managers and employees are actively looking for improvements.

Another possibility is to provide rewards for achieving variable costs per unit that are less than standard/budgeted.

This is difficult problem to overcome.

The most effective solution may be to amend the rewards system so that there are a number of bonus incentives for achieving a number of different targets. However, this will be difficult to design and implement.

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| Factor | Possible means of dealing with the problem |
|---|---|
| **Competing with other divisions and departments in the same organisation**<br><br>There will be a tendency for cost centres and profit centres to act mpetitively towards each other, in order to achieve their own budget target. This may be evident in attitudes to transfer pricing, which are described in another chapter. | otherwise might be. |
| **Making sure that all the expenditure allocation in the budget is actually spent**<br><br>Managers often see budgeting as a competition for resources and spending allocations. If a cost centre or profit centre does not spend up to its permitted limit in one year, it is at risk of having some of the spending allowance removed the next year.<br>Managers will try to avoid this by making sure that their full budgeted spending allocation is actually spent. | |
| **Providing forecasts that are inaccurate**<br><br>Managers may try to provide forecasts that are (deliberately) not accurate in order to gain an advantage and misrepresent future expectations.<br>There are various reasons why this may be done – for example to persuade senior management to make a decision that is favourable to the forecast provider in order to win a bigger allocation of resources in the budget. | |
| **Meeting the budget target, but not beating** it.<br><br>If there is no incentive to beat a budget target, managers will be satisfied with simply achieving the target. They may then prefer not to exceed the target so that their target for the following year may not be as challenging as it | |

If there are disputes between different cost centres, or between cost centres and profit centres, it may be necessary to refer the matter for resolution to the senior management at head office

Rewarding employees and managers for achieving lower fixed costs than budgeted may be a solution to this problem

A change in management culture may be necessary to overcome this problem. It is an almost unavoidable feature of management behaviour that forecasts will be presented in the most favourable light possible. It is the task of top management to establish a culture of 'no blame' within the organisation, so that managers may be willing to provide information that is more 'honest'.

As suggested above, it may be appropriate to have an incentive scheme in which higher bonuses are available according to the amount by which the budget target is exceeded.

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### Avoiding risks

Managers will be tempted to stick to the agreed plans in the budget and will be reluctant to take unplanned initiatives that could result in a failure to meet budget targets. Managers may prefer to do nothing wrong than to take risks in order to improve performance.

Possible means of dealing with risk factor:
A bonus system that rewards managers and employees for beating a range of budget targets may be effective, so that managers are prepared to take risks to improve performance. However, as the crisis in the banking system (2007 – 2009) showed, managers should never be encouraged to take on excess risks.

## 16.6.9 Management Styles

In the 1970s, research was carried out by Anthony Hopwood into performance evaluation by managers, and how the performance of managers with cost centre responsibility is judged. He identified three types of management style:

**(a)** a budget-constrained style;
**(b)** a profit-conscious style; and
**(c)** a non-accounting style

#### Budget-constrained style.

With this style of management, the performance of managers is based on their ability to meet budget targets in the short term. With this style of performance evaluation, the focus is mainly on budgeted costs actual costs and variances. Managers are under considerable pressure to meet their short-term budget targets. Stress in the job is high. Managers might be tempted to manipulate accounting data to make actual performance seem better in comparison with the budget.

#### Profit-conscious style

The performance of managers is evaluated on the basis of their ability to increase the general effectiveness of the operations under their management. Increasing general effectiveness means being more successful in achieving the longer-term aims of the organisation. For example, success in reducing costs in the long term would be considered an increase in general effectiveness.

With a profit-conscious style, budgets and variances are not ignored, but they are budgetary control information which is treated with caution, and variances are not given the same importance as with a budget-constrained style.

Hopwood found that with this style of management evaluation, costs remain important, but there is much less pressure and stress in the job. As a consequence, there was a good working relationship between managers and their subordinates. In addition, there was less manipulation of accounting data than with a budget-constrained style.

#### Non-accounting style.

With this style, budgetary control information plays a much less important part in the evaluation of managers' performance. Other (non-accounting) measures of performance were given greater prominence.

### Closing comment

The results of empirical research by Hopwood and others (notable David Otley) seem to suggest that the most appropriate approach to the evaluation of performance depends on the circumstances and conditions in which the organisations and their managers operate.

## 16.7 Discuss ethical and sustainability considerations when setting budgets.

### 16.7.1 Introduction:

Ethical and sustainability considerations are important in budget-setting processes as it will help the organisation meet with stakeholders interest and provide opportunity to manage risks and issues surrounding the company's environment.

### 16.7.2 Ethical Issues in budget Setting:

Ethical problems arise when companies fail to do those things that will enhance their reputation before third parties. The following unethical issues in budgeting will arise from the management of the budgeting processes:

**(a)** Lack of accuracy, fairness and transperancy in budget processes.
**(b)** Manipulation of financial data
**(c)** Budget Padding or inflation
**(d)** Deceptive budget reporting Distortion of resource allocation framework
**(e)** Providing deceptive or false information in budget reports
**(f)** Creating budgets that prioritize short-term financial gains over long-term sustainability can be seen as unethical
**(g)** Discriminatory Resource Allocation:
**(h)** Neglecting environmental and social responsibility in budgeting decisions, such as disregarding the environmental impact of operations or the welfare of employees, raises ethical concerns.
**(i)** Presenting budget information in a way that is intended to deceive or mislead stakeholders, including investors, employees, or the public, is an ethical violation
**(j)** Inherent conflict arising from planning and control functions.
**(k)** Dishonest tendencies arising from performance evaluation.
**(l)** Organisational conflict arising from suboptimization or dysfunctional activities.
**(m)** Setting of unattainable goals or targets.
**(n)** Lack of transparency in budget preparation
**(o)** Concealing budget deficit in order to falsely promote an organisation.

### 16.7.3 Sustainability consideration in budget setting:

Under the sustainability principle, the emphasis is to ensure that the organisation meets not only the current corporate requirements and needs but to ensure future needs are met in the areas of environment, social and economic interests of the company.

Thus , Sustainable budgeting focuses on the impact of budgeting decisions on areas such as climate, community, and pollution. A sustainability budget is a financial plan that provides resources for environmentally friendly and socially responsible initiatives in a company. These initiatives could focus on adopting energy-efficient processes, reducing waste, investing in sustainable product design, and engaging the community. Performance information related to the budget can include measures

aligned with the UN Sustainable Development Goals. Despite concerns about lower returns, investment in sustainable budgeting is becoming more attractive due to regulatory and investor sentiment on sustainability. Some of the issues that must be viewed in order to address sustainability problems are:

**(a)** Climate change
**(b)** Biodiversity loss
**(c)** Resource depletion
**(d)** Pollution
**(e)** Deforestation
**(f)** Waste management
**(g)** Overfishing
**(h)** Water scarcity and pollution
**(i)** Social inequality
**(j)** Economic disparity
**(k)** Food insecurity
**(l)** Youth unrest
**(m)** Lack of basic infrastructure
**(n)** Community conflict and political insecurity
**(o)** Dynamics of technological change
**(p)** Ethical issues

## 16.8 Chapter Review

Before moving on to the next chapter the readers are advised to check that they now know how to:

(a) Explain the purposes of budgeting and the budgeting process
(b) Describe the main features of, and explain the differences between bottom-up and top-down budgeting
(c) Explain incremental and zero-based budgeting
(d) Explain activity based budgeting (ABB)
(e) Explain the concept and benefits of
(f) Recognise and explain the importance of the behavioural aspects of budgeting

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***Question:***

*Although bottom-up budgeting, in which management elicits input from employees throughout the company, is effective in actively engaging those who have to achieve the budgeted goals, this type of budgeting is not free from problems. Ethical issues often arise in the budgeting process, particularly when employees and managers are evaluated by comparing their actual results to the budget. How might ethical issues arise in the budgeting process?*

***Answer:***

*Ethical issues in budgeting arise as a result of :*

(a) Lack of accuracy, fairness and transperancy in budget processes.
(b) Manipulation of financial data
(c) Budget Padding or inflation
(d) Deceptive budget reporting Distortion of resource allocation framework
(e) Providing deceptive or false information in budget reports
(f) Creating budgets that prioritize short-term financial gains over long-term sustainability can be seen as unethical
(g) Discriminatory Resource Allocation:
(h) Neglecting environmental and social responsibility in budgeting decisions, such as disregarding the environmental impact of operations or the welfare of employees, raises ethical concerns.
(i) Presenting budget information in a way that is intended to deceive or mislead stakeholders, including investors, employees, or the public, is an ethical violation
(j) Inherent conflict arising from planning and control functions.
(k) Dishonest tendencies arising from performance evaluation.
(l) Organisational conflict arising from suboptimization or dysfunctional activities.
(m) Setting of unattainable goals or targets.
(n) Lack of transparency in budget preparation
(o) Concealing budget deficit in order to falsely promote an organization before third parties.

**Skills level**
**Performance management**




# ANALYTICAL TECHNIQUES IN BUDGETING AND FORECASTING

## Chapter Content

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# 17 Analytical techniques in budgeting and forecasting

## 17.0 Learning Objectives

This chapter introduces to the candidates the principles of analytical techniques in budgeting and forecasting using high low methods, correlation regression ,time series and learning curve theory.

## 17.1 Learning Outcome

At the completion of this chapter, candidates should be in a position to analyse fixed and variable costs in budgeting and forecasting using techniques like high low method, correlation regression , time series learning curve theory.

## 17.2 Analyse fixed and variable cost elements in budgeting and Forecasting:

It is normally assumed that total costs can be analysed into fixed costs and a variable cost per unit of activity, such as a variable cost per unit of product or per hour of service. Some overhead costs are a mixture of fixed costs and variable costs, but these can be separated into a fixed cost portion and a variable cost portion.

To prepare reliable cost budgets or cost estimates, it may be necessary to estimate fixed costs and variable costs.

(a) Direct material costs are normally 100% variable costs.
(b) Direct labour costs may be treated as variable costs. However, when there is a fixed labour force, direct labour costs may be budgeted as fixed costs.
(c) Overhead costs may be treated as fixed costs. However, for an accurate analysis of overhead costs, it may be necessary to make an estimate of fixed costs and variable costs. These estimates are often based on an analysis of historical costs.

You will be familiar with the following two techniques for estimating fixed and variable costs from your previous studies:

(a) the high low method; and
(b) linear regression analysis.

***A full explanation of each of these techniques is repeated here for your convenience.***

### 17.2.1 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
(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
(b) the lowest activity level.

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

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

**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.

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**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 = $^{₦8,400}/_{2,400\ units}$ = ₦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

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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

### 17.2.3 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

#### 17.2.4 High/low analysis with 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:

i. the highest activity level
ii. the lowest activity level.

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

i. add the step in fixed costs to the total costs of the lower level of activity; or
ii. deduct the step in fixed costs from the total costs of the higher level of activity.

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

difference in total costs/difference in the number of units of activity.

**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.

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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 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.

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

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

### The step increase in fixed costs is 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 the other side of the step can be calculated from the first fixed cost.

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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.

### 17.2.4 High/low analysis with 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.

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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 units = ₦7.2 per unit

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

= ₦7.2 per unit ´ 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.

## 17.3 Linear regression analysis

**Section overview**

(a) The purpose of linear regression analysis
(b) The linear regression formulae
(c) Linear regression analysis and forecasting

### 17.3.1 The purpose of linear regression analysis

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

$y = a + bx$

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

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

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

### 17.3.2 Regression analysis and high-low analysis compared

There are important differences between linear regression analysis and the high-low method.

**(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.
**(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.

### 17.3.3 The linear regression formulae

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

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

**Formula: Regression analysis formula**

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

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

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

**Where:**

x, y = values of pairs of data.

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

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

x = Independent variable (units of activity) y = Dependent variable (Amounts / Costs) a = Fixed costs / yintercept

b = Variable costs per unit of activity /Slope/Gradient/Regression

Approach

**(a)** 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.

**(b)** Set up a column for $x^2$, calculate the square of each value of ***x*** and enter the value in the $x^2$ column.

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

**(d)** Sum each column.

**(e)** 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 |
| | = □x | = □y | = □$x^2$ | = □xy |

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

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

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

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

$$y = a + bx$$

$$\varepsilon = 44.72 - 24.98 = 19.74$$

Line of best fit:

$$y = 19.74 + 3.585x$$

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### 17.3.5 Linear regression analysis and forecasting

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

**Example: Linear regression analysis**

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

$$y = 19.74 + 3.585x$$
$$y = 19.74 + 3.585 \times 9$$
$$y = 52.00$$

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

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

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

## 17.4 Learning Curve Theory

(a) Learning and experience curve theory and determination of learning rate.
(b) Application of the learning and experience curve theory to relevant problems , pricing and budgeting.
(c) Calculate and apply learning rate to cost estimation.

**Exam context**

This section explains each of the above topics in turn.

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

(a) Explain the learning effect
(b) Use a tabular approach to illustrate the learning effect
(c) Use the learning effect formula to calculate time required for units at a given point in production

## Section overview

(a) The learning effect
(b) The learning curve model (tabular approach)
(c) Formula for the learning curve

### 17.4.1 The learning effect

When a team of workers begins a skilled task for the first time, and the task then becomes repetitive, they will probably do the job more quickly as the workers learn the task and so become more efficient. They will find quicker ways of performing tasks, and will become more efficient as their knowledge and understanding increase. This improvement in efficiency through experience is called the learning effect.

When a skilled task is well-established and has been in operation for a long time, the learning effect wears out, and the time to complete the task eventually becomes the same every time the task is subsequently carried out.

When the average time to produce an additional unit becomes constant, a '**steady state'** has been reached.

However, during the learning period, the time to complete each subsequent task can fall by a very large amount and the learning effect can be substantial.

The learning effect (and learning curve) was first discovered in the US during the 1940s, in aircraft manufacture. It probably still applies today in aircraft manufacture. Aircraft manufacture is a highly-skilled task, where:

(a) the skill of the work force is important; and
(b) the labour time is a significant element in production resources and production costs.

Where the learning effect is significant, it has implications for:

**(a)** costs of completing the task;
**(b)** budgeting/forecasting production requirements and production costs; and
**(c)** pricing the output so as to make a profit.

Prices charged to the customer can allow for the cost savings that will be made because of the learning effect

### 17.4.2 The learning curve model (tabular approach)

The learning effect can be measured mathematically, and shown as a learning curve.

The learning curve is measured as a percentage learning effect. For example, for a particular task, there might be an 80% learning curve effect, or a 90% learning curve effect, and so on.

### 17.4.3 The learning effect

When there is a x% learning curve for the manufacture of a product, this means that when cumulative output of the product doubles, the average time to produce all the units made so far (the cumulative total produced to date) is x% of what it

was before. For example:

(a) when there is an 80% learning curve, every time output doubles the cumulative average time to produce units falls to 80% of what it was before.

(b) The **cumulative average time per unit** is the average time for all the units made so far, from the first unit onwards. For example if an 80% learning effect applies:

(c) the average time for the first two units is 80% of the average time for the first unit;

(d) The average time for the first four units is 80% of the average time for the first two units and so on.

**Example: The learning effect**

The time to make a new model of a sailing boat is 100 days. It has been established that in the boat-building industry, there is an 80% learning curve.

Calculate:

(a) the cumulative average time per unit for the first 2 units, first 4 units, first 8 units and first 16 units of the boat

(b) the total time required to make the first 2 units, the first 4 units, the first 8 units and the first 16 units

(c) the additional time required to make the second unit, the 3rd and 4th units, units 5 – 8 and units 9 – 16.

**These can be found by constructing the following table:**

| **Total units (cumulative)** | **Cumulative average time per unit (days)** | **Total time for all units (days)** | **Incremental time for additional units (days)** | **Average time for additional units (days)** |
|---|---|---|---|---|
| 1 | 100 | 100.00 | 100.00 | |
| 2 (´ 80%) | 80 | 160.00 | 60.00 | 60.00 |
| 4 (´ 80%) | 64 | 256.00 | 96.00 | 48.00 |
| 8 (´ 80%) | 51.2 | 409.60 | 153.60 | 38.40 |
| 16 (´ 80%) | 40.96 | 655.36 | 245.76 | 30.72 |

**Practice question** **1**

The first unit of a new model of machine took 1,600 hours to make.

A 90% learning curve applies.

How much time would it take to make the first 32 units of this machine?

Calculate:

(a) the cumulative average time per unit for the first 2 units, first 4 units, first 8 units and first 16 units.

(b) the total time required to make the first 2 units, the first 4 units, the first 8 units and the first 16 units

(c) the additional time required to make the second unit, the 3rd and 4th units, units 5 – 8 and units 9 – 16.

(d) the average time required to make the second unit, the 3rd and 4th units, units 5 – 8 and units 9 – 16.

### 17.4.4 Problem with the tabular approach

It is easy to construct a table to show the learning effect and it provides useful information. However, it can only be constructed to show doubling of the output.

The table can be used to calculate how many days it would take to construct units 3 and 4 and the average time for each of these. However, it cannot be used to calculate how long unit 3 actually took and how long unit 4 actually took. (We know that boats 3 and 4 together took 96 days to make but not how long each took as the learning effect means that boat 4 would have taken less time than boat 3).

Similarly, the table can be used to calculate how many days it would take to construct units 5 to 8 and the average time for each of these. However, it cannot be used to calculate how long unit 5 actually took and how long unit 7 (say) actually took. (We know that boats 5 to 8 together took 153.6 days to make but not how long each took as the learning effect means that boat 8 would have taken less time than boat 5 for example).
The way around this is to use the learning curve formula.
Formula for the learning curve

The learning curve is represented by the following formula (mathematical model):

**Formula: Learning curve**

$$y = ax^b$$

$$b = \frac{\log \text{ of learning rate}}{\log 2}$$

**Where:**

y = the cumulative average time per unit for all units made

x = the number of units made so far (cumulative number of units) a = the time for the first unit

b = the learning factor.

The learning rate is expressed as a decimal – a learning rate of 80% is expressed as 0.8

Logarithms (usually shortened to log) are different way to express a number. Logs can have different bases. The most widely used logs are $\log_{10}$ (log to the base 10 usually written simple as log) or natural logs (log to the base e but written as written as ln).

The log of a number is number of times that you would have to multiply 10 by itself to get that number. For example:

**(a)** the log of 100 is 2 meaning that you would have to multiply 10 by itself twice to get a hundred.
**(b)** the log of 1,000 is 3 meaning that you would have to multiply 10 by itself three times to get a thousand.
**(c)** the log of 80 is 1;90301 meaning that you would have to multiply 10 by itself 1;90301 times to get 80.
**(d)** the log of 0.8 is □0.9691 meaning that you would have to multiply 10 by itself □0.9691 times to get 0.8. (Note that the log of any number less than 1 is always negative).

Admittedly, this can be a little difficult to understand but modern calculators can calculate log values easily.

The learning effect can be computed using the formula Approach thus:
$Y = ax^b$
Where the above variables are explained above.

$Y(x) = (ax^b)\ x$

$$b = \frac{\sqrt{Y(x)}}{\sqrt{(axb)x}}$$

Example:

Determine the learning rate of a process where the first unit (a) uses 720 hours and and the fourth unit is estimated to use an average of 405 hours per unit at a constant learning rate.

Solution :
Using the formula approach:

$Y = ax^b$

$$\text{Rate of learning} = \frac{\sqrt{y}\ x}{\sqrt{ax^b}x} = \frac{\sqrt{405}\ x\ 4}{\sqrt{720}\ x\ 4}$$

$$\sqrt{0.5625} = 0.75 = 75\%$$

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**Example (continued): The learning effect**

Returning to the earlier example

The time to make a new model of a sailing boat is 100 days. It has been established that in the boat-building industry, there is an 80% learning curve.

The cumulative average time per unit for the first 2 units, first 4 units, first 8 units and first 16 units of the boat can be calculated as follows:

$$b = \frac{\log \text{ of learning rate}}{\log 2} \qquad b = \frac{\log 0.8}{\log 2} = -0.32193$$

**First 2 units**

$y = ax^b$ $\qquad y = 100 \text{ days} \times 2^{-0.32193} = 80 \text{ days}$

**First 4 units**

$y = ax^b$ $\qquad y = 100 \text{ days} \times 4^{-0.32193} = 64 \text{ days}$

**First 8 units**

$y = ax^b$ $\qquad y = 100 \text{ days} \times 8^{-0.32193} = 51.2 \text{ days}$

**First 16 units**

$y = ax^b$ $\qquad y = 100 \text{ days} \times 16^{-0.32193} = 40.96 \text{ days}$

The formula can be used for any number of units.

**Example (continued): The learning effect**

Returning to the earlier example

The time to make a new model of a sailing boat is 100 days. It has been established that in the boat-building industry, there is an 80% learning curve.

The cumulative average time per unit for the first 9 units.

$$b = \frac{\log \text{ of learning rate}}{\log 2} \qquad b = \frac{\log 0.8}{\log 2} = -0.32193$$

**First 9 units**

$y = ax^b$ $\qquad y = 100 \text{ days} \times 9^{-0.32193} = 49.3 \text{ days}$

It is now a short step to work out how long any unit would take to build.

**Example (continued): The learning effect**

| Total units (cumulative) | Cumulative average time per unit (days) | Total time for all units (days) | Incremental time for additional units (days) |
|---|---|---|---|
| 8 | 51.2 | 409.60 | |
| 9 | 49.3 | 443.70 | 245.76 |

In other words. The 9th boat took 34.1 days to make.

This approach can be used to calculate the time taken to build any unit.

**Example: The learning effect**

It will take 500 hours to complete the first unit of a new product. There is a 95% learning curve effect.

Calculate how long it will take to produce the 7th unit

**The learning factor:**

$$b = \frac{\log \text{ of learning rate}}{\log 2}$$

$$b = \frac{\log 0.95}{\log 2} = -0.074$$

**First 6 units**

$$y = ax^b$$

$$y = 500 \text{ hours} \times 6^{-0.074} = 437.9 \text{ hours}$$

**First 7 units**

$$y = ax^b$$

$$y = 500 \text{ hours} \times 7^{-0.074} = 432.9 \text{ hours}$$

These can be used to find the incremental time as before.

In other words. The 7th unit took 402.9 hours to complete.

| Total units (cumulative) | Cumulative average time per unit (hours) | Total time for all units (hours) | Increment time for additional units (hours) |
|---|---|---|---|
| 6 | 437.9 | 2,627.4 | |
| 7 | 432.9 | 3,030.3 | 402.9 |

## 17.5 Other aspects of learning theory

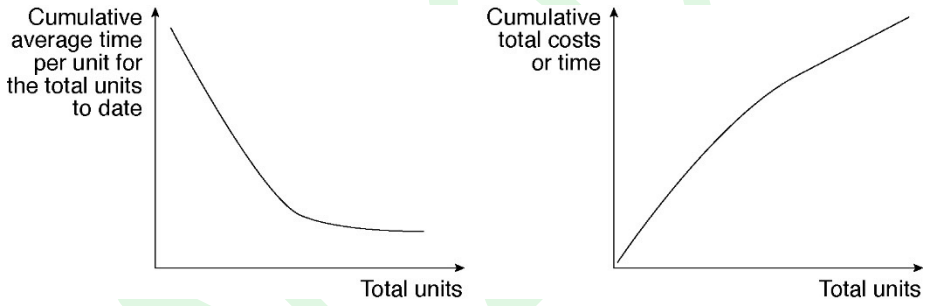
**Section overview**

(a) Graph of the learning curve
(b) Conditions for the learning curve to apply
(c) Implications of the learning curve
(d) Problems with the application of learning curve theory

### 17.5.1 Graph of the learning curve

The learning effect can be illustrated graphically.

**Illustration: Learning effect**




The cumulative average time per unit falls rapidly at first, but the learning effect eventually ends and the average time for each additional unit eventually becomes constant (a standard time).

The total cost line curves upwards.

The slope decreases as more units are made implying that the cost per unit falls as more and more units are made

### 17.5.2 Conditions for the learning curve to apply

The learning curve effect will only apply in the following conditions:

**(a)** There must be stable conditions for the work, so that learning can take place. For example, labour turnover must not be high; otherwise the learning effect is lost. The time between making each subsequent unit must not be long; otherwise the learning effect is lost because employees will forget what they did before.

**(b)** The activity must be labour-intensive and repetitive so that learning will affect the time to complete the work.

**(c)** There must be no change in production techniques, which would require the learning process to start again from the beginning.

**(d)** Employees must be motivated to learn.

The costs that are reduced as a result of the learning curve are those that vary with labour time – labour costs and any overhead costs that vary with labour time. The learning effect will not usually result in reductions in materials costs, for example, because the usage of materials (ignoring losses through wastage) is not related to labour efficiency.

### 17.5.3 Implications of the learning curve

When a process benefits from a learning curve effect, there are implications for budgeting and pricing.

**(a)** Budgets should allow for the reduction in the average labour time per unit. Total labour requirements (the size of the work force required) will be affected.

**(b)** If prices are calculated on a 'cost plus' basis, prices quoted to customers should allow for future cost savings. The sales budget will be affected by expected reductions in the sales price.

**(c)** Any system of budgetary control should make allowance for the expected reduction in the production time per unit. Actual hours taken should be compared with expected hours, allowing for the learning curve effect.

### 17.5.4 Problems with the application of learning curve theory

In practice, the learning curve effect is not used extensively for budgeting or estimating costs (or calculating sales prices on a cost plus basis).

**(a)** It may be difficult to measure the learning rate with sufficient accuracy. It also may be difficult to measure the time taken for the first unit accurately.

**(b)** In a modern manufacturing environment production is highly mechanised and therefore the learning curve effect does not apply.

**(c)** Learning curve theory assumes that stable production conditions will exist, and all subsequent units will be produced to the same specifications as the original product. In practice, the product may go through several major design changes after the first unit has been produced.

**(d)** For many products where skilled labour is required, production might have reached a 'steady state' so that there will be no further reductions in the average times to produce the item.

**(e)** Even with skilled, labour-intensive work, if there is a high rate of labour turnover, the work force might not gain enough collective experience for a learning effect to apply.

**Example: The learning effect**

X Ltd has developed a new product. The process used to produce the new product is repetitive, and around 60% automated.

Following reorganisation at X Ltd, the workforce is less motivated than it has been in the past and the number of resignations has increased in recent months.

**Required**

Evaluate the extent to which you would expect a learning curve effect to occur in respect of the new product at X Ltd.

**Answer**

Learning curves only apply to repetitive processes.

The new product may experience a learning effect as it is to be produced using a repetitive process.

The process is 60% automated, and learning curves can only be observed on a process that is highly labour intensive. The 40% of the process that is not automated could give rise to a learning curve, however the extent to which this will impact on the process overall is unknown. It is possible that a learning curve effect could occur, but it is unlikely to be significant.

Further, there are issues with motivation and staff turnover. Both of these factors reduce the likelihood of a learning curve effect taking place.

If staff are not motivated, they will not be keen to learn and keen to work quickly and so the learning curve will never arise.

Higher staff turnover prevents the learning curve taking place as staff are replaced too frequently for the benefits to be observed as the workers will not have sufficient time to learn the process and speed up.

Overall, the learning curve experienced in relation to the new product as X Ltd is likely to be minimal.

## 17.6 Dealing with uncertainty in budgeting

**Section overview**

(a) Limitations of a 'fixed' budget
(b) The nature of uncertainty in budgeting
(c) Flexible budgets
(d) Probabilities and expected values
(e) Spreadsheets and 'what if' analysis

### 17.6.1 Limitations of a 'fixed' budget

Weaknesses in the traditional budgeting process have been recognised, and alternative budgeting models have been developed to improve the quality of budgets and budgetary control.

A major weakness with an annual budget is that it is a fixed annual plan. Once

it has been prepared, it usually remains the 'official' plan until it is replaced by the next annual budget 12 months later.

'Fixed' annual budgets are unsatisfactory for two important reasons.

**(a)** When a budget is prepared, there is a great deal of uncertainty about what will happen, and the budget will be based on estimates. Even when estimates are reasonable, there is no certainty that they will turn out to be 'correct'.

**(b)** Unexpected events will happen during the year, and conditions in the business environment will change. The changes might be significant, and the 'fixed' budget will cease to be realistic and achievable. It might therefore be appropriate to re-consider and revise the budget.

### 17.6.2 The nature of uncertainty in budgeting

There is uncertainty in budgeting because estimates and forecasts may be unreliable. Information is almost never 100% reliable (or 'perfect'), and some uncertainty in budgeting is therefore inevitable.

Risk arises in business because actual events may turn out better or worse than expected. For example, actual sales volume may be higher or lower than forecast. The amount of risk in business operations varies with the nature of the operations. Some operations are more predictable than others. The existence of risk means that forecasts and estimates in the budget, which are based on expected results, may not be accurate.

Both risk and uncertainty mean that estimates and forecasts in a budget are unlikely to be correct.

Management must be aware of risk and uncertainty when preparing budgets and when monitoring performance.

(a) When preparing budgets, it may be appropriate to look at several different forecasts and estimates, to assess the possible variations that might occur. In other words, managers should think about how much better or how much worse actual results may be, compared with the budget.

(b) When monitoring actual performance, managers should recognise that adverse or favourable variances might be caused by weaknesses in the original forecasts, rather than by good or bad performance.

Several approaches may be used for analysing risk and uncertainty in budgets. These include:

**(a)** flexible budgets;
**(b)** using probabilities and expected values;
**(c)** use feed-forward control;
**(d)** using spreadsheet models and 'what if' analysis (sensitivity analysis); and
**(e)** stress testing.

### 17.6.3 Flexible budgets

Flexible budgets may be prepared during the budget-setting process. A flexible budget is a budget based on an assumption of a different volume of output and sales than the volume in the master budget or 'fixed budget'.

An organisation might prepare several flexible budgets in addition to the main budget (the master budget or fixed budget). If the actual level of activity differs significantly from the expected level, the fixed budget can be substituted by a suitable flexible budget.

For example, a company might prepare its master budget on the basis of estimated sales of ₦100 million. Flexible budgets might be prepared on the basis that sales will be higher or lower – say ₦80 million, ₦90 million, ₦110 million and ₦120 million. Each flexible budget will be prepared on the basis of assumptions about fixed and variable costs, such as increases or decreases in fixed costs if sales rise above or fall below a certain amount, or changes in variable unit costs above a certain volume of sales.

During the financial year covered by the budget, it may become apparent that actual sales and production volume will be higher or lower than the fixed budget forecast. In such an event, actual performance can be compared with a suitable flexible budget.

Flexible budgets can be useful, because they allow for the possibility that actual activity levels may be higher or lower than forecast in the master budget. The main disadvantage of flexible budgets could be the time and effort needed to prepare them. The cost of preparing them could exceed the benefits of having the information that they provide.

#### Flexible vs flexed

Note that a flexible budget is not the same as a flexed budget.

A flexible budget is prepared before the start of a budget period. It is described as being ex-ante.

A flexed budget is prepared after the end of a budget period. It is described as being ex-post. A flexed budget is one that is redrafted to actual levels of activity for control purposes. The concept of a flexed budget is fundamental to variance analysis which is covered in a later chapter.

### 17.6.3 Probabilities and expected values

Estimates and forecasts in budgeting may be prepared using probabilities and expected values. An expected value is a weighted average value calculated with probabilities.

**Example: Expected value**

A company is preparing a sales budget. The budget planners believe that the volume of sales next year will depend on the state of the economy.

| State of the economy | Sales for the year |
|---|---|
| | ₦ million |
| No growth | 40 |
| Low growth | 50 |
| Higher growth | 70 |

It has been estimated that there is a 60% probability of no growth, a 30% probability of low growth and a 10% probability of higher growth.

The expected value (EV) of sales next year could be calculated as follows:

| State of the economy | Sales for the year | Probability | EV of sales |
|---|---|---|---|
| | ₦ million | | ₦ million |
| No growth | 40 | 0.6 | 24 |
| Low growth | 50 | 0.3 | 15 |
| Higher growth | 70 | 0.1 | 7 |

The company might decide to prepare a sales budget on the assumption that annual sales will be ₦46 million.

### 17.6.4 The problems with using probabilities and expected values

There are two problems that might exist with the use of probabilities and expected values.

**(a)** The estimates of probability might be subjective, and based on the judgement or opinion of a forecaster. Subjective probabilities might be no better than educated guesses. Probabilities should have a rational basis.

**(b)** An expected value is most useful when it is a weighted average value for an outcome that will happen many times in the planning period. If the forecast event happens many times in the planning period, weighted average values are suitable for forecasting. However, if an outcome will only happen once, it is doubtful whether an expected value has much practical value for planning purposes.

This point can be illustrated with the previous example of the EV of annual sales. The forecast is that sales will be ₦40 million (0.60 probability), ₦50 million (0.30 probability) or ₦70 million (0.10 probability). The EV of sales is ₦46 million.

(a) The total annual sales for the year is an outcome that occurs only once. It is doubtful whether it would be appropriate to use ₦46 million as the budgeted sales for the year. A sales total of ₦46 million is not expected to happen.

(b) It might be more appropriate to prepare a fixed budget on the basis that sales will be ₦40 million (the most likely outcome) and prepare flexible budgets for sales of ₦50 million and ₦70 million.

When the forecast outcome happens many times in the planning period, an EV might be appropriate.

**Example: Expected value**

A company is preparing a sales budget. The budget planners believe that the volume of sales next year will depend on the state of the economy.

| State of the economy | Sales for the year |
|---|---|
| | ₦ million |
| No growth | 40 |
| Low growth | 50 |
| Higher growth | 70 |

It has been estimated that there is a 60% probability of no growth, a 30% probability of low growth and a 10% probability of higher growth.

The expected value (EV) of sales next year could be calculated as follows:

| Sales for the year ₦ | Probability | EV of sales ₦ million |
|---|---|---|
| 7,000 | 0.5 | 3,500 |
| 9,000 | 0.3 | 2,700 |
| 12,000 | 0.2 | 2,400 |
| | | 8,600 |

If the probability estimates are fairly reliable, this estimate of annual sales should be acceptable as the annual sales budget.

### 17.6.5 Spreadsheets and 'what if' analysis

Preparing budgets is largely a 'number crunching' exercise, involving large amounts of calculations. This aspect of budgeting was made much easier, simpler and quicker with IT and the development of computer-based models for budgeting. Spreadsheet models, or similar planning models, are now widely used to prepare budgets.

A feature of computer-based budget models is that once the model has been constructed, it becomes a relatively simple process to prepare a budget. Values are input for the key variables, and the model produces a complete budget.

Amendments to a budget can be made quickly. A new budget can be produced simply by changing the value of one or more input variables in the budget model.

This ability to prepare new budgets quickly by changing a small number of values in the model also creates opportunities for **sensitivity analysis** and **stress testing**. The budget planner can test how the budget will be affected if forecasts and estimates are changed, by asking 'what if' questions. For example:

**(a)** What if sales volume is 5% below the budget forecast?
**(b)** What if the sales mix of products is different?
**(c)** What if the introduction of the new production system or the new IT system is delayed by six months?
**(d)** What if interest rates go up by 2% more than expected?
**(e)** What if the fixed costs are 5% higher and variable costs per unit are 3% higher?

Sensitivity analysis and stress testing are similar.

**(a)** Sensitivity analysis considers variations to estimates and input values in the budget model that have a reasonable likelihood of happening. For example, variable unit costs might be increased by 5% or sales forecasts reduced by 5%.
**(b)** Stress testing considers the effect of much greater changes to the forecasts and estimates. For example, what might happen if sales are 20% less than expected? Or what might happen if the price of a key raw material increases by 50%?

The answers to 'what if' questions can help budget planners to understand more about the risk and uncertainty in the budget, and the extent to which actual results might differ from the expected outcome in the master budget. This can provide valuable information for risk management, and management can assess the 'sensitivity' of their budget to particular estimates and assumptions.

## 17.7 FORECASTING

**Section overview**

(a) The nature of a time series
(b) Analysing a time series
(c) Moving averages
(d) Centred moving averages
(e) Line of best fit
(f) Seasonal variations

### 17.7.1 The nature of a timeseries

A time series is a record of data over a period of time, for example, sales revenue per month or revenue per quarter. The time series is a convenient way of representing historical information but more importantly it might be used to make predictions about the future. This is done by continuing the series forward in time. In order to do this, the time series must be analysed into its component parts.

### 17.7.1 Components of a time series

A change in value of an observed variable in a time series might be due to a combination of factors. These are described as the components of the time series. There are two models of a time series which differ in how these components are linked together.

**Formula: Time series models**

Additive model:

$$YA = T + S + C + R$$

Proportional (multiplicative model)

$$YM = T \times S \times C \times R$$

**Where:**

T = Trend – the overall direction of change in the data.

S = Seasonal variation – differences between the actual data observed for a time period and the amount predicted by the trend for that period.

C = Cyclical variation – Longer term variations which might cause changes over longer periods.

R = Random fluctuations

Note that the term “seasonal variation” has a specific meaning in time series analysis. It relates to the variation in each period covered in the analysis. Therefore it could mean a daily, weekly, quarterly or annual variation depending on the analysis.

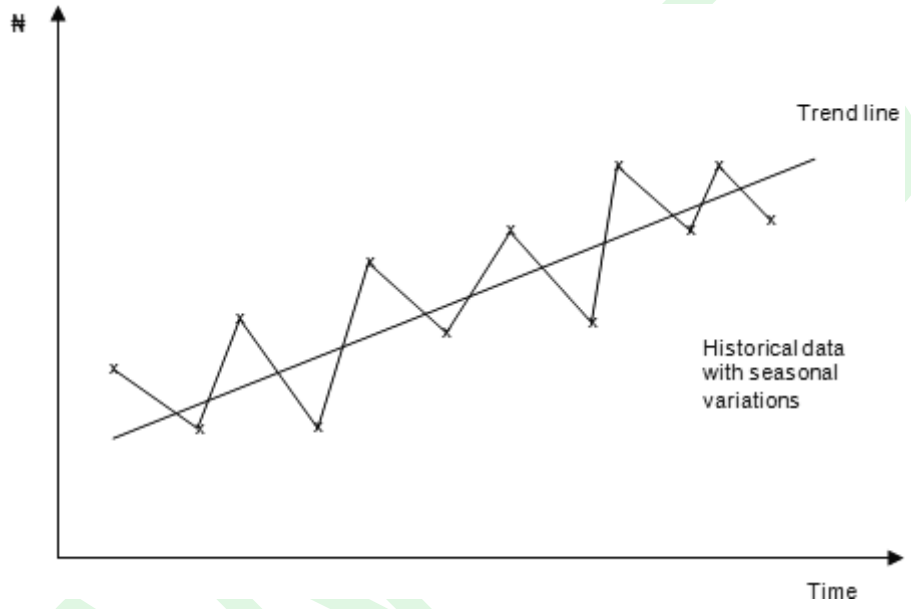
Questions requiring analysis of a time series will require the identification of a trend and seasonal variations.

**(a)** Random fluctuations cannot be predicted. The usual assumption made is that they are negligible and can be ignored in any analysis.

**(b)** Also, there is usually insufficient data to identify cyclical variations. The plot of a time series as a graph is called a historigram.

The diagram below shows a trend line with seasonal variations above and below the trend line. The general trend in this diagram is up and the trend can be shown as a straight line. However, the actual value in each time period is above or below the trend, because of the seasonal variations.

**Illustration: Historigram of a time series**




### 17.7.2 Analysing a time series

There are two aspects to analysing a time series from historical data:

**(a)** estimating the trend line; and

**(b)** calculating the amount of the seasonal variations (monthly variations or daily variations).

The time series can then be used to make estimates for a future time period, by calculating a trend line value and then either adding or subtracting the appropriate seasonal variation for that time period.

Two methods of calculating a trend line are:

**(a)** Moving averages.

**(b)** Linear regression analysis.

Linear regression analysis is a technique that produces a line of best fit for observed data. This was covered in an earlier chapter (along with the high/low method which can also be used in forecasting). Note that both might be used together. Moving averages might be used to identify the underlying trend and

then linear regression might be used to identify a line of best fit for the moving averages identified.

Methods of calculating seasonal variations are explained later.

### 17.7.3 Moving averages

Moving averages can be used to estimate a trend line, particularly when there are seasonal variations in the data.

The technique involves smoothing out fluctuations in the underlying observed data by calculating averages for small groups of observations from that data. The size of the small group is related to the type of data. If the data is quarterly then a group of 4 would be used or if the data was monthly a group of 12 would be used.

Moving averages are calculated as follows:

**Step 1**: Decide the length of the cycle. The cycle is a number of days or weeks, or seasons or years.

**(a)** 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.

**(b)** 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)** 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.

**(b)** 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 have 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)** A moving average for Quarter 1 – Quarter 4 gives a value which represents the mid-point of the range. This is Quarter 2.5.

**(b)** A moving average for Quarter 2 – Quarter 5 gives a value which represents the mid-point of the range. This is Quarter 3.5.

**(c)** 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 | = | 420 | ÷ 5 days | = 84 per day |
| 4 | 85 | | | | |
| 5 | 85 | | | | |

84 represents the sales on the middle day of the period (day 3)

| Day | Sales | | | | |
|---|---|---|---|---|---|
| 2 | 83 | | | | |
| 3 | 89 | | | | |
| 4 | 85 | = | 430 | ÷ 5 days | = 86 per day |
| 5 | 85 | | | | |
| 6 | 88 | | | | |

86 represents the sales on the middle day of the period (day 4)

The example is continued to complete the trend on the next page.

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**Example: Constructing a trend line with moving averages**

A company operates for five days each week. Sales data for the most recent three weeks are as follows:

| Sales | Monday | Tuesday | Wednesday | Thursday | Friday |
|---|---|---|---|---|---|
| | units | units | units | units | units |
| **Week 1** | 78 | 83 | 89 | 85 | 85 |
| **Week 2** | 88 | 93 | 99 | 95 | 95 |
| **Week 3** | 98 | 103 | 109 | 105 | 105 |

For convenience, it is assumed that Week 1 consists of Days 1 – 5, Week 2 consists of Days 6 – 10, and Week 3 consists of Days 11 – 15.

This sales data can be used to estimate a trend line. A weekly cycle in this example is 5 days. Moving averages are calculated for five-day periods, as follows:

| Day | Sales | 5 day total | Moving average (trend found by dividing the 5 day total by 5) |
|---|---|---|---|
| Day 1 | 78 | | |
| Day 2 | 83 | | |
| Day 3 | 89 | 420 | 84 |
| Day 4 | 85 | 430 | 86 |
| Day 5 | 85 | 440 | 88 |
| Day 6 | 88 | 450 | 90 |
| Day 7 | 93 | 460 | 92 |
| Day 8 | 99 | 470 | 94 |
| Day 9 | 95 | 480 | 96 |
| Day 10 | 95 | 490 | 98 |
| Day 11 | 98 | 500 | 100 |
| Day 12 | 103 | 510 | 102 |
| Day 13 | 109 | 520 | 104 |
| Day 14 | 105 | 530 | |
| Day 15 | 105 | 540 | |

Note that this process always results in a loss of values for points in time at the start and at the end of the range.

### 17.7.4 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:

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 can be above or below the trend).

In turn, these can be used to adjust the forecast value of the trend line to take account of whether day 50 is a Monday, Tuesday, Wednesday, Thursday or Friday.

This is explained later.

### 17.7.5 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.

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**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) |
|---|---|---|---|
| 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 | | |

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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 be 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 | Moving average | Centre total (of 2 moving averages) | Centred moving average (÷2) |
|---|---|---|---|---|
| 1 | 20 | | | |
| 2 | 24 | 25.5 | | |
| **3** | 27 | 29.25 | 25.5 + 29.25 = 54.75 | **27.38** |
| **4** | 31 | 33.00 | 29.25 + 33.00 = 62.25 | **31.13** |
| **5** | 35 | 37.25 | 33.00 + 37.25 = 70.25 | **35.13** |
| **6** | 39 | 41.25 | 37.25 + 41.25 = 78.50 | **39.25** |
| **7** | 44 | 44.75 | 41.25 + 44.75 = 86.00 | **43.00** |
| **8** | 47 | 49.00 | 44.75 + 49.00 = 93.75 | **46.88** |
| **9** | 49 | 53.00 | 49.00 + 53.00 = 102 | **51.00** |
| **10** | 56 | 57.25 | 53.00 + 57.25 = 110.25 | **55.13** |
| 11 | 60 | | | |
| 12 | 64 | | | |

The moving averages in the right hand column correspond to an actual season (quarter). These moving averages are used to estimate the trend line and the seasonal variations.

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### 17.7.6 Line of best fit

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**

| | Moving average |
|---|---|
| Quarter 10 | 55.13 |
| Quarter 3 | (27.38) |
| | 27.75 |
| | ÷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.

$$y \text{ (Sales)} = 27.38 + 3.96x$$

### 17.7.7 Seasonal variations

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.

**(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;

**(b)** The proportional model.

### 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).
**(e)** This adjusted figure is the seasonal variation.

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**Example: Additive model**

Using the previous example for quarterly sales, actual sales and the corresponding moving average value were as follows:

**Variation (Actual –**

| Quarter | Trend | Actual sales in the quarter | Moving average) |
|---|---|---|---|
| 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 |
|---|---|---|---|---|---|
| Year 1 | | | | | |
| Year 2 | | | □0.375 | □0.125 | |
| Year 3 | | | 1.000 | 0.125 | |
| Average | □0.125 | □0.250 | | | |
| Adjustment: | | | | | |
| Seasonal | □2.000 | 0.875 | | | |
| | □1.063 | 0.313 | 0.313 | 0.0 | □0.437 |
| | 0.10925 | 0.10925 | 0.10925 | 0.10925 | 0.437 |
| | □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

| | |
|---|---|
| Trend value | 78.86 |
| Quarter 4 adjustment (rounded) | 0.11 |
| Sales forecast | 78.97 |

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## 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:

**Seasonal variation: actual sales as a**

| Quarter | Trend | Actual sales in the quarter | proportion of the moving average |
|---|---|---|---|
| Year 1: Q3 | 27.375 | 27 | 0.986 |
| Year 1: Q4 | 31.125 | 31 | 0.996 |
| Year 2: Q1 | 35.125 | 35 | 0.996 |
| Year 2: Q2 | 39.250 | 39 | 0.994 |
| Year 2: Q3 | 43.000 | 44 | 1.023 |
| Year 2: Q4 | 46.875 | 47 | 1.003 |
| Year 3: Q1 | 51.000 | 49 | 0.961 |
| Year 3: Q2 | 55.125 | 56 | 1.016 |

The seasonal variation (daily variation) is now calculated as the average seasonal variation for each day, as follows:

| Variation | Q1 | Q2 | Q3 | Q4 | Total |
|---|---|---|---|---|---|
| Year 1 | | | 0.986 | 0.996 | |
| Year 2 | 0.996 | 0.994 | 1.023 | 1.003 | |
| QA1Year 3 | 0.961 | 1.016 | | | |
| Average | 0.978 | 1.004 | 1.004 | 0.999 | 3.985 |
| | 0.00375 | 0.00375 | 0.00375 | 0.00375 | 0.015 |
| | 0.98175 | 1.00775 | 1.00775 | 1.00275 | 4.000 |

**Example: Forecast sales**

The forecast for the trend value of sales in Q4 in year 4 is 78.86.

The estimated sales in this quarter are:

| | |
|---|---|
| Trend value | 78.86 |
| Quarter 4 adjustment (rounded) | ×1.003 |
| Sales forecast | 79.01 |

## 17.8 Chapter Review

**Chapter review**

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

(a) Explain the purposes of budgeting and the budgeting process

(b) Describe the main features of, and explain the differences between bottom-up and top-down budgeting

(c) Explain incremental and zero-based budgeting

(d) Explain activity based budgeting (ABB)

(e) Recognise and explain the importance of the behavioural aspects of budgeting

(f) Discuss beyond budgeting as a concept

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**Solutions** **1**

**Sales budget**

| Product | Budgeted sales quantity | Budgeted sales price | Budgeted sales revenue |
|---|---|---|---|
| | units | ₦ | ₦ |
| X | 2,500 | 410 | 1,025,000 |
| Y | 3,200 | 400 | 1,280,000 |
| Total | | | 2,305,000 |

**Production budget**

| | Product X | Product Y |
|---|---|---|
| | units | units |
| Sales budget | 2,500 | 3,200 |
| Budgeted closing inventory | 200 | 100 |
| | 2,700 | 3,300 |
| Opening inventory | 300 | 150 |
| Production budget | 2,400 | 3,150 |

**Material usage budget**

| | A (kgs) | B (kgs) | C (kgs) |
|---|---|---|---|
| Usage to make 2,400 units of X | | | |
| 2,400 units ´ 1 kgs | 2,400 | | |
| 2,400 units ´ 0.75 kgs | | 1,800 | |
| 2,400 units ´ 2 kgs | | | 4,800 |
| Usage to make 3,150 units of Y | | | |
| 3,150 units ´ 1 kgs | 3,150 | | |
| 3,150 units ´ 0.5 kgs | | 1,575 | |
| 3,150 units ´ 3 kgs | | | 9,450 |
| Usage in kgs | 5,550 | 3,375 | 14,250 |
| Cost per kg | ₦30 | ₦80 | ₦30 |
| Usage in naira | 166,500 | 270,000 | 427,500 |
| Total cost | | | ₦864,000 |

**Solution (continued)** **1**

**Material purchases budget**

| | A (kgs) | B (kgs) | C (kgs) |
|---|---|---|---|
| Usage | 5,550 | 3,375 | 14,250 |
| Closing inventory | 380 | 400 | 120 |
| | 5,930 | 3,775 | 14,370 |
| Opening inventory | (400) | (450) | (150) |
| Purchases (kgs) | 5,530 | 3,325 | 14,220 |
| Cost per kg (₦) | ₦30 | ₦80 | ₦30 |
| Purchases (₦) | 165,900 | 266,000 | 426,600 |
| Total cost | | | ₦858,500 |

**Labour usage budget**

| | Grade I (hrs) | Grade II (hrs) |
|---|---|---|
| Usage to make 2,400 units of X | | |
| 2,400 units ´ 1 hr | 2,400 | |
| 2,400 units ´ 1.5 hrs | | 3,600 |
| Usage to make 3,150 units of Y | | |
| 3,150 units ´ 0.8 hrs | 2,520 | |
| 3,150 units ´ 1 hr | | 3,150 |
| Usage in kgs | 4,920 | 6,750 |
| Cost per kg (₦) | 100 | 80 |
| Usage in naira | 492,000 | 540,000 |
| Total cost(₦) | | 1,032,000 |

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**Solution (continued)** **1**

**Budgeted profit or loss account**

| | ₦ | ₦ |
|---|---|---|
| Sales budget | | 2,305,000 |
| Cost of sales: | | |
| Opening inventory | 211,500 | |
| Purchases | 858,500 | |
| | 2,102,000 | |
| Closing inventory | (153,000) | |
| | | (1,949,000) |
| Budgeted gross profit | | 356,000 |

The budgeted gross profit can be checked as follows:

| | (Units ´ (Sales price – Unit cost) | ₦ |
|---|---|---|
| Profit from selling X | (2,500 units ´ (410 □ 370)) | 100,000 |
| Profit from selling Y | (3,200 units ´ (400 □ 320)) | 256,000 |
| | | 356,000 |

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**Skills level**
**Performance management**




# STANDARD CONTENTS

## Chapter Contts

1 Learning objective
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## 18.0 Learning objective

This chapter introduces to the candidates the xconcept of standard costing variance analysis. It also Standard output as depicted by Productivity, efficiency and capacity ratios.

## 18.1 Learning Outcome

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

(a) Explain standard costing using examples

(b) Explain and construct a flexed budget

(c) Calculate sales volume variance

(d) Calculate, analyse and interpret various variances relating to material, labour and factory overhead(both variable and fixed)

(e) Prepare an operating statement reconcile budgeted profit to actual profit using total absorption costing (TAC) and marginal costing (MC)

## 18.2 Standard Costs

**Section overview**

(a) Standard units of product or service
(b) Standard cost
(c) Standard costing
(d) The uses of standard costing
(e) Deriving a standard cost
(f) Types of standard
(g) Reviewing standards

### 18.2.1 Standard units of product or service

Standard costing involves using an expected cost (standard cost) as a substitute for actual cost in the accounting system. Periodically the standard costs are compared to the actual costs. Differences between the standard and actual are recorded as variances in the costing system.

#### When is standard costing appropriate?

Standard costing can be used in a variety of situations.

It is most useful when accounting for homogenous goods produced in large numbers, when there is a degree of repetition in the production process.

A standard costing system may be used when an entity produces standard units of product or service that are identical to all other similar units produced. Standard costing is usually associated with standard products, but can be applied to standard services too.

A standard unit should have exactly the same input resources (direct materials, direct labour time) as all other similar units, and these resources should cost exactly the same. Standard units should therefore have the same cost.

### 18.2.2 Standard cost

**Definition: Standard cost and standard costing**

Standard cost is an estimated or predetermined cost of performing an operation or producing a good or service, under normal conditions

Standard costing is a control technique that reports variances by comparing actual costs to pre-set standards so facilitating action through management by exception.

A **standard cost is a predetermined unit cost** based on expected direct materials quantities and expected direct labour time, and priced at a predetermined rate per unit of direct materials and rate per direct labour hour and rate per hour of overhead.

(a) Standard costs of products are usually restricted to production costs only, not administration and selling and distribution overheads.

(b) Overheads are normally absorbed into standard production cost at an absorption rate per direct labour hour.

**Example: Standard cost card**

The standard cost of a Product XYZ might be:

| | | |
|---|---|---|
| | ₦ | ₦ |
| Direct materials: | | |
| Material A: 2 litres at ₦4.50 per litre | 9.00 | |
| Material B: 3 kilos at ₦4 per kilo | 12.00 | |
| | | 21.00 |
| Direct labour | | |
| Grade 1 labour: 0.5 hours at ₦20 per hour | 10.00 | |
| Grade 2 labour: 0.75 hours at ₦16 per hour | 12.00 | |
| | | 22.00 |
| Variable production overheads: 1.25 hours at ₦4 per hour | | 5.00 |
| Fixed production overheads: 1.25 hours at ₦40 per hour | | 50.00 |
| Standard (production) cost per unit | | 98.00 |

**Who sets standard costs?**

Standard costs are set by managers with the expertise to assess what the standard prices and rates should be. Standard costs are normally reviewed regularly, typically once a year as part of the annual budgeting process.

(a) Standard prices for direct materials should be set by managers with expertise in the purchase costs of materials. This is likely to be a senior manager in the purchasing department (buying department).

(b) Standard rates for direct labour should be set by managers with expertise in labour rates. This is likely to be a senior manager in the human resources department (personnel department).

(c) Standard usage rates for direct materials and standard efficiency rates for direct labour should be set by managers with expertise in operational activities. This may be a senior manager in the production or operations department, or a manager in the technical department.

(d) Standard overhead rates should be identified by a senior management accountant, from budgeted overhead costs and budgeted activity levels that have been agreed in the annual budgeting process.

### 18.2.3 Standard costing

Standard costing is a system of costing in which:

**(a)** all units of product (or service) are recorded in the cost accounts at their standard cost, and
**(b)** the value of inventory is based on standard production cost.

Differences between actual costs and standard costs are recorded as variances, and variances are reported at regular intervals (typically each month) for the purpose of budgetary control.

Standard costing may be used with either a system of absorption costing or a system of marginal costing.

### 18.2.4 The uses of standard costing

Standard costing has four main uses.

**(a)** It is an alternative system of cost accounting. In a standard costing system, all units produced are recorded at their standard cost of production.
**(b)** When standard costs are established for products, they can be used to prepare the budget.
**(c)** It is a system of **performance measurement**. The differences between standard costs (expected costs) and actual costs can be measured as variances. Variances can be reported regularly to management, in order to identify areas of good performance or poor performance.
**(d)** It is also a system of **control reporting**. When differences between actual results and expected results (the budget and standard costs) are large, this could indicate that operational performance is not as it should be, and that the causes of the variance should be investigated. Management can therefore use variance reports to identify whether control measures might be needed, to improve poor performance or continue with good performances.

When there are large adverse variances, this might indicate that actual performance is poor, and control action is needed to deal with the weaknesses.

When there are large favourable variances, and actual results are much better than expected, management should investigate to find out why this has happened, and whether any action is needed to ensure that the favourable results will continue in the future.

### 18.2.4 Variances and controllability

The principle of controllability should be applied in any performance management system

When variances are used to measure the performance of an aspect of operations, or the performance of a manager, they should be reported to the manager who is:

**(a)** responsible for the area of operations to which the variances relate, and
**(b)** able to do something to control them.

There is no value or practical purpose in reporting variances to a manager who is unable to do anything to control performance by sorting out problems that the

variances reveal and preventing the variances from happening again.

It is also unreasonable to make a manager accountable for performance that is outside his control, and for variances that he can do nothing about.

### 18.2.5 Deriving a standard cost

A standard variable cost of a product is established by building up the standard materials, labour and production overhead costs for each standard unit.

In a standard absorption costing system, the standard fixed overhead cost is a standard cost per unit, based on budgeted data about fixed costs and the budgeted production volume.

Companies can often measure the standard quantities with a high degree of confidence. Remember that standard costing is appropriate in conditions of high production numbers and a lot of repetition. Companies might make thousands of items and this experience leads to knowledge of the process.

#### Deriving the standard usage for materials

The standard usage for direct materials can be obtained by using:

**(a)** historical records for material usage in the past, or
**(b)** the design specification for the product

#### Deriving the standard efficiency rate for labour

The standard efficiency rate for direct labour can be obtained by using:

**(a)** historical records for labour time spent on the product in the past, or
**(b)** making comparisons with similar work and the time required to do this work, or
**(c)** 'time and motion study' to estimate how long the work ought to take

#### Deriving the standard price for materials

The standard price for direct materials can be estimated by using:

**(a)** historical records for material purchases in the past, and
**(b)** allowing for estimated changes in the future, such as price inflation and any expected change in the trade discounts available

#### Deriving the standard rate of pay for labour

Not all employees are paid the same rate of pay, and there may be differences to allow for the experience of the employee and the number of years in the job. There is also the problem that employees may receive an annual increase in pay each year to allow for inflation, and the pay increase may occur during the middle of the financial year.

**(a)** The standard rate of pay per direct labour hour will be an average rate of pay for each category or grade of employees.
**(b)** The rate of pay may be based on current pay levels or on an expected average pay level for the year, allowing for the expected inflationary pay rise during the year.

Example: Deriving a standard cost

A company manufactures two products, X and Y. In Year 1 it budgets to make 2,000 units of Product X and 1,000 units of Product Y. Budgeted resources per unit and costs are as follows:

| | Product X | Product Y |
|---|---|---|
| Direct materials per unit: | | |
| Material A | 2 units of material | 1.5 units of material |
| Material B | 1 unit of material | 3 units of material |
| Direct labour hours | per unit | 0.75 hours |
| | 1 hour | |

**Costs**

| | |
|---|---|
| Direct material A | ₦40 per unit |
| Direct material B | ₦30 per unit |
| Direct labour | ₦200 per hour |
| Variable production overhead | ₦40 per direct labour hour |

Fixed production overheads per unit are calculated by applying a direct labour hour absorption rate to the standard labour hours per unit, using the budgeted fixed production overhead costs of ₦120,000 for the year.

**Required**

Calculate the standard full production cost per unit of:

(a) Product X, and

(b) Product Y

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**Answer**

First calculate the budgeted overhead absorption rate.

| **Budgeted direct labour hours** | **hours** |
|---|---|
| Product X: (2,000 units × 0.75 hours) | 1,500 |
| Product Y (1,000 units × 1 hour) | 1,000 |

| | |
|---|---|
| Budgeted fixed production overheads | ₦120,000 |
| Fixed overhead absorption rate/hour | ₦48 |

| | | **Product X** | | **Product Y** |
|---|---|---|---|---|
| | | ₦ | | ₦ |
| Direct materials | | | | |
| Material A | (2 units ´ ₦40) | 80 | (1.5 units ´ ₦40) | 60 |
| Material B | (1 unit ´ ₦30) | 30 | (3 units ´ ₦30) | 90 |
| Direct labour | (0.75 hours ´ ₦200) | 150 | (1 hour ´ ₦200) | 200 |
| Variable production overhead | (0.75 hours ´ ₦40) | 30 | (1 hour ´ ₦40) | 40 |
| Standard variable prod'n cost | | 290 | | 390 |
| Fixed production overhead | (0.75 hours ´ ₦48) | 36 | (1 hour ´ ₦48) | 48 |
| Standard full production cost | | 326 | | 438 |

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**Practice question** 1

A company manufactures two products, Laurel and Hardy. In Year 1 it budgets to make 6,000 units of Product Laurel and 2,000 units of Product Hardy. Budgeted resources per unit and costs are as follows:

| | Laurel | Hardy |
|---|---|---|
| Direct materials per unit: | | |
| Material X | 3 kg | 1kg |
| Material Y | 2 kg | 6 kg |
| Direct labour hours per unit | 1.6 hours | 3 hours |

**Costs**

| | |
|---|---|
| Direct material X | ₦30 per unit |
| Direct material Y | ₦40 per unit |
| Direct labour | ₦250 per hour |
| Variable production overhead | ₦50 per direct labour hour |

Fixed production overheads per unit are calculated by applying a direct labour hour absorption rate to the standard labour hours per unit, using the budgeted fixed production overhead costs of ₦1,800,000 for the year.

**Required**

Calculate the standard full production cost per unit of:

(a) Product Laurel, and

(b) Product Hardy

### 18.2.6 Types of standard

Standards are predetermined estimates of unit costs but how is the level of efficiency inherent in the estimate determined? Should it assume perfect operating conditions or should it incorporate an allowance for waste and idle time? The standard set will be a performance target and if it seen as unattainable this may have a detrimental impact on staff motivation. If the standard set is too easy to attain there may be no incentive to find improvements.

There are four types of standard, and any of these may be used in a standard costing system:

**(a) Ideal standards**. These assume perfect operating conditions. No allowance is made for wastage, labour inefficiency or machine breakdowns. The ideal standard cost is the cost that would be achievable if operating conditions and operating performance were perfect. In practice, the ideal standard is not achieved.

**(b) Attainable standards**. These assume efficient but not perfect operating conditions. An allowance is made for waste and inefficiency. However the attainable standard is set at a higher level of efficiency than the current

performance standard, and some improvements will therefore be necessary in order to achieve the standard level of performance.

**(c)** **Current standards**. These are based on current working conditions and what the entity is capable of achieving at the moment. Current standards do not provide any incentive to make significant improvements in performance, and might be considered unsatisfactory when current operating performance is considered inefficient.

**(d)** **Basic standards**. These are standards which remain unchanged over a long period of time. Variances are calculated by comparing actual results with the basic standard, and if there is a gradual improvement in performance over time, this will be apparent in an improving trend in reported variances.

When there is waste in production, or when idle time occurs regularly, current standard costs may include an allowance for the expected wastage or expected idle time. This is considered in more detail later.

### 18.2.7 Types of standard: behavioural aspects

One of the purposes of standard costing is to set performance standards that motivate employees to improve performance. The type of standard used can have an effect on motivation and incentives.

**(a)** Ideal standards are unlikely to be achieved. They may be very useful as long term targets and may provide senior managers with an indication of the potential for savings in a process but generally the ideal standard will not be achieved. Consequently the reported variances will always be adverse. Employees may become de-motivated when their performance level is always worse than standard and they know that the standard is unachievable.

**(b)** Current standards may be useful for producing budgets as they are based on current levels of efficiency and may therefore give a realistic guide to resources required in the production process. However current standards are unlikely to motivate employees to improve their performance, unless there are incentives for achieving favourable variances (for achieving results that are better than the standard), such as annual cash bonuses.

**(c)** Basic standards will not motivate employees to improve their performance as they are based on achievable conditions at some time in the past. They are also not useful for budgeting because they will often be out of date. In practice, they are the least common type of standard.

**(d)** Attainable standards are the most likely to motivate employees to improve performance as they are based on challenging but attainable targets. It is for this reason that standards are often based on attainable conditions. However, a problem with attainable standards is deciding on the level of performance that should be the target for achievement. For example, if an attainable standard provides for some improvement in labour efficiency, should the standard provide for a 1% improvement in efficiency, or a 5% improvement, or a 10% improvement?

### 18.2.8 Reviewing standards

How often should standards be revised? There are several reasons why standards should be revised regularly.

**(a)** Regular revision leads to standards which are meaningful targets that employees may be motivated to achieve (for example, through incentive schemes).

**(b)** Variance analysis is more meaningful because reported variances should be realistic.

**(c)** In practice, standards are normally reviewed annually. Standards by their nature are long-term averages and therefore some variation is expected over time. The budgeting process can therefore be used to review the standard costs in use.

## 18.3 Introduction to variance analysis: Calculation of basic variances:

**Section overview**

(a) Standard cost cards
(b) Fixed budget
(c) Flexed budget
(d) Comparison of actual results to the flexed budget
(e) Cost variances

### 18.3.1 Standard cost cards

Standard costs are constructed by estimating the quantities of standard amounts of input (for example materials and labour) and estimating the cost of buying these over the future period covered by the standard. Standard costs for a unit are often set out in a record called a standard cost card. Thus a standard cost card is a document used in standard costing system to show details of predetermined standard costs for materials, labour and overhead required to produce one unit of a product. A typical standard cost card is as follows.

**Example: Standard cost card (Lagos Manufacturing Limited)**

| | | ₦ |
|---|---|---|
| Direct materials | 5 kg @ ₦1,000 per kg | 5,000 |
| Direct labour | 4 hours @ ₦500 per hour | 2,000 |
| Variable overhead | 4 hours @ ₦200 per hour | 800 |
| Marginal production cost | | 7,800 |
| Fixed production overhead | 4 hours @ ₦600 per hour | 2,400 |
| Total absorption cost | | 10,200 |

The above standard costs will be used in examples throughout this chapter to illustrate variance analysis .

Standard costs link to the budget through activity levels.

For example, if a company wanted to make 1,200 of the above units the budget would show a material cost of ₦6,000,000 (1,200 ´ ₦5,000)

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### 18.3.2 Fixed budget

The original budget prepared at the beginning of a budget period is known as the fixed budget. A fixed budget is a budget for a specific volume of output and sales activity, and it is the 'master plan' for the financial year that the company tries to achieve.

**Example: Fixed budget for a period**

Lagos Manufacturing Limited has budgeted to make 1,200 units and sell 1,000 units in January.

The selling price per unit is budgeted at ₦15,000.

The standard costs of production are as given in the previous example.

The budget prepared for January is as follows:

| | | |
|---|---|---|
| Unit sales | | 1,000 |
| Unit production | | 1,200 |
| **Budget** | | ₦'000 |
| Sales | (1,000 units × 15,000) | 15,000 |
| Cost of sales: | | |
| Materials | (1,200 units × ₦5,000 per unit) | 6,000 |
| Labour | (1,200 units × ₦2,000 per unit) | 2,400 |
| Variable overhead | (1,200 units × ₦800 per unit) | 960 |
| Fixed overhead | (1,200 units × ₦2,400 per unit) | 2,880 |
| | | 12,240 |
| Closing inventory | (200 units × ₦10,200 per unit) | (2,040) |
| Cost of sales | (1,000 units × ₦10,200 per unit) | (10,200) |
| Profit | | 4,800 |

**Note:**

Budgeted profit = 1,000 units × (₦15,000 – ₦10,200 per unit) = ₦4,800,000

One of the main purposes of budgeting is budgetary control and the control of costs. Costs can be controlled by comparing budgets with the results actually achieved.

Differences between expected results and actual results are known as variances. Variances can be either favourable (F) or adverse (A) depending on whether the results achieved are better or worse than expected.

Consider the following:

**Example: Fixed budget and actual results for a period.**

At the end of January Lagos Manufacturing Limited recorded its actual results as follows.

| | Budget | Actual |
|---|---|---|
| Unit sales | 1,000 | 900 |
| Unit production | 1,200 | 1,000 |

| **Budget** | Budget<br>₦'000 | Actual<br>₦'000 |
|---|---|---|
| Sales | 15,000 | 12,600 |
| Cost of sales: | | |
| Materials | 6,000 | 4,608 |
| Labour | 2,400 | 2,121 |
| Variable overhead | 960 | 945 |
| Fixed overhead | 2,880 | 2,500 |
| | 12,240 | 10,174 |
| Closing inventory | (2,040) | (1,020) |
| Cost of sales | (10,200) | (9,154) |
| Profit | 4,800 | 3,446 |

**Note:**

The actual closing inventory of 100 units is measured at the standard cost of ₦10,200 per unit. This is what happens in standard costing systems.

### What does this tell us?

The actual results differ from the budget. The company has not achieved its plan in January. Profit is less than budgeted. The company would like to understand the reason for this in as much detail as possible.

The technique that explains the difference between actual results and the budget is called variance analysis. This technique identifies the components of the difference between the budgeted profit and the actual profit in detail so that they can be investigated and understood by the company.

The sales figure is less than budgeted but why? The sales figure is a function of the quantity sold and the selling price per unit. The quantity sold is 100 units less than budgeted but what about the impact of any difference in the sales price?

At first sight it looks as if the company has made savings on every cost line. For example budgeted material cost was ₦6,000,000 but actual spend was only ₦4,608,000. However, this is not a fair comparison because the budgeted cost was to make 1200 units whereas the company only made 1,000 units.

### 18.3.3 Flexed budget

Variances are not calculated by comparing actual results to the fixed budget directly because the figures relate to different levels of activity and the comparison would not be like to like. A second budget is drawn up at the end of the period. This budget is based on the actual levels of activity and the standard revenue and standard costs. This budget is called a flexed budget.

**Example: Flexed budget for a period**

The flexed budget prepared by Lagos Manufacturing Limited at the end of January (based on actual levels of activity and standard revenue per unit and standard cost per unit) is as follows:

| | | |
|---|---|---|
| Unit sales | | 900 |
| Unit production | | 1,000 |
| **Budget** | | ₦'000 |
| Sales | (900 units ´ 15,000) | 13,500 |
| Cost of sales: | | |
| Materials | (1,000 units ´ ₦5,000 per unit) | 5,000 |
| Labour | (1,000 units ´ ₦2,000 per unit) | 2,000 |
| Variable overhead | (1,000 units ´ ₦800 per unit) | 800 |
| Fixed overhead | (1,000 units ´ ₦2,400 per unit) | 2,400 |
| | | 10,200 |
| Closing inventory | (100 units ´ ₦10,200 per unit) | (1,020) |
| Cost of sales | (900 units ´ ₦10,200 per unit) | (9,180) |
| Profit | | 4,320 |

This shows the amount that the company would have received for the actual number of units sold if they had been sold at the budgeted revenue per item.

It shows what the actual number of units produced (1,000 units) would have cost if they had been made at the standard cost.

The flexed budget is a vital concept. It sits at the heart of variance analysis.

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### 18.3.4 Comparison of actual results to the flexed budget.

All three statements can be combined as follows:

**Example: Fixed budget, flexed budget and actual results for a period.**

At the end of January, Lagos Manufacturing Limited has recorded its actual results as follows (together with the original fixed budget and the flexed budget for the month).

| | Fixed budget | Flexed budget | Actual |
|---|---|---|---|
| Unit sales | 1,000 | 900 | 900 |
| Unit production | 1,200 | 1,000 | 1,000 |
| | **Budget** | **Actual** | **Actual** |
| **Budget** | **₦'000** | **₦'000** | **₦'000** |
| Sales | 15,000 | 13,500 | 12,600 |
| Cost of sales: | | | |
| Materials | 6,000 | 5,000 | 4,608 |
| Labour | 2,400 | 2,000 | 2,121 |
| Variable overhead | 960 | 800 | 945 |
| Fixed overhead | 2,880 | 2,400 | 2,500 |
| | 12,240 | 10,200 | 10,174 |
| Closing inventory | (2,040) | (1,020) | (1,020) |
| Cost of sales | (10,200) | (9,180) | (9,154) |
| Profit | 4,800 | 4,320 | 3,446 |

**Note:**

The actual closing inventory of 100 units is measured at the standard total absorption cost of ₦10,200 per unit. This is what happens in standard costing systems.

The information for Lagos Manufacturing Limited's performance in January will be used throughout this chapter to illustrate variance analysis.

Note that the above example is unlikely to be something that you would have to produce in the exam. It is provided to help you to understand what variance analysis is about.

#### Commentary

Variance analysis explains the difference between the fixed budget profit and the actual profit in detail. This paragraph provides an initial commentary before looking at the detailed calculations in later sections of this chapter.

Both the fixed budget and the flexed budget are based on the standard revenue per unit and the standard costs per unit. Therefore, the difference between the fixed budget and the flexed budget is caused only by difference in volume. This figure of ₦480,000 (₦4,800,000 □ ₦4,320,000) is called the sales volume variance. This is revisited in detail later in this chapter.

Revenue is sales quantity ´ sales price per unit. The revenue in the flexed budget and the actual revenue are both based on the actual quantity sold. Therefore the difference between the two figures of ₦900,000 (₦13,500,000 □ ₦12,600,000) is due to a difference in the selling price per unit. This difference is called the sales price variance. This is revisited in detail later in this chapter.

The difference between each variable cost line in the flexed budget and the equivalent actual figure is a total cost variance for that item. For example the actual results show that 1,000 units use material which cost ₦4,608,000. The flexed budget shows that these units should have used material which cost ₦5,000,000. The difference of ₦392,000 is due to a combination of the actual material used being different to the budgeted usage of 5kgs per unit and the actual price per kg being different to the budgeted price per kg. In other words, the total variance can be explained in terms of usage and price. This is explained in detail later in this chapter.

Variable cost variances can be calculated for all items of variable cost (direct materials, direct labour and variable production overhead). The method of calculating the variances is similar for each variable cost item.

**(a)** The total cost variance for the variable cost item is the difference between the actual variable cost of production and the standard variable cost of producing the items.

**(b)** However, the total cost variance is not usually calculated. Instead, the total variance is calculated in two parts, that add up to the total cost variance:

i. a price variance or rate variance or expenditure per hour variance.

ii. a usage or efficiency variance.

The difference between the fixed overhead in the flexed budget and the actual fixed overhead is over absorption. This was covered in an earlier chapter but will be revisited in full later in this chapter.

### 18.3.4 Cost variances

#### Adverse and favourable cost variances

In a standard costing system, all units of output are valued at their standard cost. Cost of production and cost of sales are therefore valued at standard cost.

Actual costs will differ from standard costs. A cost variance is the difference between an actual cost and a standard cost.

(a) When actual cost is higher than standard cost, the cost variance is adverse (A) or unfavourable (U).

(b) When actual cost is less than standard cost, the cost variance is favourable (F).

Different variances are calculated, relating to direct materials, direct labour, variable production overhead and fixed production overhead. (There are also sales variances. These are explained in a later section.)

In a cost accounting system, cost variances are adjustments to the profit in an accounting period.

**(a)** Favourable variances increase the reported profit.

**(b)** Adverse variances reduce the reported profit.

The method of calculating cost variances is similar for all variable production cost items (direct materials, direct labour and variable production overhead).

A different method of calculating cost variances is required for fixed production overhead.

Variances and performance reporting

Variance reports are produced at the end of each control period (say, at the end of each month).

**a.** Large adverse variances indicate poor performance and the need for control action by management.
**b.** Large favourable variances indicate unexpected good performance. Management might wish to consider how this good performance can be maintained in the future.

Variances might be reported in a statement for the accounting period that reconciles the budgeted profit with the actual profit for the period. This statement is known as an **operating statement**.

### 18.4.2 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 reducing 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 (Lagos Manufacturing Limited)**

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

Direct materials total cost variance is calculated as follows:

| | ₦'000 |
|---|---|
| Standard: 1,000 units should cost (@ ₦5,000 per unit) | 5,000 |
| Actual: 1,000 units did cost | (4,608) |
| Total cost variance | 392 **F** |

The direct materials total cost variance can be analysed into a price variance and a usage variance.

**(a)** A price variance measures the difference between the actual price paid for materials and the price that should have been paid (the standard price).

**(b)** 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** **2**

A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre. The standard direct material cost per unit of Product P123 is therefore ₦15.

In a particular month, 2,000 units of Product P123 were manufactured. These used 10,400 litres of Material A, which cost ₦33,600.

## 18.4 Basic Variances:

### 18.4.1 Direct Materials Variances

**Section overview**

(a) Direct materials: total cost variance
(b) Direct materials price variance
(c) Direct materials usage variance
(d) Alternative calculations
(e) Direct materials: possible causes of variances

### 18.4.3 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** | (X) |
| Actual kgs purchased × Actual price per kg | |

**Example: Direct materials – price variance (Lagos Manufacturing Limited)**

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

If there are two or more direct materials, a price variance is calculated separately for each material.

**Practice question** **3**

A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre. The standard direct material cost per unit of Product P123 is therefore ₦15. In a particular month, 2,000 units of Product P123 were manufactured. These used 10,400 litres of Material A, which cost ₦33,600.

### 18.4.4 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 (in kgs) | X |
| Standard cost per kg (multiply by) | X |
| | v |

**Example: Direct materials – Usage variance (Lagos Manufacturing Limited)**

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

Direct materials usage variance is calculated as follows:

| | Kgs |
|---|---|
| **Standard:** | |
| Making 1,000 units should have used (@ 5 kgs per unit) | 5,000 |
| **Actual:** Making 1,000 units did use | (4,850) |
| Usage variance (kgs) | 150 **F** |
| Standard cost per kg | ₦1,000 |

**Practice question** **4**

A unit of Product P123 has a standard cost of 5 litres of Material A at ₦3 per litre.

The standard direct material cost per unit of Product P123 is therefore ₦15.
In a particular month, 2,000 units of Product P123 were manufactured.

These used 10,400 litres of Material A, which cost ₦33,600.

### 18.4.5 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**

| | | | |
|---|---|---|---|
| $AQ_{purchased} \times AC$ | X | | |
| | | X | Price variance |
| $AQ_{purchased} \times SC$ | X | | |
| | | X | Inventory movement |
| $AQ_{used} \times SC$ | X | | |
| | | X | usage variance |
| $SQ_{used} \times SC$ | X | | |

**Where:**

AQ = Actual quantity
AC = Actual cost per kg

SC = Standard cost per kg

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**Example: Alternative method for calculating material variances (Lagos Manufacturing Limited)**

Standard material cost per unit: (5kgs × ₦1,000 per kg) = ₦5,000 per unit

Actual production in period = 1,000 units.

Materials purchased and used: 4,850 kgs at a cost of ₦4,608,000

| | ₦'000 | ₦'000 |
|---|---|---|
| $AQ_{purchased} \times AC$ | | |
| 4,850 kgs × ₦X per kg | 4,608 | |
| $AQ_{purchased} \times SC$ | | 242 (F) Price variance |
| 4,850 kgs × ₦1,000 per kg | 4,850 | |
| $AQ_{used} \times SC$ | | nil inventory movement |
| 4,850 kgs × ₦1,000 per kg | 4,850 | |
| $SQ_{used} \times SC$ | | 150 (F) Usage variance |
| 5,000 kgs × ₦1,000 per kg | 5,000 | |

SQ = 1,000 units × 5 kgs per unit = 5,000 kgs

**Practice question** **5**

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 P123 is therefore ₦15.
In a particular month, 2,000 units of Product P123 were manufactured.

These used 10,400 litres of Material A, which cost ₦33,600.

Calculate the direct materials price and usage variances using the alternative approach.

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### 18.4.5 Direct materials: possible causes of variances

When variances occur and they appear to be significant, management should investigate the reason for the variance. If the cause of the variance is something within the control of management, control action should be taken. Some of the possible causes of materials variances are listed below.

**Materials price variance: causes**

Possible causes of favourable materials price variances include:

**(a)** Different suppliers were used and these 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.

**(c)** Materials were bought that 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 these 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.
**(d)** Materials were bought that were 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.
**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 amount of breakages (adverse usage variance). Breakages mean that a quantity of materials input to the production process are wasted.
**(c)** Materials used were of cheaper quality than standard, with the result that more materials had to be thrown away as waste.

## 18.5 Direct Labour Variances

**Section overview**

(a) Direct labour: total cost variance
(b) Direct labour rate variance
(c) Direct labour efficiency variance
(d) Idle time variance
(e) Alternative calculations
(f) Idle time variance where idle time is included in standard cost
(g) Direct labour: possible causes of variances

### 18.5.1 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 (Lagos Manufacturing Limited)**

Standard labour cost per unit: (4 hrs × ₦500 per hr) = ₦2,000 per unit

Actual production in period = 1,000 units.
Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour total cost variance is calculated as follows:

| | ₦'000 |
|---|---|
| Standard: 1,000 units should cost (@ ₦2,000 per unit) | 2,000 |
| Actual: 1,000 units did cost | (2,121) |
| Total cost variance | (121) **A** |

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) 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).

(b) 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).

### 18.5.2 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 (Lagos Manufacturing Limited)**

Standard labour cost per unit: (4 hrs × ₦500 per hour) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour rate variance is calculated as follows:

| | ₦'000 |
|---|---|
| Standard: 4,200 hours should cost (@ ₦500 per hour) | 2,100 |
| Actual: 4,200 hours did cost | (2,121) |
| Labour rate variance | (21) **A** |

If there are two or more different types or grades of labour, each paid at a different standard rate per hour, a rate variance is calculated separately for each labour grade.

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### 18.5.3 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 used 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 |
| | Y |

**Example Direct labour – Efficiency variance (Lagos Manufacturing Limited)**

Standard labour cost per unit: (4 hrs × ₦500 per hour) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Direct labour efficiency variance is calculated as follows:

| | Hours |
|---|---|
| **Standard:** | |
| Making 1,000 units should have used (@ 4 hours per unit) | 4,000 |
| **Actual:** Making 1,000 units did use | (4,200) |
| Efficiency variance (hours) (A) | (200) **A** |
| Standard rate per hour | ₦500 |
| Efficiency variance (₦) (A) | (₦100,000) **A** |

**Practice question** **6**

Product P234 has a standard direct labour cost per unit of:

0.5 hours × ₦12 per direct labour hour = ₦6 per unit.

During a particular month, 3,000 units of Product P234 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.

### 18.5.4 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.
**(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.

**(a)** If idle time is not built into the standard cost the idle time variance is always adverse.
**(b)** 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 |

Calculating the idle time variance will affect the calculation of the direct labour efficiency variance. If idle time occurs but is not recorded the idle time variance is part of the direct labour efficiency variance.

**Example: Direct labour – idle time variance (Lagos Manufacturing Limited)**

Standard labour cost per unit: (4 hours × ₦500 per kg) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000
Labour hours worked: 4,100 hours

Direct labour idle time variance is calculated as follows:

| | Hours |
|---|---|
| Actual hours paid for | 4,200 |
| Actual hours worked | (4,100) |
| Idle time (hours) | (100) **A** |
| Standard rate per hour (multiply by) | ₦500 |

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) | (100) **A** |
| Standard rate per hour | ₦500 |

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### 18.4.4 Alternative calculations

The following shows the line by line approach for labour variances.

**Formula: Alternative method for calculating labour variances**

| | | | |
|---|---|---|---|
| $AH_{paid\ for} \times AR$ | X | | |
| | | X | Rate variance |
| $AH_{paid\ for} \times SR$ | X | | |
| | | X | Idle time variance |
| $AH_{worked} \times SR$ | X | | |
| | | X | Efficiency variance |
| $SH_{worked} \times SR$ | X | | |

**Where:**

AH = Actual hours

AR = Actual rate per hour

SR = Standard rate per hour

**Example: Alternative method for calculating labour variances (Lagos Manufacturing Limited)**

Standard labour cost per unit: (4 hours × ₦500 per kg) = ₦2,000 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Labour hours worked: 4,100 hours

| | ₦'000 | ₦'000 |
|---|---|---|
| $AH_{paid\ for} \times AR$ | | |
| 4,200 hours × ₦X per hour | 2,121 | |
| $AH_{paid\ for} \times SR$ | | 21 (A) Price variance |
| 4,200 hours × ₦500 per hour | 2,100 | |
| $AH_{worked} \times SR$ | | 50 (A) Idle time |
| 4,100 hours × ₦500 per hour | 2,050 | |
| $SH_{worked} \times SR$ | | 50 (A) Efficiency |
| | 2,000 | |

SQ = 1,000 units × 4 hours per unit = 4,000 hours

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**Practice question** **7**

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 P234 were manufactured. These took 1,400 hours to make and the direct labour cost was ₦16,200. Calculate the direct labour rate variance and the direct labour efficiency variance for the month using the alternative approach.

### 18.4.5 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.

**(a)** **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.

**(b)** **Method 2**. Allow for a standard amount of idle time in the standard hours per unit for each product. The standard hours per unit therefore include an allowance for expected idle time.

**Example: Idle time in standard (Lagos Manufacturing Limited)**

Standard labour rate = ₦500 per hour

A unit of production should take 3.6 hours to produce.
Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.
4 hours must be paid for (3.6/90%) to make 1 unit).

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) (Lagos Manufacturing Limited)

Standard labour rate = ₦500 per hour

A unit of production should take 3.6 hours to produce. Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit. 4 hours must be paid for (3.6/90%) to make 1 unit).

Expected idle time is 0.4 hours (10% of 4 hours).

Idle time can be built into the standard as follows:

Method 1

| ₦ | | |
|---|---|---|
| Labour | 3.6 hours ´ ₦500 per hour | 1,800 |
| Idle time | 0.4 hours ´ ₦500 per hour | 200 |
| | | 2,000 |

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours at a cost of ₦2,121,000

Labour hours worked: 4,100 hours

Direct labour idle time variance is calculated as follows:

| | Hours | |
|---|---|---|
| Expected idle time (1,000 units ´ 0.4 hours per unit) | 400 | |
| Actual idle time (4,200 hours □ 4,100 hours) | (100) | |
| Idle time (hours) | 300 | F |
| Standard rate per hour (multiply by) | ₦500 | |
| Idle time (₦) | ₦150,000 | F |

Direct labour efficiency variance is calculated as follows:

| | Hours |
|---|---|
| **Standard:** | |
| Making 1,000 units should have used (@ 3.6 hours per unit) | 3,600 |
| **Actual:** Making 1,000 units did use | (4,100) |

| | | |
|---|---|---|
| Efficiency variance (hours) | (500) | A |
| Standard rate per hour | ₦500 | |
| Efficiency variance (₦) | (₦250,000) | A |

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**Example: Method 2 – idle time variance (Idle time allowed for as a standard amount of idle time in the standard hours per unit for each product) (Lagos Manufacturing Limited)**

Standard labour rate = ₦500 per hour

A unit of production should take 3.6 hours to produce.

Expected idle time is 10% of total time paid for.

Therefore 3.6 hours is 90% of the time that must be paid for to make 1 unit.

4 hours must be paid for (3.6/90%) to make 1 unit).

Idle time can be built into the standard as follows:

Expected idle time is 0.4 hours (10% of 4 hours).

| **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 | F |
| Standard rate per hour (multiply by) | ₦500 | |
| Idle time (₦) | ₦160,000 | F |

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) | A |
| Standard rate per hour | ₦500 | |
| Efficiency variance (₦) | (₦260,000) | A |

In summary the idle time variance is part of the efficiency variance. Different methods result in a different split of the idle time variance and efficiency variance but the figures always sum to the same total.

Revisiting the previous examples:

**Example: Sum of idle time and efficiency variances (Lagos Manufacturing Limited)**

| | Idle time variance | Efficiency variance | Total |
|---|---|---|---|
| Idle time not recorded | – | 100 (A) | 100 (A) |
| Idle time recorded: | | | |
| not part of standard cost | 50 (A) | 50 (A) | 100 (A) |
| part of standard cost (method 1) | 150 (F) | 250 (A) | 100 (A) |
| part of standard cost (method 2) | 160 (F) | 260 (A) | 100 (A) |

**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').
**(b)** Actual pay increase turning out to be less than expected. Possible causes of adverse labour rate variances include:
**(c)** An increase in pay for employees.
**(d)** Working overtime hours paid at a premium above the basic rate.
**(e)** 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.
**(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.
**(b)** An event causing poor morale.

## 18.6 Variable production overhead variances

**Section overview**

(a) Variable production overhead: total cost variance
(b) Variable production overhead expenditure variance
(c) Variable production overhead efficiency variance
(d) Alternative calculations
(e) Variable production overheads: possible causes of variances

### 18.6.1 Variable production overhead: total cost variance

The total variable production overhead cost variance is the difference between the actual variable production overhead cost in producing units in the period and the standard variable production overhead cost of producing those units.

**Illustration: Variable production overhead – total cost variance**

| | ₦ |
|---|---|
| **Standard variable production overhead cost of actual production:** | |
| Actual units produced × Standard hrs per unit × Standard rate per hr | X |
| **Actual variable production overhead cost of actual production:** | |
| Actual units produced × Actual hours per unit × Actual rate per hour | (X) |
| | X |

The variance is adverse (A) if actual cost is higher than the standard cost, and favourable (F) if actual cost is less than the standard cost.

**Example: Variable production overhead – Total cost variance (Lagos Manufacturing Limited)**

Standard variable production overhead cost per unit: (4 hrs × ₦200 per hr) = ₦800 per unit

Actual production in period = 1,000 units.
Variable production overhead = ₦945,000.
Labour hours paid for: 4,200 hours

Direct variable production overhead total cost variance is calculated as follows:

| | ₦'000 |
|---|---|
| Standard: 1,000 units should cost (@ ₦800 per unit) | 800 |
| Actual: 1,000 units did cost | (945) |
| Total cost variance | (145) **A** |

The variable production overhead total cost variance can be analysed into an expenditure variance (spending rate per hour variance) and an efficiency variance.

(a) 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).

(b) 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.

### 18.6.1 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.

**(a)** The variable production overhead expenditure variance is calculated by taking the actual number of hours worked.

**(b)** 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 purchases** | |
| Actual hours worked × Actual rate per hour | (X) |

**Example: Variable production overhead expenditure variance (Lagos Manufacturing Limited)**

Standard variable production overhead cost per unit: (4 hrs × ₦200 per hr) = ₦800 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100 hours at a variable overhead cost of ₦945,000.

Variable production overhead rate variance is calculated as follows:

| | ₦'000 |
|---|---|
| Standard: 4,100 hours should cost (@ ₦200 per hour) | 820 |
| Actual: 4,100hours did cost | (945) |
| Variable production overhead rate variance | (125) **A** |

### 18.6.2 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 used to make the actual production | (X) |
| Efficiency variance (hours) | X |
| Standard rate per hour (multiply by) | X |
| | v |

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**Example Variable production overhead efficiency variance (Lagos Manufacturing Limited)**

Standard variable production overhead cost per unit: (4 hrs × ₦200 per kg) = ₦800 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100 hours at a variable overhead cost of ₦945,000.

Variable production overhead efficiency variance is calculated as follows:

| | Hours | |
|---|---|---|
| **Standard:** | | |
| Making 1,000 units should have used (@ 4 hours per unit) | 4,000 | |
| **Actual:** Making 1,000 units did use | (4,100) | |
| Efficiency variance (hours) | (100) | **A** |
| Standard rate per hour | ₦200 | |
| Efficiency variance (₦) | (₦20,000) | **A** |

**Practice question** **8**

Product P123 has a standard variable production overhead cost per unit of:

1.5 hours × ₦2 per direct labour hour = ₦3 per unit.

During a particular month, 2,000 units of Product P123 were manufactured. These took 2,780 hours to make and the variable production overhead cost was ₦6,550.

Calculate the total variable production overhead cost variance, the variable production overhead expenditure variance and the variable production

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### 18.6.3 Alternative calculations

The following shows the line by line approach for variable production overhead variances.

**Formula: Alternative method for calculating variable production overhead variances**

| | | | |
|---|---|---|---|
| AH $_{worked}$ × AR | X | | |
| | | X | Rate variance |
| AH $_{worked}$ × SR | X | | |
| | | X | Efficiency variance |
| SH $_{worked}$ × SR | X | | |

**Where:**

AH = Actual hours

AR = Actual rate per hour

SR = Standard rate per hour

| | ₦'000 | ₦'000 |
|---|---|---|
| AH worked ´ AR | | |
| 4,100 hours ´ ₦X per hour | 945 | |
| AH worked ´ SR | | 125 (A) Expenditure |
| 4,100 hours ´ ₦200 per hour | 820 | |
| SH worked ´ SR | | 20 (A) Efficiency |
| 4,000 hours ´ ₦200 per hour | 800 | |

**Practice question** **9**

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 P123 were manufactured. These took 2,780 hours to make and the variable production overhead cost was ₦6,550.

Calculate the variable production overhead expenditure variance and the variable production overhead efficiency variance for the month using the

### 18.6.4 Variable production overhead: possible causes of variances

Possible caues of favourable variable production overhead expenditure variances include:

(a) Forecast increase in costs not materialising.

Possible causes of adverse variable production overhead variances include:

**(a)** 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:

**(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.
**(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 variable production overhead efficiency variances include:

**(a)** Using employees who are less experienced than 'standard', resulting in adverse efficiency variances.
**(b)** An event causing poor morale.

**Section overview**

(a) Over/under absorption
(b) Total fixed production overhead cost variance
(c) Fixed production overhead expenditure variance
(d) Fixed production overhead volume variance
(e) Fixed production overhead efficiency and capacity variances
(f) Fixed production overheads: possible causes of variances

## 18.7 Fixed Production Overhead Cost Variances: Absorption Costing

### 18.7.1 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 for absorbed 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 from a standard number of direct labour hours per unit and 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

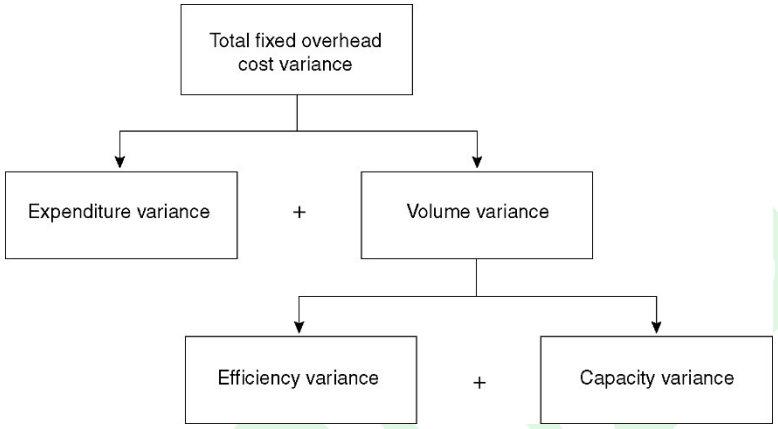
overhead cost per unit.

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**




### 18.7.2 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 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.

Example: Fixed production overhead – Total cost variance (Over/under absorption) (Lagos Manufacturing limited .

Budgeted Fixed production overhead ₦2,880,000

Budgeted production hours:

= Budgeted Production hours:

= Budgeted production volume x Standard hours per unit 4,800 hours

= (1200 units x 4 hours per unit) ₦600 per hour

( Overhead Absorption rate = N2,880,000/ 4,800 hours)

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:

Fixed production overhead absorbed in the period: ₦'000

Actual units produced x Fixed production overhead per unit

= 1000 units x N2,400 per unit = 2,400

### 18.7.3 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 (Lagos Manufacturing Limited)**

| | ₦'000 |
|---|---|
| Budgeted fixed production overhead | 2,880 |
| Actual fixed production overhead | (2,500) |
| Fixed production overhead expenditure variance | 380 **F** |

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

**(b)** a sales and distribution fixed overhead expenditure variance is the difference between budgeted and actual fixed sales and distribution overhead costs

### 18.7.4 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 |

**Example Fixed production overhead – volume variance (Lagos Manufacturing Limited)**

| | |
|---|---|
| Budgeted fixed production overhead | ₦2,880,000 |
| Budgeted production hours: | |
| = Budgeted production volume × Standard hours per unit | 4,800 hours |
| = 1,200 units × 4 hours per unit | ₦600 per hour |
| Overhead absorption rate ₦2,880,000/4,800 hours | |
| Actual fixed production overhead | ₦2,500,000 |
| Actual production | 1,000 units |

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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) | (200) | **A** |
| Fixed production overhead per unit | ₦2,400 | |

**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.

Calculate the total fixed production overhead cost variance, the fixed overhead expenditure variance and the fixed overhead volume variance for the year.

### 18.7.5 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.

**(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.

### 18.7.6 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 |

**Example: Fixed production overhead efficiency variance (Lagos Manufacturing Limited)**

Standard fixed production overhead cost per unit: (4 hrs × ₦600 per hr) = ₦2,400 per unit

Actual production in period = 1,000 units.

Labour hours paid for: 4,200 hours

Labour hours worked: 4,100

Fixed production overhead efficiency variance is calculated as follows:

| | Hours |
|---|---|
| **Standard:** | |
| Making 1,000 units should have used (@ 4 hours per unit) | 4,000 |
| **Actual:** Making 1,000 units did use | (4,100) |
| Efficiency variance (hours) | (100) **A** |
| Standard rate per hour | ₦600 |
| Efficiency variance (₦) | (₦60,000) **A** |

### 18.7.8 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 |

**Example: Fixed production overhead capacity variance (Lagos Manufacturing Limited)**

| | |
|---|---|
| Budgeted fixed production overhead | ₦2,880,000 |
| Budgeted production hours: | |
| = Budgeted production volume × Standard hours per unit | 4,800 hours |
| = 1,200 units × 4 hours per unit | ₦600 per hour |
| Overhead absorption rate ₦2,880,000/4,800 hours | |
| 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) | (700) **A** |
| Standard rate per hour (multiply by) | ₦600 |
| Capacity variance x variance (₦) | |

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**Practice questions** **11**

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.

Calculate the fixed overhead efficiency variance and the fixed overhead capacity variance for the year.

### 18.7.9 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 over 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.

### 18.7.10 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).
**(d)** Strike action by the workforce, resulting in a fall in output below budgeted output (adverse capacity variance).
**(e)** Extensive breakdowns in machinery, resulting in lost production (adverse capacity variance).

## 18.8 Sales variances

**Section overview**

(a) Sales variances: Introduction
(b) Sales price variance
(c) Sales volume variance
(d) Sales: possible causes of variances

### 18.8.1 Sales variances: Introduction

Sales variances, unlike cost variances, are not recorded in a standard costing system of cost accounts (in the cost ledger). However, sales variances are included in variance reports to management.

They help to reconcile actual profit with budgeted profit. They help management to assess the sales performance. There are two sales variances:

**(a)** a sales price variance; and
**(b)** a sales volume variance

### 18.8.2 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 (Lagos Manufacturing Limited)**

| | |
|---|---|
| | 1,000 units |
| Budgeted sales volume | ₦15,000 |
| Actual sales volume | 900 units |
| Actual revenue | ₦12,600,000 |
| Sales price variance is calculated as follows: | |
| | ₦'000 |
| **Standard revenue for actual sales** | |
| 900 units × ₦15,000 per unit | 13,500 |
| **Actual revenue** | |
| Actual sales × Actual selling price per unit | (12,600) |
| Sales price variance | 900 **A** |

### 18.8.3 Sales volume variance

A sales volume variance shows the effect on profit of the difference between the actual sales volume and the budgeted sales volume.

In a **standard absorption costing system**, the sales volume variance might be called a sales volume **profit** variance.

The variance is calculated by comparing the actual number of units sold (actual sales volume) to the number of units expected to be sold when the original budget was drafted (budgeted sales volume).

This is then expressed as a money value by multiplying it by the standard profit per unit.

**Illustration: Sales volume variance**

| | Units |
|---|---|
| Budgeted sales volume | X |
| Actual sales volume | (X) |
| Sales volume variance (units) | X |
| Standard profit per unit (multiply by) | X |

**Example: Sales volume variance (Lagos Manufacturing Limited)**

| | |
|---|---|
| Budgeted sales volume | 1,000 units |
| Budgeted selling price per unit | ₦15,000 |
| Standard cost per unit (from the standard cost card) | ₦10,200 |
| Actual sales volume | 900 units |
| Actual revenue | ₦12,600,000 |

Sales volume variance is calculated as follows:

| | Units |
|---|---|
| Budgeted sales volume | 1,000 |
| Actual sales volume | 900 |
| Sales volume variance (units) | (100) **A** |
| Standard profit per unit (multiply by) | ₦4,800 |

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** **12**

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.

### 18.8.4 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.

### 18.8.5 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.

## 18.9 Interrelationships between variances

**Section overview**

(a) The nature of interrelationships between variances
(b) Sales price and sales volume
(c) Materials price and usage
(d) Labour rate and efficiency
(e) Labour rate and variable overhead efficiency
(f) Capacity and efficiency
(g) Footnote: the importance of reliable standard costs

### 18.9.1 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.

### 18.9.1 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.

### 18.9.2 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.

### 18.9.3 Labor 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:

**(a)** there should be a favourable rate variance because the workers will be paid less than the standard rate

**(b)** 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 be not only adverse labour efficiency, but also adverse materials usage.

### 18.9.3 Labour rate and variable overhead efficiency

When a production process operates at a different level of efficiency the true cost of that difference is the sum of any costs associated with labour hours. Therefore, the issues described above also affect the variable overhead efficiency variance.

### 18.9.4 Capacity and efficiency

If a production process operates at a higher level of efficiency that might mean that it does not have to operate for as long 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 that might mean that it has to operate for longer than was budgeted. The adverse efficiency fixed production overhead variance would cause a favourable fixed production overhead capacity variance.

### 18.9.5 Footnote: the importance of reliable standard costs

It is important to remember that the value of variances as control information for management depends on the reliability and accuracy of the standard costs. If the standard costs are inaccurate, comparisons between actual cost and standard cost will have no meaning. Adverse or favourable variances might be caused by inaccurate standard costs rather than by inefficient or efficient working.

## 18.10 Reconciling budgeted and actual profit: Standard absorption costing

**Section overview**

(a) Purpose of an operating statement

(b) Format of an operating statement

### 18.10.1 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.

### 18.10.2 Format of an operating statement

In a standard absorption costing system, an operating statement can be set out as follows.

**Example: Operating statement for Lagos Manufacturing Limited (standard total absorption costing)**

| | ₦'000 | ₦'000 | ₦'000 | |
|---|---|---|---|---|
| Budgeted profit | | | 4,800 | |
| Sales price variance | | | (900) | (A) |
| Sales volume variance | | | (480) | (A) |
| | | | 3,420 | |
| Cost variances | (F) | (A) | | |
| Direct materials price | 242 | | | |
| Direct materials usage | 150 | | | |
| Direct labour rate | | 21 | | |
| Direct labour efficiency | | 50 | | |
| Direct labour idle time | | 50 | | |
| Variable production o'head expenditure | | 125 | | |
| Variable production o'head efficiency | | 20 | | |
| Fixed production overhead expenditure | 380 | | | |
| Fixed production overhead efficiency | | 60 | | |
| Fixed production overhead capacity | | 420 | | |
| Total cost variances | 772 | 746 | 26 | F |
| Actual profit | | | 3,446 | |

This is best demonstrated with an example. The variances calculated for Lagos Manufacturing Limited will be used.

***Note***: Other overhead expenditure variances, assuming administration overheads and selling and distribution overheads are all fixed costs, are the difference between:

**(a)** budgeted other overheads expenditure, and
**(b)** actual other overheads expenditure . In a system of absorption costing :
**(c)** The operating statement begins with the budgeted profit.
**(d)** The sales variances are shown next. These are added to (favourable variances) or subtracted from (adverse variances), and the resulting figure is shown as a sub-total. This figure is the actual sales revenue in the period minus the standard production cost of sales.
**(e)** The cost variances are listed next. They can be listed in any format, but showing separate columns for favourable variances and adverse variances helps to make the statement clear to the reader. Adverse variances reduce the profit and favourable variances add to profit.
**(f)** The cost variances are added up and then shown as a total.
**(g)** The actual profit is shown as the final figure, at the bottom of the operating statement.

## 18.11 Standard marginal costing

**Section overview**

(a) Standard marginal costing
(b) Standard marginal costing variances
(c) Standard marginal costing operating statement

### 18.11.1 Standard marginal costing

The Lagos Manufacturing Limited example used in the earlier sections was based on the company using standard total absorption costing.

This sections looks at what happens when a company uses standard marginal costing instead.

Under marginal costing units produced and finished goods inventory are valued at standard variable production cost, not standard full production cost. This means that the budgeted profit will differ from that found for the same scenario under total absorption costing.

Marginal costing variances are calculated exactly as before with two important differences:

**(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 Lagos Manufacturing Limited example will be used to illustrate the approach.

**Example: Standard cost card (Lagos Manufacturing Limited)**

| | | ₦ |
|---|---|---|
| Direct materials | 5 kg @ ₦1,000 per kg | 5,000 |
| Direct labour | 4 hours @ ₦500 per hour | 2,000 |
| Variable overhead | 4 hours @ ₦200 per hour | 800 |
| Marginal production cost | | 7,800 |

### 18.11.1 Fixed budget

Here is the flexed budget to show the detailed calculation of the budgeted profit.

**Example: Flexed budget for a period**

Lagos Manufacturing Limited has budgeted to make 1,200 units and sell 1,000 units in January.

The selling price per unit is budgeted at ₦15,000.

The standard costs of production are as given in the previous example.

The budget prepared for January is as follows:

| | | |
|---|---|---|
| Unit sales | | 1,000 |
| Unit production | | 1,200 |
| **Budget** | | ₦'000 |
| Sales | (1,000 units ´ 15,000) | 15,000 |
| Cost of sales: | | |
| Materials | (1,200 units ´₦5,000 per unit) | 6,000 |
| Labour | (1,200 units ´ ₦2,000 per unit) | 2,400 |
| Variable overhead | (1,200 units ´ ₦800 per unit) | 960 |
| | | 9,360 |
| Closing inventory | (200 units ´ ₦7,800 per unit) | (1,560) |
| Cost of sales | (1,000 units ´ ₦7,800 per unit) | (7,800) |
| | | 7,200 |
| Fixed overhead | | (2,880) |
| Profit | | 4,320 |

This figure could have been calculated more easily as follows:

**Example: Fixed budget for a period**

| | ₦'000 |
|---|---|
| Budgeted contribution (1,000 units × (₦15,000 – ₦7,800) | 7,200 |
| Less: Budgeted fixed production overhead | (2,880) |
| Profit | 4,320 |

### 18.11.2 Flexed budget

Here are profit statements redrafted to marginal cost basis.

**Example: Fixed budget, flexed budget and actual results for a period. (La r Manufacturing Limited)**

| | Fixed budget | Flexed budget | Actual |
|---|---|---|---|
| Unit sales | 1,000 | 900 | 900 |
| Unit production | 1,200 | 1,000 | 1,000 |

| | Budget | Actual | Actual |
|---|---|---|---|
| **Budget** | **₦'000** | **₦'000** | **₦'000** |
| Sales | 15,000 | 13,500 | 12,600 |
| Cost of sales: | | | |
| Materials | 6,000 | 5,000 | 4,608 |
| Labour | 2,400 | 2,000 | 2,121 |
| Variable overhead | 960 | 800 | 945 |
| | 9,360 | 7,800 | 7,674 |
| Closing inventory | (1,560) | (780) | (780) |
| Cost of sales | (10,200) | (7,020) | (6,894) |
| | | 6,480 | 5,706 |
| Fixed overhead | (2,880) | (2,400) | (2,500) |
| Profit | 4,800 | 4,080 | 3,206 |

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### 18.11.3 Standard marginal costing variances

#### Identical variances

All variable cost variances are the same under standard total absorption costing and standard marginal costing.

Sales price variance is the same under standard total absorption costing and standard marginal costing.

#### Fixed overhead variances

Only the fixed production overhead expenditure variance is relevant and this is calculated in the same way as seen previously.

There is no fixed production overhead volume variance

#### Sales volume variance

The sales volume variance shows the effect on contribution of the difference between the actual sales volume and the budgeted sales volume.

The variance is calculated by comparing the actual number of units sold (actual sales volume) to the number of units expected to be sold when the original budget was drafted (budgeted sales volume).

This is then expressed as a money value by multiplying it by the standard contribution per unit.

**Illustration: Sales volume variance (marginal**

| | Units |
|---|---|
| Budgeted sales volume | X |
| Actual sales volume | (X) |
| Sales volume variance (units) | X |
| Standard contribution per unit (multiply by) | ₦X |

**Example: Sales volume variance (Lagos Manufacturing Limited)**

| | |
|---|---|
| Budgeted sales volume | 1,000 units |
| Budgeted selling price per unit | ₦15,000 |
| Standard cost per unit (from the standard cost card) | ₦7,800 |
| Therefore, standard contribution per unit | ₦7,200 |

Sales volume variance is calculated as follows:

| | Units |
|---|---|
| Budgeted sales volume | 1,000 |
| Actual sales volume | 900 |
| Sales volume variance (units) | 100 **A** |
| Standard contribution per unit (multiply by) | ₦7,200 |
| Sales volume variance | ₦720,000 **A** |

### 18.11.4 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.

**Example: Operating statement for Lagos Manufacturing Limited (standard marginal costing)**

| | ₦'000 | ₦'000 | ₦'000 | |
|---|---|---|---|---|
| Budgeted contribution | | | 7,200 | |
| Sales price variance | | | (900) | (A) |
| Sales volume variance | | | (720) | (A) |
| | | | 5,580 | |
| Cost variances | (F) | (A) | | |
| Direct materials price | 242 | | | |
| Direct materials usage | 150 | | | |
| Direct labour rate | | 21 | | |
| Direct labour efficiency | | 50 | | |
| Direct labour idle time | | 50 | | |
| Variable production o'head expenditure | | 125 | | |
| Variable production o'head efficiency | | 20 | | |
| Total cost variances | 392 | 266 | 126 | F |
| | | | 5,706 | |
| Budgeted fixed production overhead | | 2,880 | | |
| Fixed production overhead expenditure variance | | (380) **F** | | |
| Less: Actual fixed production overheads | | | (2,500) | |
| Actual profit | | | 3,206 | |

Fixed cost expenditure variances are presented in a separate part of the operating statement.

## 18.12 Productivity, efficiency and capacity ratios

**Section overview**

(a) Resource utilisation
(b) Efficiency ratio
(c) Capacity utilisation ratio
(d) Production volume ratio (activity ratio)
(e) Summary of example
(f) Link to variance analysis

### 18.12.1 Resource utilisation

Resource utilisation is about how effectively resources have been used to

generate output. It is also described as productivity.

Performance measures are based on comparisons of the actual hours used to make the actual production, the number of hours that were expected to be used to make the actual production and the total number of hours that were expected to be used in the period.

Three ratios are used to provide information on resource utilisation. These ratios are related to the fixed overhead variances which were explained earlier.

The three ratios are:

a. **Efficiency ratio:** This is concerned with how well the actual hours worked have been used to generate output.
b. **Capacity ratio:** This is concerned with how many hours were worked compared to the hours that should have been worked.
c. **Production volume ratio:** This is a function of the other two ratios. Differences between efficiency of the hours worked compared to budgeted efficiency and the number of the hours worked compared to the budgeted hours, result in volume of output being different to that budgeted.

### Link between the ratios

The three ratios are linked as follows:

**Formula: Relationship between the three ratios**

$$\text{Efficiency ratio} \times \text{Capacity ratio} = \text{Production volume ratio}$$

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### 18.12.2 Efficiency ratio

**Formula: Efficiency ratio**

$$\text{Efficiency ratio} = \frac{\text{Expected hours to produce the actual output}}{\text{Actual hours to produce the actual output}} \times 100$$

or (stated in terms of standard hours):

$$\text{Efficiency ratio} = \frac{\text{Standard hours to produce the actual output}}{\text{Actual hours to produce the actual output}} \times 100$$

**Example: Efficiency ratio**

During July, a factory planned to make 4,000 units of a product. The expected production time is 3 direct labour hours for each unit.

The factory actually produced 3,600 units of the product.

The actual number of direct labour hours worked in the month was 10,000 hours.

Therefore:

| | |
|---|---|
| Actual hours to make actual production | 10,000 |
| Expected time to make the actual production (3,600 units should have used 3 hours per unit) | 10,800 |
| Total number of hours expected to be used (4,000 units should have used 3 hours per unit) | |

The efficiency ratio is calculated as follows:

$$\text{Efficiency ratio} = \frac{10{,}800 \text{ hours}}{10{,}000 \text{ hours}} \times 100 = 108\%$$

The efficiency ratio expresses the number of hours that the actual production should have taken (according to the budget) as a percentage of the actual number of hours taken.

**(a)** When output is produced in exactly the time expected, the efficiency ratio is 100%.

**(b)** The efficiency ratio is above 100% when output is produced more quickly (i.e. taking fewer hours) than expected.

**(c)** The efficiency ratio is below 100% when output is produced more slowly (i.e. taking more hours) than expected.

### 18.12.3 Efficiency ratio and idle time

Employees are not always engaged in active work during the time they attend the work place. Employees might be 'idle' for several reasons, such as waiting for the next work to come along, or because of a halt in production due to a machine breakdown.

When a labour efficiency ratio is calculated, the actual hours worked should **exclude** any hours recorded as idle time.

### 18.12.4 Capacity utilisation ratio

The capacity utilisation ratio measures the actual hours actively working as a percentage of the total hours available for work.

The total number of hours available for work is known as capacity. Capacity might be expressed in terms of the budgeted hours or the actual hours that were available for working. (It is usually expressed as the budgeted number of hours).

**Formula: Capacity ratio**

$$\text{Capacity ratio} = \frac{\text{Actual hours worked}}{\text{Total hours available for work}} \times 100$$

### 18.12.5 Capacity ratio

**Example: Capacity ratio**

During July, a factory planned to make 4,000 units of a product. The expected production time is 3 direct labour hours for each unit.

The factory actually produced 3,600 units of the product.

The actual number of direct labour hours worked in the month was 10,000 hours.

Therefore:

| | |
|---|---|
| Actual hours to make actual production | 10,000 |
| Expected time to make the actual production (3,600 units should have used 3 hours per unit) | 10,800 |
| Total number of hours expected to be used (4,000 units should have used 3 hours per unit) | |

The capacity ratio is calculated as follows:

$$\text{Capacity ratio} = \frac{10{,}000 \text{ hours}}{12{,}000 \text{ hours}} \times 100 = 83.33\%$$

The information provided allows the calculation of capacity as the actual hours that should have been might worked in the week. For example, if a factory had 10 workers, who worked 8 hours per day for 6 days a week, the capacity would be 10 employees ´ 8 hours ´ 6 days = 480 hours).

**Example: Capacity ratio**

A production department has 6 employees who each work 40 hours a week. In a particular week, the recorded idle time was 25 hours.

Total hours available for work = 6 employees × 40 hours = 240 hours.

The capacity ratio is calculated as follows:

$$\text{Capacity ratio} = \frac{(240 - 25) = 215 \text{ hours}}{240 \text{ hours}} \times 100 = 89.63\%$$

### 18.12.6 Production volume ratio (activity ratio)

Labour activity can also be measured by a production volume ratio which is calculated as follows:

**Production volume ratio**

**Formula: Production volume ratio**

$$\text{Volume ratio} = \frac{\text{Expected hours to produce the actual output}}{\text{Total hours available for work}} \times 100$$

**Example: Production volume ratio**

During July, a factory planned to make 4,000 units of a product. The expected production time is 3 direct labour hours for each unit.

The factory actually produced 3,600 units of the product.

The actual number of direct labour hours worked in the month was 10,000 hours.

Therefore:

| | |
|---|---|
| Actual hours to make actual production | 10,000 |
| Expected time to make the actual production (3,600 units should have used 3 hours per unit) | 10,800 |
| Total number of hours expected to be used (4,000 units should have used 3 hours per unit) | |

The production volume ratio is calculated as follows:

$$\text{Production volume ratio} = \frac{10{,}800 \text{ hours}}{12{,}000 \text{ hours}} \times 100 = 90\%$$

### 18.12.7 Summary of example

**Example: Efficiency ratio**

During July, a factory planned to make 4,000 units of a product. The expected production time is 3 direct labour hours for each unit.

The factory actually produced 3,600 units of the product.

The actual number of direct labour hours worked in the month was 10,000 hours.

Therefore:

| | |
|---|---|
| Actual hours to make actual production | 10,000 |
| Expected time to make the actual production (3,600 units should have used 3 hours per unit) | 10,800 |
| Total number of hours expected to be used (4,000 units should have used 3 hours per unit) | |

The three ratios are calculated as follows:

$$\text{Efficiency ratio} = \frac{\text{10,800 hours}}{\text{10,000 hours}} \times 100 = 108\%$$

$$\text{Capacity ratio} = \frac{\text{10,000 hours}}{\text{12,000 hours}} \times 100 = 83.33\%$$

$$\text{Production volume ratio} = \frac{\text{10,800 hours}}{\text{12,000 hours}} \times 100 = 90$$

Using the answers obtained above:

| | |
|---|---|
| Labour efficiency ratio | 108% |
| Capacity utilisation ratio | × 83.33% |
| | 90% |

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### 18.12.8 Link to variance analysis

The ratios discussed in this section offer another way of looking at the information which underpins the calculation of the fixed production overhead variances.

**Example: Efficiency ratio**

Returning to the variance analysis example that runs through this chapter:

| | Hours |
|---|---|
| Actual hours to make actual production | 4,100 |
| Expected time to make the actual production (1,000 units should have used 4 hours per unit) | 4,000 |
| Total number of hours expected to be used (1,200 units should have used 4 hours per unit) | |

The three ratios are calculated as follows:

$$\text{Efficiency ratio} = \frac{4{,}000 \text{ hours}}{4{,}100 \text{ hours}} \times 100 = 97.56\%$$

$$\text{Capacity ratio} = \frac{4{,}100 \text{ hours}}{4{,}800 \text{ hours}} \times 100 = 85.42\%$$

$$\text{Production volume ratio} = \frac{4{,}000 \text{ hours}}{4{,}800 \text{ hours}} \times 100 = 83.33\%$$

Using the answers obtained above:

| | |
|---|---|
| Labour efficiency ratio | 97.56% |
| Capacity utilization ratio | × 85.42% |
| | |

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**Practice question** **13**

A business planned to make 1,200 units at a standard time of 2 hours per unit.

Actual production was 1,100 units.

The actual time taken was 2,250 hours.

Therefore:

| | |
|---|---|
| Actual hours to make actual production | 2,250 |
| Expected time to make the actual production (1,100 units should have used 2 hours per unit) | 2,200 |
| Total number of hours expected to be used (1,200 units should have used 1 hours per unit) | |

Calculate the efficiency, capacity and production volume ratios and show how they are linked to each other.

**Practice question** **14**

A business planned to make 1,200 units at a standard time of 2 hours per unit.

Actual production was 1,100 units.

The actual time taken was 2,250 hours.

Therefore:

During May there were 21 working days of 8 hours per day. The workforce consists of 10 employees, who all do the same work.

Due to problems in the production system and a machine breakdown, 240 hours were recorded as idle time during the month.

During May, the workforce produced 5,400 units of output. The expected time per unit of output is 15 minutes (= 0.25 hours).

Calculate the efficiency, capacity and production volume ratios and show how they are linked to each other.

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## 18.13 CHAPTER REVIEW

**Chapter review**

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

(a) Explain standard costing using examples
(b) Explain and construct a flexed budget
(c) Calculate sales volume variance
(d) Calculate, analyse and interpret various variances relating to material, labour and factory overhead (both variable and fixed)
(e) Calculate , analyse and interpret variances relating to sales.
(f) Calculate , analyse and interpret standard ratios .
(g) Prepare an operating statement reconcile budgeted profit to actual profit using total absorption costing (TAC) and marginal costing (MC)

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**Solution** **1**

First calculate the budgeted overhead absorption rate.

| **Budgeted direct labour hours** | **hours** |
|---|---|
| Laurel: (6,000 units × 1.5 hours) | 9,000 |
| | 6,000 |

| | |
|---|---|
| Budgeted fixed production overheads | ₦1,800,000 |
| Fixed overhead absorption rate/hour | ₦120 / hour |

| | **Laurel** | | **Hardy** | |
|---|---|---|---|---|
| | | ₦ | | ₦ |
| Direct materials | | | | |
| Material X | (3 kg × ₦30) | 90 | (1 kg × ₦30) | 30 |
| Material Y | (2 kg × ₦40) | 80 | (6 kg × ₦40) | 240 |
| Direct labour | (1.6 hrs × ₦250) | | | 750 |
| Variable production overhead | (1.6 hrs × ₦50) | 80 | (3 hrs × ₦50) | 150 |
| Standard variable prod'n cost | | 650 | | 1170 |
| Fixed production overhead | (1.6 hrs × ₦120) | 192 | (3 hrs × ₦120) | 360 |
| | | 842 | | 1530 |

| | ₦ | |
|---|---|---|
| 2,000 units of output should cost (´ ₦15) | 30,000 | |
| They did cost | 33,600 | |
| Total direct materials cost variance | 3,600 | (A) |

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**3**

**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 | (A) |

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** **4**

**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 | (A) |
| Standard price per litre of Material A | ₦3 | |
| Material usage variance in ₦ | ₦1,200 | (A) |

The usage variance is adverse because more materials were used than expected, which has added to costs.

**Solutions** **5**

| | ₦ | ₦ |
|---|---|---|
| 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 | |
| SQ used ´ SC | | 1,200 (A) Usage variance |
| SQ = 2,000 units × 5 litres per unit = 10,000 litres | | |
| 10,000 litres ´ ₦3 per kg | 30,000 | |

Solutions 6

| **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 (F) |

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 (F) |

The rate variance is favourable because the labour hours worked cost less than they should have done.

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

| | | |
|---|---|---|
| 3,000 units of Product P234 should take (´ 0.5 hours) | hours | 1,500 |
| They did take | | 1,400 |
| Efficiency variance in hours | | 100 (F) |
| Standard direct labour rate per hour | | ₦12 |
| Direct labour efficiency variance in ₦ | | ₦1,200 (F) |

The efficiency variance is favourable because production took less time than expected, which has reduced costs.

| **Labour cost variances: summary** | ₦ | |
|---|---|---|
| Labour rate variance | 600 | (F) |
| Labour efficiency variance | 1,200 | (F) |
| Total direct labour cost variance | 1,800 | (F) |

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**Solutions** **7**

| | ₦'000 | ₦'000 |
|---|---|---|
| AH paid for ´ AR | | |
| 1,400 hours ´ ₦X per hour | 16,200 | |
| AH paid for ´ SR | | 600 (F) Price variance |
| 1,400 hours ´ ₦12 per hour | 16,800 | |
| AH worked ´ SR | | zero idle time |
| 1,400 hours ´ ₦12 per hour | 16,800 | |
| SH 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 8

| **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 | (A) |

| Variable production overhead expenditure variance | ₦ | |
|---|---|---|
| 2,780 hours should cost (´ ₦2) | 5,560 | |
| They did cost | 6,550 | |
| Variable production overhead expenditure variance | 990 | (A) |

The expenditure variance is adverse because the expenditure on variable overhead in the hours worked was more than it should have been.

Variable production overhead efficiency variance

| | hours | |
|---|---|---|
| 2,000 units of Product P123 should take (´ 1.5 hours) | 3,000 | |
| They did take | 2,780 | |
| Efficiency variance in hours | 220 | (F) |
| Standard variable production overhead rate per hour | ₦2 | |
| Variable production overhead efficiency variance in | ₦440 | (F) |

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 | (A) 440 | |
| Total variable production overhead cost variance | (F) 550 | (A) |

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**Solutions** **9**

| | ₦'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** **10**

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 (F) |

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 | (A) |

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 | (F) |

| | |
|---|---|
| Standard fixed production overhead cost per unit | ₦8 |
| Fixed overhead volume variance in ₦ | ₦1,600 (F) |

This variance is favourable because actual production volume exceeded the budgeted volume.

**Summary** ₦

| | | |
|---|---|---|
| Fixed overhead expenditure variance | 500 | (A) |
| Fixed overhead volume variance | 1,600 | (F) |
| Fixed overhead total cost variance | 1,100 | (F) |

**Solutions** **11**

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 | (F) |
| Standard fixed overhead rate per hour | ₦4 | |
| Fixed overhead efficiency variance in ₦ | ₦600 | (F) |

**Fixed overhead capacity variance**

| | hours |
|---|---|
| Budgeted hours of work | 10,000 |
| Actual hours of work | 10,250 |
| Capacity variance in hours | 250 (F) |
| Standard fixed overhead rate per hour | ₦4 |
| Fixed overhead capacity variance in ₦ | ₦1,000 (F) |

The capacity variance is favourable because actual hours worked exceeded the budgeted hours (therefore more units have been produced).

**Summary**

| | ₦ | |
|---|---|---|
| Fixed overhead efficiency variance | 600 | (F) |
| Fixed overhead capacity variance | 1,000 | (F) |
| Fixed overhead volume variance | 1,600 | (F) |

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**Solutions** **12**

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 |

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 |
| Standard profit per unit (₦50 – ₦42 = ₦8) | ₦8 |
| Sales volume variance (profit variance) | ₦1,600 (F) |

The sales volume variance is favourable because actual sales exceeded budgeted sales.

**Solutions** **13**

The three ratios are calculated as follows:

$$\text{Efficiency ratio} = \frac{(1{,}100 \times 2 \text{ hours}) = 2{,}200 \text{ hours}}{2{,}250 \text{ hours}} \times 100 = 97.78\%$$

$$\text{Capacity ratio} = \frac{2{,}250 \text{ hours}}{(1{,}200 \times 2 \text{ hours}) = 2{,}400 \text{ hours}} \times 100 = 93.75\%$$

$$\text{Production volume ratio} = \frac{(1{,}100 \times 2 \text{ hours}) = 2{,}200 \text{ hours}}{2{,}400 \text{ hours}} \times 100 = 91.67$$

Using answers obtained above:

| | |
|---|---|
| Labour efficiency ratio | 97.78% |
| Capacity utilisation ratio | × 93.75% |

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**Solutions** **14**

| | Hours |
|---|---|
| Actual hours to make actual production<br>(10 employees × 21 days × 8 hours ) – 240 hours | 1,440 |
| Expected time to make the actual production<br>(5,400 units should have used 0.25 hours per unit) | 1,350 |
| Total number of hours expected to be used<br>(10 employees × 21 days × 8 hours ) | |

The three ratios are calculated as follows:

$$\text{Efficiency ratio} = \frac{1{,}350 \text{ hours}}{1{,}440 \text{ hours}} \times 100 = 93.75\%$$

$$\text{Capacity ratio} = \frac{1{,}440 \text{ hours}}{1{,}680 \text{ hours}} \times 100 = 85.71\%$$

$$\text{Production volume ratio} = \frac{1{,}350 \text{ hours}}{1{,}680 \text{ hours}} \times 100 = 80.35$$

Using answers obtained above

| | |
|---|---|
| Labour efficiency ratio | 93.75% |
| Capacity utilisation ratio | × 85.71% |
| Productivity volume ratio | [illegible] |

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**Skills level**

**Performance management**




# ADVANCED VARIANCE ANALYSIS-MATERIAL AND LABOUR MIX, YIELD AND EFFICIENCY VARIANCES

**Chapter Contents**

19.0 Learning objective
19.1 Learning outcomes
19.2 Materials mix and yield variances
19.3 Labour mix and efficiency variances
19.4 Sales volume, mix and quantity variances
19.5 Planning and operational variances
19.6 Market share and market size variances
19.7 Chapter review

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# 19 Advanced Variance Analysis- Material and Labour Mix, Yield And Efficiency Variances

## 19.0 Learning Objectives

This chapter is aimed at introducing the candidates the calculation of advanced variances such as mix and yield variances of relevant cost elements, explaining the causes and interpretation of the computed variances. It helps candidates to reconcile such variances using absorption and marginal costing techniques.

## 19.1 Learning outcomes

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

(a) Calculate and interpret Labour mix and yield variances

(b) Calculate and interpret material mix and yield variances

## 19.2 Materials mix and yield variances

**Section overview**

(a) Introduction
(b) Direct materials mix variance
(c) Direct materials yield variance
(d) Summary
(e) Alternative method
(f) Factors to consider when changing the mix

### 19.2.1 Introduction

When standard costing is used for products which contain two or more items of direct material, the total materials usage variance can be calculated by calculating the individual usage variances in the usual way and adding them up (netting them off).

**Example: Usage variances**

Product X is produced from three direct materials, A, B and C that are mixed together in a process. The following information relates to the budget and output for the month of January

| Standard cost: | | | | Actual: |
|---|---|---|---|---|
| Material | Quantity | Standard price per kilo | Standard cost | Quantity used |

| | kg | ₦ | ₦ | kg |
|---|---|---|---|---|
| A | 1 | 20 | 20 | 160 |
| B | 1 | 22 | 22 | 180 |
| C | 8 | 6 | 48 | 1,760 |
| | 10 | | 90 | 2,100 |
| Output | 1 unit | | | 200 units |

Usage variances can be calculated in the usual way:

| Making 200 units should have used: | A (kgs) | B (kgs) | C (kgs) |
|---|---|---|---|
| 200 ´ 1 kg of A | 200 | | |
| 200 ´ 1 kg of B | | 200 | |
| 200 ´ 8 kgs of C | | | 1,600 |
| Making 200 units did use: | (160) | (180) | (1,760) |
| Usage variance in kgs | 40 (F) | 20 (F) | (160) (A) |
| Standard cost per kg (₦) | 20 | 22 | 6 |
| Usage variance in ₦ | 800 (F) | 440 (F) | (960) (A) |

**Substitutable materials**

If the materials are substitutable (i.e. less of one type of material can be compensated for by more of another) the direct materials usage variance can be analysed into:

**(a)** a materials mix variance; and
**(b)** a materials yield variance

The total of these two variances is the total material usage variance.

It is vital to understand that this further analysis should only be performed if the materials can be substituted for each other. Mix and yield variances have a useful meaning only when the proportions (or 'mix') of the different raw materials in the final product can be varied and so are subject to management control.

For example, in the above example fewer kilograms of A than expected were used to make 200 units but more of B and C.

In contrast if a company manufactured a car no number of extra tyres could compensate for one less engine!

### 19.2.2 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 the example above):

(a) Take the total quantity of all the materials used (2,100 kgs in the example) 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 (1:1:8 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.

(e) These figures are summed to give the total mix variance.

**Example: Mix variance**

| Material | Actual mix (kgs) | Standard mix | Mix variance (kgs) | Std. cost per kg | Mix variance (₦) |
|---|---|---|---|---|---|
| A | 160 | (10% × 2,100) 210 | 50 (F) | 20 | 1,000 (F) |
| B | 180 | (10% × 2,100) 210 | 30 (F) | 22 | 660 (F) |
| C | 1,760 | (80% × 2,100) 1,680 | (80) (A) | 6 | (480) (A) |
| | 2,100 | 2,100 | 0 | | 1,180 (F) |

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 favourable in this example because the actual mix of materials used is cheaper than the standard mix.

### 19.2.2 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 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).

**Working**

Based on the above example note that:

**(a)** The standard cost of each unit (kg) of input = ₦90/10kgs = ₦9 per kilo
**(b)** The standard cost of each unit of output = ₦90 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 10 kgs of material should result in 1 unit of output.

Therefore, 2,100 kgs of material in should result in 210 units of output.

The difference between this figure and the actual output is the yield variance as a number of units. This is then multiplied by the expected cost of a unit of output.

**Example: Yield variance**

| | Units | |
|---|---|---|
| 2,100 kgs of input should yield (@10 kgs per unit) | 210 | |
| 2,100 kgs of input did yield | 200 | |
| Yield variance (units) | 10 | (A) |
| Standard cost of output | ₦90 | |
| Materials yield variance (₦) | ₦900 | (A) |

**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 10 kgs of input.

Therefore, 200 units should use 2,000 kgs of input.

The difference between this figure and the actual input is the yield variance as a number of units. This is then multiplied by the expected cost of a unit of output

**Example: Yield variance**

| | Units | |
|---|---|---|
| 200 units of product X should use (× 10 kgs) | 2,000 | |
| did use | 2,100 | |
| Yield variance in quantities | 100 | (A) |
| Standard cost of input | ₦9/kg | |
| Yield variance in money value | ₦900 | (A) |

### 19.2.3 Summary

**Example: Mix variance + yield variance = usage variance**

| | ₦ | |
|---|---|---|
| Mix variance | 1,180 | (F) |
| Yield variance | (900) | (A) |
| Usage variance (= mix + yield variances) | | (F) |

**1**

**Practice question**

Product X is produced from two direct materials, X and Y that are mixed together in a process.

The following information relates to the budget and output for the month of July.

Calculate the direct materials mix and yield variances.

| **Standard** | | | | Actual: |
|---|---|---|---|---|
| **Material** | **Quantity** | **Standard price per litre** | **Standard cost** | **Quantity used** |
| | litres | ₦ | ₦ | litres |
| X | 12 | 250 | 3,000 | 984 |
| Y | 18 | 300 | 5,400 | 1,230 |
| | 30 | | 8,400 | 2,214 |
| Output | 1 unit | | | 72 units |

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### 19.2.4 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:

**(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 has been written in bold.

**Example: Mix and yield**

| | AQ in AM kgs | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| A | 160 | × | 20 | 3,200 | | |
| B | 180 | × | 22 | 3,960 | | |
| C | 1,760 | × | 6 | 10,560 | | |
| | 2,100 | | | 17,720 | | |
| | AQ in **SM** | @ | SC | | | |
| A (0.1) | **210** | × | 20 | 4,200 | **1,180 F** | **MIX** |
| B (0.1) | **210** | × | 22 | 4,620 | | |
| C (0.8) | **1,680** | × | 6 | 10,080 | | |
| | 2,100 | | | 18,900 | | |
| | **SQ** in SM | @ | SC | | | |
| A (0.1) | **200** | × | 20 | 4,000 | | |
| B (0.1) | **200** | × | 22 | 4,400 | **900 A** | **YIELD** |
| C (0.8) | **1,600** | × | 6 | 9,600 | | |
| | **2,000**[1] | | | 18,000 | | |

1 This figure is the number of kgs that making 200 units should

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At first sight this seems to be a 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**

| | AQ in AM kgs | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| A | 160 | × | 20 | 3,200 | | |
| B | 180 | × | 22 | 3,960 | | |
| C | 1,760 | × | 6 | 10,560 | | |
| | 2,100 | | | 17,720 | | |
| | AQ in **SM** | @ | SC of input | | **1,180 F** | **MIX** |
| | 2,100 | | 9 | 18,900 | | |
| | **SQ** in SM | @ | SC of input | | **900 A** | **YIELD** |
| | **2,000** | | 9 | 18,000 | | |
| | or | | SC of output | | | |
| | 200 units | | 90 | 18,000 | | |

You are encouraged to use the above method as it is much quicker.

### 19.2.5 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** **2**

Product X is produced from two direct materials, X and Y that are mixed together in a process.

The following information relates to the budget and output for the month of July.

| Standard Material | Quantity | Standard price per litre | Standard cost | Actual: Quantity used |
|---|---|---|---|---|
| | litres | ₦ | ₦ | litres |
| X | 12 | 250 | 3,000 | 984 |
| Y | 18 | 300 | 5,400 | 1,230 |
| | 30 | | 8,400 | 2,214 |
| Output | 1 unit | | | 72 units |

Calculate the direct materials mix and yield variances using the line by line method.

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**Skills level**
**Performance management**




# ADVANCED VARIANCE ANALYSIS-OPERATIONAL AND PLANNING VARIANCES, SALES VOLUME, MIX AND QUANTITY VARIANCES AND MARKET SHARE AND SIZE VARIANCES

## Chapter Contents

20.0 Learning Objectives
20.1 Learning Outcome
20.2 Sales volume, mix and quantity variances
20.3 Market share and market size variances
20.4 Chapter review

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# 20 Advance Variance Analysis- Operational and Planning Variances, Sales Volume, Mix, and Quantity Variances and Market Share and Size Variances

## 20.0 Learning objective

This chapter is aimed at introducing to the candidates the computation of sales mix, sales quantity , market share and size variances

## 20.1 Learning outcomes

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

(a) Calculate and interpret planning and operational variances

(b) Calculate and interpret sales mix and quantity variances

(c) Sales market size and market share variances

## 20.2 Sales volume, mix and quantity variances

**Section overview**

(a) Sales volume variance
(b) The sales quantity variance
(c) The sales mix variance
(d) Alternative method

### 20.2.1 Sales volume variance

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.

**Example: Sales volume 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 |

The individual sales volume variances and the total sales volume variance for the month of March are as follows:

**Sales volume variances**

| | X | Y | Z |
|---|---|---|---|
| Actual sales (units) | 200 | 220 | 180 |

In the above example, there are two differences between the budgeted unit sales and the actual unit sales. Firstly, the budget was to sell 500 units whereas the company has actually sold 600 units. The second difference is that the company had budgeted to sell 500 units containing a budgeted mix of units X, Y and Z but they have actually sold 600 units with a different mix of these items.

The total sales volume variance can be analysed into:

**a.** a sales quantity variance; and
**b.** a sales mix variance.

### 20.2.2 The sales quantity variance

The sales quantity variance indicates the effect on profits of the total quantity of sales being different from that budgeted, assuming that they are sold in the budgeted sales mix. If this was the case the average standard contribution per unit would be the same as budgeted.

The quantity variance is calculated as follows:

**Illustration: Sales quantity variance**

| | Units |
|---|---|
| Budgeted sales in total | X |
| Actual sales in total | (X) |
| Sales quantity variance in units | X |
| Weighted average standard contribution per unit | ₦X |

**Example: Sales quantity variance**

Returning to the facts from the previous example the 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 | (F) |

### 20.2.2 The 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 (making reference 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 percentages 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 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<br>units | Standard mix<br>Units | Mix variance (units)<br>units | Std. contⁿ per unit<br>₦ | Mix variance (Std contⁿ)<br>₦ |
|---|---|---|---|---|---|
| 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.

The total of the sales mix variance and the sales quantity variance adds up to the total sales volume variance.

**Example: Sales quantity variance**

| | ₦ | |
|---|---|---|
| Sales mix variance | 1,400 | (F) |
| Sales quantity variance | 5,800 | (F) |
| Sales volume variance | 7,200 | (F) |

### 20.2.2 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 has been written in bold.

**Example: Sales mix and quantity variances**

| | AQ in AM units | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| X | 200 | × | 50 | 10,000 | | |
| Y | 220 | × | 70 | 15,400 | | |
| Z | 180 | × | 60 | 10,800 | | |
| | 600 | | | 36,200 | | |
| | AQ in **SM** | @ | SC | | **1,400 F** | **MIX** |
| X (0.48) | **288** | × | 50 | 14,400 | | |
| Y (0.28) | **168** | × | 70 | 14,760 | | |
| Z (0.24) | **144** | × | 60 | 8,640 | | |
| | 600 | | | 34,800 | | |
| | **SQ** in SM | @ | SC | | **5,800 F** | **QUANTITY** |
| X (0.48) | **240** | × | 50 | 12,000 | | |
| Y (0.28) | **140** | × | 70 | 9,800 | | |
| Z (0.24) | **120** | × | 60 | 7,200 | | |
| | **5,000** | | | 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).

This 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**

| | AQ in AM Units | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| X | 200 | × | 50 | 10,000 | | |
| Y | 220 | × | 70 | 15,400 | | |
| Z | 180 | × | 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** | **QUANTITY** |
| | **500** | | 58 | 29,000 | | |

## 20.3 Market share and market size variances

**Section overview**

(a) Further analysis of sales volume variance
(b) Market size variance
(c) Market share variance
(d) Alternative method

### 20.3.1 Further analysis of sales volume variance

Sales volume is a function of market share and market size. If the original budget derives budgeted sales volume from budgeted market share and budgeted market size it should be possible to split the sales volume variance into a market share variance and a market size variance.

The total size of the market is a factor that is largely outside a company's control but is estimated at the start of the period. The market size variance is therefore a planning variance. Note that the ex post budgeted market size is the actual size of the market. If the business had been better at forecasting the market size this is what they would have expected.

The market share obtained by a company is under the influence of management (through marketing activities). The market share variance is an operational variance.

**Example: Sales volume variance**

Colorco set the following sales budget to sell 70,000 units of Product Y and budgeted to earn a contribution per unit of ₦20

Colorco estimates that the total size of the market in the budget period will be 700,000 units. It budgets to have a market share of 10% or 70,000 units.

Actual sales of Product Y by Colorco in the period = 58,000

units Total market size of Product Y = 645,000 units

In retrospect, it is accepted that the budget should have been based on a total market size of 645,000 units.

The traditional sales volume variance is calculated as follows:

| | Units | |
|---|---|---|
| Actual sales volume | 58,000 | |
| Budgeted sales volume | 70,000 | |
| Sales volume variance (units) | 12,000 | (A) |
| Standard contribution per unit (multiply by) | ₦20 | |

| | | |
|---|---|---|
| Sales volume variance (in contribution) | ₦240,000 | (A) |

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20.3.2 Market size variance

A market size variance is the effect on sales volume (and so on contribution or profit) if the actual total size of the market is:

**(a)** larger than expected (favourable market size variance); or
**(b)** smaller than expected (adverse market size variance).

The total difference between the budgeted total market size and the actual total market size is calculated initially either in units of sale or sales revenue at standard selling prices.

**a.** It is assumed that the company should achieve its budgeted market share.
**b.** The market size variance for the company is therefore (in units or in sales revenue at standard sales price) the difference in the total market size multiplied by the estimated market share.

This is then converted into an amount of standard contribution or standard profit, using the same method used to calculate the sales volume variance.

**Example: Market size variance**

Returning to the previous example the market size variance is calculated as follows:

| **Market size variance** | **units** | |
|---|---|---|
| Ex ante (budgeted) total market size | 700,000 | |
| Ex post (actual) total market size | 645,000 | |
| Total difference | 55,000 | (A) |
| Budgeted market share | 10% | |
| Market size variance (units) | 5,500 | (A) |
| Standard contribution per unit | ₦20 | |
| Market size variance (in ₦ contribution) | ₦110,000 | (A) |

## 20.3.2 Market share variance

A market share variance is calculated by taking the actual total market size (the ex post estimate of the market size) and comparing:

**(a)** the expected sales volume, if the budgeted market share had been achieved: and
**(b)** actual sales volume.

This variance (in sales units or in sales revenue at standard sales price) is converted into a contribution or profit variance using the same method used to calculate the sales volume variance.

**Example: Market share variance**

Returning to the previous example the market share variance is calculated as follows:

| | units | |
|---|---|---|
| **Market share variance** | 645,000 | |
| Ex post (actual) total market size | 10% | |
| Budgeted market share | 64,500 | |
| Expected sales if budgeted market share achieved | 58,000 | |
| Actual sales | 6,500 | (A) |
| Market share variance (units) | ₦20 | |
| Standard contribution per unit | ₦130,000 | (A) |

The market size variance and the market share variance together add up to the total sales volume variance for the period.

**Example: Summary**

| | Units | | CPU | ₦ |
|---|---|---|---|---|
| Market size variance | 5,500 | (A) | 20 | 110,000 |
| Market share variance | 6,500 | (A) | 20 | 130,000 |
| Total sales volume variance | 12,000 | (A) | 20 | 240,000 |

**Practice question** **4**

Brunco prepared a sales budget based on an estimated market size of 200,000 units and a budgeted market share of 25%

Standard contribution per unit ₦40

At the end of the year it was estimated that the actual size of the market during the year had been 260,000 units.

Actual sales in the year were 61,000 units.

**Required**

(a) the total sales volume variance

(b) the market size variance

(c) the market share variance.

### 20.3.3 Alternative method

The market share and market size variances can be identified using a line by line approach. This starts with the actual sales volume (actual market share of actual

market size) and ends with the budgeted sales volume (standard market share of standard market size). It is easier to measure the variances in units and then apply a standard contribution to express these variances as monetary amounts.

Remember that the actual units sold is a function of the actual market size and this is the ex post forecast of market size.

**Example: Alternative method for identifying market share and market size variances**

Returning to the previous example the market share variance and market size variances (in units) are calculated as follows:

| | Units | |
|---|---|---|
| Actual market size × Actual market share | | |
| 645,000 units × X% | 58,000 | |
| | | Market share 6,500 units (A) |
| Actual market size × standard market share | | |
| 645,000 units × 10% | 64,500 | |
| | | Market size 5,500 units (A) |
| Budgeted market size × standard market share | | |
| 700,000 units × 10% | 70,000 | |

**Practice question** **5**

Brunco prepared a sales budget based on an estimated market size of 200,000 units and a budgeted market share of 25%

Standard contribution per unit ₦40

At the end of the year it was estimated that the actual size of the market during the year had been 260,000 units.

Actual sales in the year were 61,000 units.

**Required**

(a) the total sales volume variance

(b) the market size variance

(c) the market share variance.

## 20.4 CHAPTER REVIEW

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

(a) Calculate and interpret material mix and yield variances

(b) Calculate and interpret sales mix and quantity variances

(c) Calculate and interpret planning and operational variances

## Chapter review

(a)

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## SOLUTIONS TO PRACTICE QUESTIONS

**Solution 1**

**Mix variance**

| Material | Actual mix (litres) | Standard mix | Mix variance (litres) | Std. cost per litre | Mix variance (₦) |
|---|---|---|---|---|---|
| X | 984 | (40% ´ 2,214) 885.6 | 98.4 (A) | 250 | 24,600 (A) |
| Y | 1,230 | (60% ´ 2,214) 1,328.4 | 98.4 (F) | 300 | 29,520 (F) |
| | 2,214 | 2,100 | 0 | | 4,920 (F) |

**Yield variance based on output**

| | Units | |
|---|---|---|
| 2,214 litres of input should yield (@30 litres per unit) | 73.8 | |
| 2,100 litres of input did yield | 72.0 | |
| Yield variance (units) | 1.8 | (A) |
| Standard cost of output | ₦8,400 | |
| Materials yield variance (₦) | ₦15,120 | (A) |

**Yield variance based on input**

| | litres | |
|---|---|---|
| Making 72 units did use | 2,214 | |
| but, making 72 units of product X should use (´ 30 litres) | 2,160 | |
| Yield variance in quantities | 54 | (A) |
| Standard cost of input (₦8,400/30 litres) | ₦280/litre | |
| Yield variance in money value | ₦15,120 | (A) |

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**2**

**Solution**

| | AQ in AM litres | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| X | 984 | × | 250 | 246,000 | | |
| Y | 1,230 | × | 300 | 369,000 | | |
| | 2,214 | | | 615,000 | | |
| | AQ in **SM** | @ | SC | | | |
| X (0.4) | **885.6** | × | 250 | 221,400 | | |
| Y (0.6) | **1,328.4** | × | 300 | 398,520 | | |
| | 2,214 | | | 619,920 | **4,920 F** | **MIX** |
| | **SQ** in SM | @ | SC | | | |
| X (0.4) | **864** | × | 250 | 216,000 | | |
| Y (0.6) | **1,296** | × | 300 | 388,800 | | |
| | **2,160** | | | 604,800 | **15,120 A** | **YIELD** |

Making 72 units should use 72 units × 30 litres per unit = 2,160 litres.

**Quicker version:**

| | AQ in AM litres | @ | SC ₦ | ₦ | | |
|---|---|---|---|---|---|---|
| X | 984 | × | 250 | 246,000 | | |
| Y | 1,230 | × | 300 | 369,000 | | |
| | 2,214 | | | 615,000 | | |
| | AQ in **SM** | @ | SC of input | | | |
| | 2,214 | | ₦8,400/30 litres | 619,920 | **4,920 F** | **MIX** |
| | **SQ** in SM | @ | SC of input | | | |
| | **2,160** | | ₦8,400/30 litres | 604,800 | **15,120 A** | **YIELD** |
| | or | | | | | |
| | 72 units | | SC of output 8,400 | 604,800 | | |

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**Solution** **3**

| | ₦'000 | ₦'000 |
|---|---|---|
| AQ × AC | | |
| 2,650 hrs × ₦X per hr | 51,600 | |
| AQ × SC | | 1,400 (F) Price |
| 2,650 hrs × ₦20 per kg | 53,000 | |
| SQ ex post × SC ex post | | 3,000 (A) Usage |
| 2,500 hrs × ₦20 per kg | 50,000 | |
| SQ ex ante × SC ex ante | | 2,000 (A) Planning |
| | 48,000 | |

Ex post standard quantity to make actual production

SQ = 10,000 units × 0.25 hrs per unit = 2,500 hrs

Ex ante standard quantity to make actual production

SQ = 10,000 units × 0.3 hrs per unit = 3,000 hrs

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**Solution** **4**

| | | |
|---|---|---|
| | units | |
| Actual sales volume | 61,000 | |
| Budgeted sales volume (25% ´ 200,000) | 50,000 | |
| Sales volume variance in units | 11,000 | (F) |
| Standard contribution per unit | ₦40 | |
| Sales volume variance in ₦ contribution | ₦440,000 | (F) |

| **Market size variance** | **units** | |
|---|---|---|
| Ex post (actual) total market size | 260,000 | |
| Ex ante (budgeted) total market size | 200,000 | |
| Total difference | 60,000 | (F) |
| Budgeted market share | 25% | |
| Market size variance (in units) | 15,000 | (F) |
| Standard contribution per unit | ₦40 | |
| Market size variance in ₦ contribution | ₦600,000 | (F) |

| **Market share variance** | units | |
|---|---|---|
| Ex post (actual) total market size | 260,000 | |
| Budgeted market share | 25% | |
| Expected sales if budgeted market share achieved | 65,000 | |
| Actual sales | 61,000 | |
| Market share variance (units) | 4,000 | (A) |
| Standard contribution per unit | ₦40 | |
| Market share variance in ₦ contribution | ₦160,000 | (A) |

| **Summary** | ₦ | |
|---|---|---|
| Market size variance | 600,000 | (F) |
| Market share variance | 160,000 | (A) |
| Total sales volume variance | 440,000 | (F) |

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**Solution 5**

Units

Actual market size ´ Actual market share

260,000 units ´ X%

6

1,000

Market share 4,000 units (A)

Actual market size ´ standard market share

260,000 units ´ 25%

6

5,000

Market size 15,000 units (F)

Budgeted market size ´ standard market share

200,000 units ´ 25%

5

0,000

| Total sales volume variance: | Units | Contribution (@₦40) |
|---|---|---|
| Market share variance | 4,000 (A) | (160,000) |
| Market size variance | 15,000 (F) | 600,000 |
| Total sales volume variance | 11,000 (F) | 440,000 |

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**Skills level**
**Performance management**

CHAPTER 21

# PLANNING AND OPERATIONAL VARIANCES

Chapter Contents


21.0 Learning objective
21.1 Learning outcomes
21.2 Planning and Operational variances


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# 21 Planning and Operational variances

## 21.0 Learning objective

This chapter is aimed at introducing candidates to the advanced aspect of explaining and calculating planning and operational variances as they affect materials and Labour costs.

## 21.1 Learning outcomes

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

(a) Understand the concept of planning and operational variances

(b) Identify reasons for revision of original budget

(c) Preparation of revised budgets

(d) Calculate and interpret planning and operational variances for materials, and Labour

**Section overview**

(a) The reasons for planning and operational variances
(b) Ex ante and ex post standards or budgets
(c) Using ex post standards (or ex post budgets) to calculate planning and operational variances
(d) Calculating planning and operational variances
(e) Alternative approaches
(f) More than one difference between the ex ante and ex post standard costs
(g) Analysing the planning variance

## 21.2 Planning and operational variances

### 21.2.2 The concept and reasons for planning and operational variances

Planning variances analyses the differences between the original budget and a revised budget reflecting the current conditions while the operational variances compare actual performance against the revised budget showing the controllable performance deviations.Variance analysis serves to identify levels of performance, costs etc. that have been different to those budgeted. The aim is to use information about variances to identify problems that should be investigated, and where appropriate:

**(a)** take control action to correct adverse results; or
**(b)** take measures to exploit favourable results.

The quality of the information provided by variance analysis depends on

the quality of the budget being used as a basis for comparison. For example, if the standard steel usage for making a bulldozer was set at 10 kgs there would obviously be huge adverse material usage variances (as making a bulldozer uses much more than 10 kgs of steel). There would be no point taking the production manager to task over the adverse variance as it was simply not possible to build bulldozers using this amount of steel. It is the budget that is at fault. This is perhaps a silly example but it serves to illustrate an important point. If management are taking action based on variances those variances should reflect operational issues and not arise as a result of a flawed plan.

If a budget or standard is unreliable, the variance reports will also be unreliable – and so of limited use to management.

### 21.2.3 Preparation of revised budgets

Revised budgets are prepared due to unforeseen circumstances or changes in projections, following a process that involves identifying the need for revision, analysing the impact, proposing adjustments, and securing approval from relevant stakeholders. Thus in revising an original budget, the following conditions must be considered:

(a) Identifying the need for the revision which will include - unforeseen events, performance deviations and new corporate strategic direction.
(b) In order to analyse the impact of problems associated with the original budget which include identifying the root cause of the problems, level of the impact, and work out a scenarios.
(c) working out adjustment or revisions to bring the budget to a realistic one by proposing adjustments, through revised budget, ensuring justifications for every revised figure and seek adequate input to match the revision.
(d) Secure necessary approval and authorization from relevant authorities
(e) Monitoring and Review through feedback information.

### 21.2.4 Ex ante and ex post standards or budgets

If management decide that the standard cost is unreliable and invalid, they can prepare a more realistic or accurate standard cost. Similarly, if the original budget is invalid, a more realistic budget can be prepared.

**(a)** The original standard cost or budget is known as the **ex ante standard or ex ante budget**.
**(b)** The revised and more realistic standard cost or budget is known as the **ex post standard or ex post budget**.

Variances are usually calculated by comparing actual results to an ex ante budget. This process might reveal variances which on further investigation are due to the budget being unrealistic rather than due to operating factors. When this is the case a new, more realistic budget (the ex post budget) is drafted for the period that has already past and this allows the calculation of more reasonable variances.

### 21.2.5 Using ex post standards (or ex post budgets) to calculate planning and operational variances

Ex post standards or budgets can be used to calculate variances, as an alternative to the 'normal' method of calculating variances.

**(a)** Actual results are compared with the ex post standard (or ex post budget) and variances are calculated using the ex post standard. These variances are the **operational variances.**

**(b)** The ex post standard cost (or ex post budget) is compared with the ex ante standard cost (or ex ante budget) and the difference between them is the **planning variance**.

The planning variance is therefore a measurement of the amount by which an unreliable standard cost (or unreliable budget) – in other words, poor planning or a major revision to plans – is the cause of the difference between **Planning variances are uncontrollable,** in the sense that control action by management will not eliminate a weakness in planning.

The operational variances, by comparing actual results with a realistic standard cost, provide useful control information for management. **Operational variances may be controllable variances**.

It is important to remember that there is nothing new to learn in calculating operational variances (in fact, all variance calculated so far have been operational variances). The calculation of operational variances is exactly the same as already described but comparing actual results to the new ex post budget.

### 21.2.6 Calculating planning and operational variances

Planning and operational variances can be calculated for any aspect of a standard cost or budget. For example, an ex post standard cost can be calculated for the direct materials cost per unit, or the direct materials usage per unit, or the direct materials price per unit, or the direct labour cost per unit, the direct labour hours per unit, and so on.

Similarly, an ex post budget can be prepared with revised figures for sales volumes or sales prices.

The following example will be used to illustrate and explain the issue and the method of calculating planning and operational variances.

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**Example: Planning and operational variances**

Product Z has a standard labour cost of 3 hours per unit at ₦8 per hour = ₦24 per unit.

During the first month of the current year, 500 units of Product Z were manufactured. These took 1,960 hours to make, at a labour cost of ₦16,500.

Using **traditional variances**, the labour variances for the month would be as follows:

| **Labour rate variance** | ₦ |
|---|---|
| 1,960 hours did cost | 16,500 |
| but, 1,960 hours should cost (× ₦8) | 15,680 |

| **Labour efficiency variance** | hours | |
|---|---|---|
| 500 units of product Z did take | 1,960 | |
| but, 500 units of product Z should take (× 3 hours) | 1,500 | |
| Efficiency variance in hours | 460 | (A) |
| Standard labour rate per hour | ₦8 | (A) |

The **total labour cost variance** is ₦820 (A) + ₦3,680 (A) = ₦4,500

In the usual course of events a variance might be investigated and the manager responsible for the part of the business within which the variance arose might be taken to task over an adverse variance.

Suppose, however, that it is discovered early during the month that planned improvements in efficiency that were expected from introducing new equipment and were introduced into the budget could not be achieved, because the new equipment had suffered a major breakdown and had been returned to the supplier for repair.

This means that the budget used above could not be achieved in the period. With hindsight the budgeted labour cost for each unit of Product Z should have been: 4 hours × ₦8 per hour = ₦32.

Variances are recalculated using this as a **new ex post standard cost** for direct labour cost.

### 21.2.7 Operational variances

Operational variances are calculated exactly as before but using the ex post budget.

The planning variance is the difference between:

**(a)** the original standard cost of making the actual production (the ex ante standard cost or ex ante budget of actual production), and

**(b)** the revised standard cost or budget of making the actual production (the ex

post standard cost or ex post budget of actual production).

**Example: Operational variances**

| **Labour rate variance** | **₦** | |
|---|---|---|
| 1,960 hours did cost | 16,500 | |
| but, 1,960 hours should cost (× ₦8) | | |
| Labour rate variance (as before as the ex ante | 820 | (A) |

| **Labour efficiency variance** | **hours** | |
|---|---|---|
| 500 units of product Z should take (× **4 hours**) | 2,000 | |
| But they did take | 1,960 | |
| Efficiency variance in hours | 40 | (F) |
| Standard labour rate per hour | ₦8 | |
| Efficiency variance in ₦ | | (F) |

The calculation of the labour efficiency variance using the ex post budget shows a very different picture showing a favourable variance as opposed to the adverse variance shown by comparison to the original budget. The manager responsible should be congratulated rather than admonished!

Operational variances can be caused by factors like production inefficiencies, changes in material prices or usage, or labor inefficiencies.

### 21.1.6 Planning variances

The planning variance is not a very useful figure other than being part of the reconciliation between actual results and the ex ante cost of achieving those results. (It is not a useful figure as the fact that it has been calculated means that management already knows that the budget was suspect. Knowing the size of the difference is not particularly helpful in running the business).

The planning variance is reported as the effect that this difference has had on reported profit or cost.

Since direct labour is a variable cost, the planning variance is calculated as the difference between:

**(a)** the standard labour cost of actual production at the ex ante standard, and
**(b)** the standard labour cost of actual production with the ex post standard.

Planning variances are variances due to planning errors like inaccurate budgeting or forecasting and exigencies associated with external factors unplanned for such as market factors, strikes, government policies, mistake in accounting records etc.

**Example: Planning variances**

| **Total labour cost for 500 units of Z** | **₦** |
|---|---|
| Ex post standard cost (´ ₦32) | 16,000 |
| Ex ante standard cost (´ ₦24) | 12,000 |
| Planning variance: labour efficiency | 4,000 (A) |

The planning variance is adverse because the ex post standard cost is less favourable (is more costly) than the ex ante standard cost.

**Method 2**

Since the planning error is in the labour hours per unit, the planning variance can be calculated in labour hours:

| **Labour hours: time required to make 500 units of** | **hours** |
|---|---|
| Ex post standard (´ 4 hours) | 2,000 |
| Ex ante standard (´ 3 hours) | 1,500 |
| Planning variance in standard hours | 500 (A) |
| | |
| Standard labour rate per hour | ₦8 |
| Planning variance in ₦, labour efficiency | ₦4,000 (A) |

## Summary

The planning and operational variances in the previous example can be summarised as follows:

**Example: Variances under traditional and planning/operational methods**

| | Traditional | | Planning and operational | |
|---|---|---|---|---|
| Operational variances | ₦ | | ₦ | |
| Labour efficiency | 3,680 | (A) | 820 | (A) |
| Labour rate | 820 | (F) | 320 | (F) |
| Planning variance (labour efficiency) | | | 4,000 | (A) |
| Total | 4,500 | (A) | 4,500 | (A) |

The total variances come to the same amount.

In this case the planning and operational variances provide much more useful control information to management than the traditional variances, because the original (ex ante) standard cost is unreliable and incorrect.

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### 21.2.8 Alternative approach

An alternative approach is to use a line by line method.

This starts with actual cost. One factor is changed at a time using the ex post standard usage and cost. A final line is inserted as the ex ante standard cost of the actual production.

**Example: Alternative method identifying planning and operational variances**

Ex ante standard material cost per unit:

3 hours × ₦8 per hour = ₦24 per unit

Actual production in period = 500 units.

Labour worked and paid for was 1,960 hours to make 500 units, at a labour cost of ₦16,500

Ex post standard material cost per unit:

| | ₦ | ₦ |
|---|---|---|
| AQ × AC | | |
| 1,960 hrs × ₦X per hr | 16,500 | |
| | | 820 (A) Price |
| AQ × SC | 15,680 | |
| | | 320 (F) Usage |
| 1,960 hrs × ₦8 per hr | 16,000 | |
| | | 4,000 (A) Planning |
| SQ ex post × SC | | |
| 2,000 hrs × ₦8 per hr | | |
| SQ ex ante × SC | 12,000 | |

Ex post standard quantity to make actual production

SQ = 500 units × 4 hrs per unit = 2,000 hrs

Ex ante standard quantity to make actual production

SQ = 500 units × 3 hrs per unit = 1,500 hrs

You are encouraged to use this approach as an alternative method.

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### 21.2.8 More than one difference between the ex ante and ex post standard costs

In the above example only the standard usage changed between the ex ante and ex post budgets. A situation could arise where both standard usage and standard cost changed.

The principle to apply in calculating the planning and operational variances is the same as before.

**(a)** The operational variances are calculated using the ex post standard cost.
**(b)** The planning variance in total is the difference between the ex ante standard cost of actual production and the ex post standard cost of actual production.

The only difference is that if the total planning variance is caused by two factors, it should be possible to analyse the total planning variance into its different causes though the resultant figures are not really useful.

The following example shows the calculation of planning and operational variances when two factors change between the ex ante and ex post budgets. In the first instance only the total planning variance will be calculated. Analysis of the planning variance will follow that.

This will be worked using the line by line approach.

**Example: Planning and operational variances**

Greenco manufactures product G, which has a standard direct material cost per unit of: 5 kilos at ₦6 per kilo = ₦30.

Actual output during a month is 4,000 units of product G, and the materials actually used in production were 16,500 kilos at a cost of ₦119,000.

Investigation of the resultant variances has shown that the original standard was

The planning and operational variances can be identified as follows.

| | ₦ | ₦ |
|---|---|---|
| AQ × AC | | |
| 16,500 kgs × ₦X per kg | 119,000 | |
| AQ × SC | | 3,500 (A) Price |
| 16,500 kgs × ₦7 per kg | 115,500 | |
| SQ ex post × SC ex post | | 3,500 (A) Usage |
| 16,000 kgs × ₦7 per kg | 112,000 | |
| SQ ex ante × SC ex ante | | 8,000 (F) Planning |
| | 120,000 | |

Ex post standard quantity to make actual production
SQ = 4,000 units × 4 kgs per unit = 16,000 kgs

Ex ante standard quantity to make actual production
SQ = 4,000 units × 5 kgs per unit = 20,000 kgs

### 21.2.9 Analysing the planning variance

In the above example, the difference between the ex ante standard cost per unit and the ex post standard cost per unit is due to both price and usage. This implies that the total planning variance can be analysed into a price planning and price usage variance.

This is done by changing one factor between the ex ante standard cost of actual production and the ex post standard cost of actual production. Either the usage or cost of each unit of resource might be changed. Changing one, as opposed to the other, results in a different split of the price planning and price usage variances

## 21.3 Chapter Review

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

(a) Calculate and interpret Planning and operational variances , the revision of budgets and interpretation of material and labour planning and operational variances

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This is difficult to understand until you see an example.

**Example: Analysing planning variance**

Returning to the previous example the total planning variance may be split as follows.

**Changing price first**

| | ₦ | ₦ | | |
|---|---|---|---|---|
| SQ ex post ´ SC ex post 16,000 kgs ´ ₦7 per kg | 112,000 | 16,000 | (A) | Planning |
| SQ ex post ´ SC 16,000 kgs ´ ₦6 per kg | 96,000 | price | 24,000 | (F) |
| SQ ex ante ´ SC ex ante 20,000 kgs ´ ₦6 per kg | 120,000 | Planning | usage | |

**Changing usage first**

| | ₦'000 | ₦'000 | | |
|---|---|---|---|---|
| SQ ex post ´ SC ex post 16,000 kgs ´ ₦7 per kg | 112,000 | | | |
| SQ ex post ´ SC 20,000 kgs ´ ₦7 per kg | 140,000 | 28,000 | (F) | Planning |
| SQ ex ante ´ SC ex ante 20,000 kgs ´ ₦6 per kg | 120,000 | price | 20,000 | (A) |
| | | Planning | usage | |

In the above example the total planning variance is being split in different ways.

**Practice question** **3**

Redco manufactures product K, which at the start of the budget period had a standard direct labour cost per unit of:

0.3 hours per unit × ₦16 per hour = ₦4.80.

Due to an unexpected pay agreement with the direct labour employees, the standard rate per hour is revised to ₦20. In addition, since the pay rise is linked to a productivity agreement, the standard time per unit of product K is reduced to 0.25 hours.

The revised standard labour cost for product K is therefore:

0.25 hours × ₦20 per hour = ₦5.

Actual output during the month is 10,000 units of product K, and these took

Analyse the total direct labour variance into operational variances and a planning variance.

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**Skills level**

# PERFORMANCE ANALYSIS USING BUDGETARY CONTROL

## Chapter Contents

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22.1 Learning outcomes
22.2 Discuss the effect of variances on staff motivation and actions
22.3 Describe the dysfunctional nature of some variances in the environment of JIT and TQM.
22.4 Discuss the behavioural problems resulting from using standard costs in rapidly changing environment
22.5 Other budget based performance measures.
22.6 Financial performance indicators (FPIs)
22.7 Non-financial performance indicators (NFPIs)
22.8 Chapter review

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# 22 Performance Analysis Using Budgetary Control

## 22.0 Learning objective

This chapter is aimed at introducing to the candidates on performance analysis using budgetary control techniques. Candidates are expected to be capable of analysing financial and non-financial data and information to support management decisions, and also to consider the strategic implications of performance indicators for the long-term success of an organisation.

## 22.1 Learning outcome

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

(a) Explain the nature of performance and non-performance indicators in a performance management system

(b) Measure and use a range of financial performance indicators

(c) Measure and use a range of non-financial performance indicators

(d) Explain the nature of short-termism in performance measurement

(e) Explain the relevance of sustainability measurements (social and environmental measurements) for an assessment of longer-term performance

## 22.2 Discuss the effect of variances on staff motivation and actions

Staff will naturally accept the use of variances and budgetary control measures as a tool for performance measurement, if they know that they will not be held responsible for deviations arising from poor planning and faulty standard setting. But this is hardly the case because corporate management believes that variances between budget and actual performance are usually blamed on ineffective and inefficient performance . consequently, staff are significantly held responsible and focus on staff can affect motivation and actions in one way or the other. The following effects are characterised by negative and unmanaged variances:

**(a)** Demotivation and staff frustration leading to decline in staff morale, reduced effort and a sense of unfairly blamed for poor performance.

**(b)** Low morale and staff burnout in the desperate desire to meet unattainable goals.

**(c)** Staff defensiveness and resistant to change occasioned by the budget introducing innovations that are not brought to staff knowledge.

**(d)** High budget expectation from staff can reduce productivity and work quality

**(e)** High unattainable budget target can lower staff morale, bring about resentment, increase absenteeism and operationally lower turnover.

On the other hand, a well managed budgetary control system and variances which continues to show positive variances will result in the following:

**(a)** Increased motivation and staff commitment on the job. This will facilitate growth.

**(b)** Continued staff improvement in performance will will continue to enhance productivity.

**(c)** It will enhance collaboration and culture of open communication.

**(d)** Rather than staff resistance, it will bring a sense of ownership and accountability as the staff does everything that will eliminate operational deviation.
**(e)** It will lead to continuous improvement in all that staff does while areas that need improvement will be easily isolated and addressed.
**(f)** It will bring about fairness and transparency
**(g)** It will lead to variance identification and rectification and subsequent improvement in operation, reduce costs and enhance operational performance.

## 22.3 Describe the dysfunctional nature of some variances in the environment of JIT and TQM.

Just in time systems referred to as JIT, focuses on the management of manufacturing processes as well as inventory management emphasizing on how to minimize time of inventory control between receipt of material and production of goods.

Total quality management is the system that minimizes operational cost through continuous improvement and focused more on customer satisfaction.
Variances on the other hand are deviations between actions and planned costs. Variance analysis is the budgetary control techniques aimed at identifying deviations between actual and planned costs.
The JIT emphasizes efficiency , responsiveness to demand as well as continuous improvement in the production process. JIT reduces inventory levels, thereby lowering storage costs as well as improving cashflow. It also reduces waste and ensures delivery of materials for production.
Both JIT and TQM commonly emphasizes on continuous improvement in production , the material management which deals with management of receipt of material from suppliers (input management) is the focus of JIT while the focus of TQM is output and customer satisfaction. Variance Analysis interfaces the two system especially in material variances and sales variances
The JIT affects material usage variance , labour efficiency variance while TQM affects material usage variance, labour efficiency variance as well as sales mix, sales quantity variances. The efficiency variances are related to continuous improvement. Variance analysis can be useful in a JIT environment, it's important to consider how JIT's focus on efficiency and continuous improvement may require a different approach to variance analysis than traditional methods.
JIT pose the following problems on variances :

**(a)** There is potential conflict with traditional variance analysis which focuses on cost elements rather than inventory efficiency as well as maximization of efficiency.
**(b)** Secondly, JIT provides a shift in emphasis by focusing on cost reduction and continuous improvement. Variance analysis is more on individual cost and deviations between planned and actual.
**(c)** For variance analysis to to be valuable in a JIT environment , the emphasis must be on total costs rather than individual costs.
**(d)** Both variance analysis and JIT are inconsistent when it comes to continuous improvement. Both TQM and JIT emphasizes on continuous improvement while the focus of variance analysis is on traditional control of costs.

TQM emphasizes improvement through understanding and managing variances as it help identify problems that are resolved to enhance continuous improvement. The variances affected are material variances, labour variances, quality related variances. This is achieved through:

**(a)** Continous improvement
**(b)** Customer focus through satisfaction
**(c)** Employee participation
**(d)** Process management , and
**(e)** Data-driven decision making

Variance Analysis, Just-in-Time (JIT), and Total Quality Management (TQM) share the common goal of improving operational efficiency, their objectives can sometimes clash, particularly when focusing on short-term cost reduction versus long-term quality and process improvement.

Thus from the context of variance analysis, variances can arise from Materials, labour, overhead, sales and market related. The dysfunctional nature of some variances on JIT and TQM can be showcased as the conflicting objectives of variances in a JIT and TQM environments. This can be displayed in the scheduled below:

| S/n | Variances Analysis | TQM | JIT |
|---|---|---|---|
| 1 | Identifying and analysing deviations between actual and budgeted costs in the short run cost control | TQM emphasizes continuous improvement in all aspects of the organisation, with a strong focus on quality and customer satisfaction. | JIT aims to minimize inventory and waste by producing goods only when they are needed timely scheduling. |
| 2 | The focus of variance analysis is also on cost reduction which is narrow. | Variance analysis pays more attention on operational performance which is a short un metrics ignoring the importance of TQM principles on employee empowerment, process improvement, and customer feedback. | JIT principles, emphasis such as holding excess inventory to avoid short-term cost increases or compromising quality to meet production targets. |
| 3 | A increase in cost detected by material price increase can be make management to cut costs by using lower-quality materials, which could negatively impact JIT's focus on quality | JIT and TQM aim to improve operational efficiency. JIT focuses on minimizing inventory and waste while TQM emphasizes continuous improvement in all | Strict adherence to JIT principles without a strong TQM foundation can lead to a lack of flexibility and responsiveness to unexpected events or changes in demand |

| | | | |
|---|---|---|---|
| | and lead to increased waste and rework | aspects of the organisation. | |

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## 22.4 Discuss the behavioural problems resulting from using standard costs in rapidly changing environment

Standard costs can be originated from realistic data and sometimes unrealistic data. Such unrealistic data could be based on historical data, assumptions, or averages, which may not capture the current market conditions, customer preferences, or production efficiency. Thus in a rapidly changing environments, relying on standard costs can lead to behavioral issues like overemphasis on unfavorable variances, manipulation of data to meet targets, and a lack of focus on true performance improvement, potentially hindering adaptability and innovation. This will bring about poor motivation, staff restiveness and resistance to work. Behavioral issues that result from standard costing include:

**(a)** Over-focus on unfavourable variance which can arise from unattainable targets.

**(b)** Variances resulting from unfair data manipulation leading to staff pressure which goes a long way to compromise quality and efficiency.

**(c)** Lack of focus on true performance improvement as standards can overshadow continuous improvement and innovation.

**(d)** Poorly set out standard plot can lead resistance to change especially when budgets and standards are not flexed enough to align with dynamics.

**(e)** Low morale and disengagement can be as a result of unrealistic standards.

**(f)** Poor standards can lead to inaccurate decision making in the areas of pricing, production and other strategic decisions.

**(g)** Finally, poorly set standards can result in misallocation of resources and lack of focus on true drivers of performance

## 22.5 Other budget based performance measures:

Performance of an organisation is concerned with what the organisation has done or expects to do, and with how well this compares with a target or budget, or with past performance, or with long-term (strategic) objectives.

Performance management is concerned with:

**(a)** setting targets for performance;

**(b)** monitoring actual performance and progress towards the targets; and

**(c)** taking control measures when actual performance is worse than expected.

Other Performance is measured, and measurements may be both financial and non-financial.

## 22.6 Financial performance

Financial performance for an organisation is concerned with the extent to which the financial objectives of the organisation are being met. Performance is measured in financial/monetary terms.

For most businesses, the main objective is to make a profit or return on capital invested. Financial performance is concerned with the factors that contribute to profitability and return, such as sales and costs, as well as profits and return.

Not-for-profit organisations such as government and charities do not have an objective of making a profit. However, financial performance is relevant to them too, in terms of keeping spending within the limits of the money or funds available to them, and using the money that they have in the best way they can.

## 22.7 Non-financial performance

Non-financial performance is performance that is not measured in financial or monetary terms, although non-financial performance can be a contributing factor to overall financial performance.

Examples of non-financial performance in business are output capacity, labour productivity, labour turnover, customer satisfaction and innovation.

Organisations measure non-financial performance as well as financial performance.

Performance management systems are constructed to drive the behaviour of employees so that the company achieves its corporate objectives.

Performance management systems have a key role to play in many aspects of strategic planning and are concerned with:

**(a)** setting targets for the achievement of the organisation's main strategic objective;
**(b)** setting targets for each strategy that is implemented for achieving the main strategic objective;
**(c)** setting targets at all levels of management within the organisation: all planning targets (at all levels within the entity) should be consistent with the strategic targets and objectives;
**(d)** measuring actual performance;
**(e)** comparing actual performance with the targets;
**(f)** where appropriate, taking control measures; and
**(g)** where appropriate, changing the targets.

Performance management is therefore concerned with planning and controlling, at all levels within an organisation.

A business entity must have management information systems that are capable of providing reliable and relevant information about all the important aspects of performance.

Performance targets are set, and actual performance is measured, by means of performance indicators. These may be financial or non-financial, and non-financial indicators may be either quantitative or qualitative. A key performance indicator (KPI) is a measure of performance that is considered critically important for achieving success or progress in relation to a specified goal.

It is important to understand that performance measurement can indicate when aspects of performance are much better or much worse than expected, but they do not usually indicate the reason for the good or bad performance. When performance measures indicate an unexpected difference between actual and expected performance, management should investigate the reason or reasons for

the difference and take any appropriate measures when they discover the cause of the problem.

## 22.8 Chapter review

At the end of this chapter, candidates are expected to be highly knowledgeable in performance analysis using budgetary control techniques. Candidates are expected to be capable of analysing financial and non-financial data and information to support management decisions, and also to consider the strategic implications of performance indicators for the long-term success of an organisation.

**PART E: PERFORMANCE MEASUREMENT CONTROL AND MANAGEMENT SYSTEM**

1. Performance analysis for profit oriented organisation.
2. Performance analysis in not-for -profit organisations.
3. Explain the balanced scorecard approach to performance management and apply it in a given scenario
4. Explain the Fitzgerald and Moon Building Block model and its application to performance measurement in service industries
5. Divisional performance and transfer pricing
6. Analyse and evaluate business objectives and strategies using value chain analysis.
7. Analyse and evaluate suitable performance measures for profitability, liquidity and solvency.

**Skills level**
**Performance management**




# PERFORMANCE ANALYSIS FOR PROFIT ORIENTED ORGANISATION

## Chapter Content

23.0 Learning objective
23.1 Learning outcomes
23.2 Select and calculate suitable financial performance measures and objective
23.3 Primary measures of business growth
23.4 Measuring financial risk: liquidity and gearing
23.5 Measuring financial risk: solvency

# 23 Performance analysis for profit oriented organisation

## 23.0 Learning objective

This chapter is aimed at introducing candidates to be able to carry out performance analysis for profit oriented organisations.

## 23.1 Learning outcomes

At the end of this chapter , candidates should be able to calculate suitable financial performance and non- financial performance indices and use same to measure business growth, financial risk, liquidity and gearing situations.

## 23.2 Select and calculate suitable financial performance measures and objective

For companies, the suitable performance measures that agree with corporate objectives should relate to the benefits of their owners, the shareholders. The aim should be to provide benefits to shareholders over the long term, in the form of dividends from profits and share price growth.

Share price growth comes mainly from growth in the business and earnings per share. However, growth should not be achieved if it exposes the company to excessive risks. The primary objective of financial performance targets should therefore be consistent with the long-term objectives of both:

(a) business growth; and

(b) survival.

Strategically, companies should seek to balance risk and return.

### 23.2.1 Primary measures of business growth

There are several measures of financial performance that could be used to assess success in achieving corporate objectives.

(a) It is inappropriate to use targets for share price growth and dividend growth as formal planning targets and measures of actual performance. Share prices can be volatile and affected by stock market conditions outside the control of a company's management. Dividend policy, on the other hand, is under the control of the board of directors, but can be manipulated. Dividend payments do not have to move in line with changes in profitability or longer-term financial expectations of profit.

(b) It is therefore more appropriate to measure financial performance in terms of conditions that should lead to share price growth and dividend growth in the future.

(c) To assess strategic performance, financial measurements should consider the longer term, and prospects for the future. Typically, this means considering changes in profits over the past few years, and projections of profitability in the future.

(d) The same measurements are used to assess short-term performance, but at a strategic level, the longer-term view is considered, not simply the result for

the previous financial year.

Suitable Financial measures used to measure historical performance, and assess whether a company appears to be achieving its corporate objectives, may be:

(a) return on capital employed (ROCE)

(b) earnings per share (EPS) and growth in earnings per share

(c) earnings before interest, tax, depreciation and amortisation (EBITDA)

(d) for investment centres, return on investment (ROI) or residual income

None of these performance measures is ideal for assessing performance and progress towards achieving the corporate objective, because none of them on their own measure the success of the company in achieving a return that is consistent with the risks to which the company (and its owners) are exposed.
.

(a) **Return on capital employed (ROCE)** is a useful measure of performance, because it relates the amount of profit earned to the amount of capital employed in the business. However, the measurement of ROCE depends on accounting conventions for the measurement of profit and capital employed. Measure of profit in financial statements are not a reliable guide to financial returns on investment.

(b) **Earnings per share (EPS) and EPS growth** are also commonly used to assess performance. On the assumption that in the long term, the ratio of the share price to EPS (the price/earnings ratio or P/E ratio) remains fairly constant, growth in EPS should result in a higher share price. However, the P/E ratio does not necessarily remain constant over the long term and could change if the perception of investment risk in the company changed.

Some 'tech' companies, particularly in the USA, have achieved growth in their share price without yet making any profits. Investors have been willing to put money into loss-making companies in the expectation that future returns will eventually be huge. Measurements of EPS (or loss per share) are inappropriate in these cases.

(c) **EBITDA** (Earnings before interest tax depreciation and amortisation). EBITDA is a useful measure of performance only if it is assumed that management have no control over interest costs or depreciation and amortisation charges. This may be true for profit centre management, but is unlikely to be the case when managers have control over investment and financing decisions. EBITDA is a useful approximation of cash flow from operations before interest and tax, and can be a useful measurement of financial performance for this reason. (Note: If you are not sure about this, think about the calculation of operational cash flows in a statement of cash flows, using the indirect method.)

The benefits and limitations of returns on investment (**ROI)** and **residual income (RI)** are considered in chapter 25.

Other Primary measures of business survival : Measuring financial risk: liquidity and gearing

A strategic objective of a company should be survival, as well as to achieve growth and financial returns. It is therefore appropriate to assess and measure financial risk. Measures of financial risk include:

(a) **liquidity** risk, measured by ratios such as the current ratio or quick ratio, or by cash flow analysis

(b) **gearing** or debt/equity ratios.

**Liquidity** can be important. Liquidity means having cash or access to cash to make payments when these are due. For example, a company must have cash to pay salaries and wages of its employees, and to pay suppliers and other creditors. In some cases, profitable companies might become insolvent because they cannot pay their debts.

A lack of liquidity also restricts flexibility of action. A company that is short of cash is often unable to take advantage of new opportunities that might arise, because they do not have the money to spend.

From a strategic perspective, liquidity can be assessed by cash flows. Cash flows as reported in a statement of cash flows show where a company is obtaining its cash and how it is using and spending its cash. From a strategic perspective, cash flows must be sustainable.

For example, a company should be obtaining much of its cash from profitable operations. If it is loss-making, and obtaining cash by borrowing or from new share issues, there may be questions about the long-term liquidity of the company.

**Gearing** and debt levels can also be important. Gearing or debt levels can be measured as the ratio of debt to equity, or the ratio of debt to total assets. Highly- geared companies are exposed to the risk of a big fall in earnings per share whenever there is a fall in their operating profits. When they borrow at variable rates of interest, an increase in interest rates will also reduce profitability.

### 23.2.2 Measuring financial risk: solvency

Solvency can be defined as an ability to pay debts when they fall due. Insolvency is the opposite – an inability to pay debts when they fall due.

Companies may have some short-term problems with payments of debt, and can overcome the problem by deferring payments for a short time (obtaining more credit).

However from a strategic perspective, solvency is a long-term consideration. A company must be able to pay its debts. If it cannot, there is a high risk that major creditors will take legal initiatives to have the company declared insolvent.

Solvency for a commercial company depends on a combination of:

(a) **Profitability**: companies may make losses in some years, but from a strategic perspective, it needs to be profitable over the longer term. Companies cannot remain loss-making for ever.

(b) **Liquidity**: companies need cash to operate. Cash flow and profits are not the same thing. A profitable company may run out of cash. A loss-making company can raise cash by borrowing. However, over the long term,

companies must obtain cash to meet their expenditures.

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(d) **Debt**: companies are potentially at risk if they borrow too much. Interest rates have been low throughout the 2010s, following the financial crisis of 2008 and low-interest policies of central banks (particularly in the USA and Europe). In an environment of low interest rates, many companies have borrowed large amounts of money.

(e) An **insolvency risk** arises if the company would be unable to meet its debt payment obligations (interest payments and capital repayments) if interest rates were to rise.

## 23.3 Non-financial performance indicators (NFPIs)

| Section overview |
| --- |
| (a) Select and calculate non-financial performance measures and indicators |
| (b) Non-financial aspects of performance |
| (c) Common areas in which companies adopt NFPIs |
| (d) NFPIs for departments or functions |
| (e) NFPIs in different types of industry |
| (f) Analysing NFPIs |
| (g) Benchmarking |

### 23.3.1 Select and calculate non-financial performance indicators

Financial performance alone does not give a complete picture of the performance of an entity. Financial performance is the result of other factors such as market share and customer satisfaction. Understanding the performance of an entity requires an understanding of the underlying factors which drive that performance. The critical non-financial performance factors must also be assessed, because they determine the size of profits that a company will make in the longer-term.
Therefore targets must be established for non-financial aspects of performance, and performance should be measured against those targets.

Non-financial performance indicators (NFPIs) are measurements of performance that are not financial or monetary. Whereas financial performance indicators are quantitative, non-financial performance indicators may be either:

(a) quantitative indicators, i.e. measured numerically; or

(b) qualitative indicators, i.e. not measured numerically.

Where possible, it is usually preferable to use quantitative measures of performance, because these make comparisons easier. For example, customer satisfaction is a non-financial aspect of performance, and could be measured in qualitative terms – i.e. is customer satisfaction improving or getting worse?
However it might be possible to measure customer satisfaction quantitatively, by asking customers to provide feedback and satisfaction ratings for the products or services they have bought. Satisfaction ratings, say on a scale of 1 to 10, turn a qualitative aspect of performance into one that can be measure numerically.

### 23.3.2 Variability in the circumstances of different businesses

With financial performance measurement, there are a limited number of financial performance indicators that are used and applied to all types of business. For example, the ratios discussed in the previous section can be used to measure the performance of many different types of company (though interpretation should be carried out in the light of knowledge of the relevant business sector).

With NFPIs, the key measures of performance vary between different types of business and depend on the nature of the business. For example, the key non-financial measures of performance for a chemical manufacturer will differ from those of a passenger transport company such as a bus or train company.

Also, non-financial performance indicators might differ between companies within the same industry. This is because the companies might operate on different business models or might be trying to achieve different objectives or might simply have a different view of what is important to the success of their business.

### 23.3.3 Time scale for achievement

Financial performance targets are often set for a budget period, and actual performance is compared against budget. Non-financial performance targets need not be restricted to one year, and in some cases it may be sensible to establish targets for a longer term (or possibly a shorter term) than one year.

Unfortunately, if some employees are awarded cash bonuses for achieving non-financial performance targets, there will be a tendency to set annual targets in order to fit in with the annual budget cycle.

### 23.3.4 Non-financial aspects of performance

For the purpose of assessing the performance of the entity as a whole, it is necessary to identify which aspects of non-financial performance are the most important in terms of the organisation's objectives. The problem is to decide which aspects of performance are critically important. An organisation might identify a number of critical aspects of performance across in different departments within the business.

The whole process would involve:

(a) Identification of objective

(b) Identification of the critical aspects of performance necessary to achieve the objective

(c) Setting targets to drive behaviour towards addressing these critical aspects of performance

(d) Measuring actual performance so that it can be compared to the desired level of performance

(e) Communicating results to managers of responsibility centres.

### 23.3.5 Identifying performance indicators In organisation would need to carry out some form of analysis to identify suitable non-financial performance indicators

**Example: Identifying NFPIs for a railway company.**

| | |
|---|---|
| Objective | To increase passenger revenue by improving the utilisation of each train |
| How will we do this? | By attracting more passengers |
| How? | By giving them what they value |
| | Trains being on time |
| | Cleanliness and comfort |
| **Possible NFPIs** | |
| Overall | Percentage capacity utilisation |
| | Percentage change in number of passenger journeys |
| Trains being on time | Percentage of trains that arrive late |
| | Number of cancellations |
| Cleanliness and comfort | Level of customer satisfaction |

For each of the NFPIs identified above the company would need to establish suitable targets, systems for measuring the performance and systems for communicating results to managers.

### 23.3.6 Common areas in which companies adopt NFPIs

Many companies identify non-financial performance indicators in the following areas:

(a) human resources;

(b) customer satisfaction; and

(c) quality.

In all cases suitable indicators and associated targets would be established as a result of analysis similar to that illustrated above.

#### Human resources

A motivated and well-trained workforce of adequate size is often vital to an organisation achieving its objectives.

Possible NFPIs include the following

(a) labour productivity: output produced per man per hour; or average time to produce a unit of output; or number of customer calls handled per day
(b) labour turnover rate;
(c) training days per year;
(d) absenteeism rates (e.g sick days) often used as a measure of staff morale;
(e) average hours worked;
(f) idle time;
(g) proportion of billable hours;

(h) head count by grade of labour.

**Customer satisfaction**

It is customers that ultimately determine the level of profits. Companies often analyse what is important to their customers and structure their marketing offering in line with this.

**Measures of customer satisfaction might include:**

(a) percentages of new and returning customers;
(b) percentage of subscribers renewing their annual subscription;
(c) results of customer satisfaction surveys;
(d) number of complaints;
(e) speed of complaint resolution;
(f) subsequent sales to customers who registered a complaint previously.

**Quality**

Quality is linked closely to customer satisfaction. Resolving quality issues has a direct cost (e.g. the cost of replacing an item) and indirect costs (e.g. lost goodwill leading to future lost sales).

Possible quality measures include:

(a) proportion of re-worked items during production;
(b) proportion of returns;
(c) proportion of fails;
(d) number of successful inspections.

## 23.4 NFPIs for departments or functions

Performance targets can be set for an entity's departments or in respect of its functions.

Possible non-financial performance indicators might be as follows for different departments:

(a) Sales and customer service
(b) calls per hour
(c) conversion rates of calls to orders
(d) proportion of returning customers
(e) proportion of 'very satisfied' customers
(f) average waiting time
(g) number of advertising campaigns run
(h) Online sales
(i) Number of visits to website
(j) Conversion rates (number of sales as a percentage of the number of visits)
(k) Number of return visits
(l) Number of sales to returning customers
(m) Customer satisfaction (number of return visits/number of complaints)
(n) Website down time
(o) Delivery times (time between an order being placed and filled)
(p) Inventory control
(q) average inventory holding
(r) proportion of wastage
(s) number of stock outs
(t) number of returns to suppliers
(u) Sustainability/environmental measures

(v) proportion of components sourced from 'green materials';
(w) annual percentage reduction in $CO_2$ emissions;
(x) proportion of packaging that is recyclable.
(y) Research and development
(z) number of new invention ideas
(aa) conversion rate of invention ideas to production

**Practice question** **1**

Suggest possible performance measures for a health and safety function in a company.

### 23.4.1 NFPIs in different types of the Industry.

Key measures of non-financial performance vary between different types of business and depend on the nature of the business. It is impossible to provide examples for all industries, but the following are some possible examples of NFPIs that might be important in certain industries.

(a) Airlines
(b) average utilisation rates (i.e. percentage of aircraft occupied);
(c) average non-availability;
(d) planes - proportion of time in the air;
(e) average turnaround time for when plane is on the ground.
(f) Manufacturing operations
(g) average build time
(h) average production line down-time
(i) capacity utilization
(j) Hotels
(k) occupancy rates for rooms; customer satisfaction measures.

### 23.4.2 Analysing NFPIs

Our earlier guidance about measuring and assessing performance applies to non-financial performance as to financial performance.

(a) It is not sufficient simply to calculate a performance ratio or other performance measurement.

(b) You need to explain the significance of the ratio – What does it mean? Does it indicate good or bad performance, and why?

(c) Look at the background information given in the exam question and try to identify a possible cause or reason for the good or bad performance.

(d) Possibly, think of a suggestion for improving performance. What might be done by management to make performance better?

**Practice question** **2**

The following results relate to a company that makes and sells electric appliances to retailers.
Comment on the following results:

| | 2017 | 2018 |
|---|---|---|
| Unit sales | 28,000 | 30,000 |
| On time delivery | 95% | 80% |

| | | |
|---|---|---|
| Sales returns | 2% | 6% |

### 23.4.3 Benchmarking

It may be useful to be aware of benchmarking as a method of assessing performance. Benchmarking involves comparing performance with the performance of another, similar organisation or operation. In other words, another organisation or department is used as a 'benchmark for comparison'.

Performance can be assessed in terms of whether it has been better or worse than the selected benchmark. By making such comparisons, it should be possible to identify strengths and weaknesses in performance.

There are three main types of benchmarking.

(a) **Internal benchmarking**. An entity may have many similar operations, such as regional or area branches. For example, a retail company may have a network of retail stores. The best-performing stores or departments within stores can be used as a benchmark, and the performance of other branches compared against it.

(b) **Competitive benchmarking**. This involves comparing the performance of the organisation against the performance of its most successful competitors. In this way, the areas of performance where the competitor is better can be identified, and measures can then be planned for reducing the gap in performance.

(c) **Operational benchmarking**. A company might use benchmarking to assess the performance of a particular aspect of its operations, such as customer order handling, handling e-commerce orders from the internet, or warehousing and despatch operations. It may be able to identify a company in a completely different industry that carries out similar operations successfully. The other company might be prepared to act as a benchmark, and allow its operations to be studied and its staff interviewed. The benefit of this type of benchmarking is that a business is able to learn from world- class companies how to improve its operations and raise its performance levels.

## 23.5 Causes and problems of short termism and longer-term views of performance measurement

**Section overview**

(a) Short-termism in performance measurement

(b) Performance and sustainability

(c) Stakeholder-based measures of performance: social and environmental performance

### 23.5.1 Short-termism in performance measurement

Performance management systems are often used as a basis for rewarding managers for successful performance. For example, a manager may be given an annual bonus for keeping departmental costs below budget, or a sales manager may be rewarded if the sales and marketing department achieve sales in excess

of the budget target.

Bonus systems can encourage short-termism. **Short-termism** means taking measures to improve performance in the short-term, even though they are either misleading or harmful to the business in the longer term. Short-termism can take a variety of forms. Here are just a few examples.

(a) A departmental manager is paid a bonus for keeping departmental costs within budget. As a result, the manager decides to defer the purchase of new equipment that would eventually improve output in the department. The reason for deferring the expenditure is to avoid the higher depreciation cost of a new item of equipment, so that departmental costs will not exceed the budget.

(b) Members of a management team are paid bonuses on the basis of sales revenue obtained in the year. Near the end of the year, actual sales are below budget. Management therefore decide to offer to sell a substantial quantity of product to a customer at a heavily discounted price, even though the sale would be loss-making, in order to meet budget sales targets and obtain their bonus.

(c) Managers might also manipulate financial results, such as treating expenditures as a long-term asset, or moving revenues from one accounting period to the next.

**Causes of short-termism include:**

The thinking by management and other corporate stakeholders to lay emphasis on strategies that provide short term returns and advantages to the detriment of value creating long term advantages had created the avenue for short-termism. Hence the causes of short-termism can be traced to new technologies to enhance corporate goals, problems associated with market volatility, and an increased role of institutional investors to achieve their sub-objectives in the short term. Also, the desire by management and investors to reduce transaction costs as well as reduce trading can also cause short-termism in business.

Short-termism can be harmful to a company, and also misleading. Managers should be encouraged to make decisions that are in the longer-term interests of their organisation, instead of focusing on performance in the short term. An appropriate way of doing this might be for the organisation's senior management to:

(a) establish performance targets that are linked to the long-term success of the organisation, such as growth in profits over several years, or sales revenues from new and innovative products;

(b) establish a reward scheme that rewards managers for achieving these long-term targets rather than (or as well as) short-term targets for performance.

The problems associated with short-termism include:

(a) Short termism can lead to emphasis on rewarding executives for short-term results which invariably lead such management to take excessive short term risks.

(b) Excessive short-termism may affect the corporate governance practices of listed companies.

**(c) Short-termism creates fewer jobs as companies de-emphasizes on recruitment but more emphasis on remunerations like bonuses,**

**overtime that will fill bour requirement gap.**

(d) **Short-termism harms economic growth.** Short-termism is all about quick financial returns..

(e) Companies focused on long-termism enjoy revenue growth, higher earnings, and a higher level of economic profit. Short-termism companies grow at a slower rate than long-termism companies.

(f) Short-termism hurts the ability to survive financial crises and changes in economic downturns.

(g) Short-termism leads to pressure over quarterly earnings.

(h) Short-termism leads to more buybacks to boost short-term performance.

(i) Short-termism does not encourage sustainability objectives.

(j) Short-termism hurts corporate managers through pressures from other stakeholders.

(k) Short-termism focuses on short-term stock price.

### 23.5.2 Performance measurement and sustainability considerations

To succeed over the long term, a business must be sustainable. It needs to remain profitable, but to do this it also needs to consider the non-financial aspects of a sustainable business. Sustainability has been defined in terms of setting performance objectives for three areas or aspects of performance:

(a) economic performance/ financial performance;

(b) performance relating to the environment; and

(c) social aspects of performance.

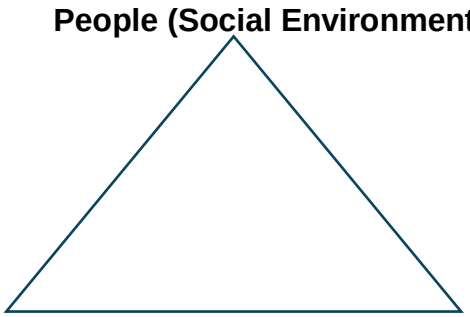
Economic, social and environmental performance are known as the 'three pillars of sustainability'. They are also known as the three Ps (a phrase coined by John Elkington in 1994):

(a) **People** refers to fair and beneficial business practices for labour (employees), the community and region in which a corporation conducts its business, and the organisation's customers.

(b) **Planet** (natural capital) refers to sustainable ('green') environmental practices so environmental indicators might include measurements relating to improving energy efficiency; minimising pollution; using renewable materials or sources of energy and avoiding the use of non-renewable items; and minimising waste, for example by recycling materials;

(c) **Profit** is the economic value created by the organisation after deducting the cost of all inputs, including the cost of the capital tied up. It is the real economic impact the organisation has on its economic environment.

Arguably, a business will not survive over the long term unless it gives due consideration to people and planet, as well as to profit. This can be shown in the pictorial below referred to as the sustainability pillars:




### 23.5.3 Stakeholder-based measures of performance: social and environmental performance

**Definitions: Stakeholder**

A person, group or organisation that has an interest in an organisation.

Anybody who can affect or is affected by an organisation, strategy or project

The primary stakeholders in a typical company are its owners, employees, customers and suppliers. However, increasing globalisation, greater environmental and social awareness, and more efficient communication, have resulted in a wider and deeper understanding of the impact that organisations have on society and on the environment. In consequence many organisations take a view of stakeholders that includes other groups in addition to these including the community at large.

There is an increasing understanding that although companies increase economic wealth through growth and the search for profit maximisation, society may well be getting poorer because of the damage that economic activity is having on the environment and society.

A successful business now must not only be financially secure but it must minimise its negative environmental impacts and must meet the expectations of society.

As companies have become increasingly aware of environmental issues, and have started to accept that economic growth might not be sustainable, they have become more interested in measuring sustainability and environmental impact.

Public companies report their financial performance in their published annual financial statements, but many companies also provide information about social and environmental goals and performance, in a strategic report or a sustainability report (or corporate social responsibility report).

### 23.5.4 Triple bottom line reporting

Performance relating to sustainability may be presented in a triple bottom line report. In traditional financial reporting the bottom line refers to either the profit or loss, which is presented at the very bottom line on in a statement of profit or loss.

Environmentalists and economists have argued that the traditional bottom line does not include the full costs of the business.

> **Example: Full cost of operation**
>
> A company runs a gold mine at a profit.
>
> The operation of the mine has caused significant pollution of the local water supply leading to death and illness among the local population and livestock.
>
> The financial statements bottom line only shows the profit but not these other costs to society.

The triple bottom line adds two more bottom lines. These are social and environmental (ecological) concerns. Triple bottom line (abbreviated as TBL or 3BL) incorporates the notion of sustainability into business decisions.

TBL is an accounting framework with three dimensions, social, environmental (or ecological) and economic (financial). Many organisations have adopted the TBL framework to evaluate their performance in a broader context.

### 23.5.5 Measures of social and environmental performance

Measures of profitability are similar for all for-profit businesses. However, measures of social and environmental performance may differ widely between companies, because of their size and the nature of their business operations.

One major global company using triple bottom line reporting reported its environmental performance in terms of:

(a) global energy use, measured in thousands of GWh (giga watt hours)

(b) global carbon dioxide emissions, measured in metric tonnes

(c) production of non-recycled waste, measured in metric tonnes

Emissions of other polluting cases can be converted into a 'carbon dioxide equivalent', so that the total quantities of polluting emissions by a company can be expressed in a common measure – carbon dioxide. Total emissions of carbondioxide equivalents by a company are commonly known as the company's 'carbon footprint'.

The same global company reported, as social indicators:

(a) its donations to communities and sponsorships;

(b) diversity: the percentage of its employees who were female and the percentage who came from minority groups;

(c) the number of discrimination charges brought against the company during the year;

(d) employee satisfaction, based on a census of employee opinion; and

(e) the recordable injury rate per 1,000 employees.

Some companies publish targets for improvements in the social or environmental aspects of their operations. For example, some global packaging and bottling companies now have targets for the replacement of non-recyclable plastic

materials with recyclable or biodegradable materials.

### 23.5.6 A system for social and environmental reporting

Traditional performance measures are directed primarily at the owners and those who act on their behalf (the management) with most companies using performance measurement systems that are extensions of their financial reporting systems.

Such traditional accounting systems do not provide information which could be used to explain the company's performance in terms of environmental and social impacts. Performance measurement systems must be designed to do this.

In order for a company to design a suitable performance reporting system it must do the following:

(a) identify its stakeholders;

(b) find out what aspects of the company's performance are important to each stakeholder group;

(c) design performance metrics to show the company's performance in each area of interest;

(d) set targets for each metric and communicate these to the stakeholder;

(e) design information systems that integrate data collection and information processing so that performance can be measured against these metrics; and

(f) introduce a transparent system of reporting to stakeholder groups.

Triple bottom line reporting is a framework that can be used to inform this process.

## 23.6 The Balanced scorecard approach:

| Section overview |
| --- |
| (a) The concept of the balanced scorecard |
| (b) The balanced scorecard: four perspectives of performance |
| (c) Using the balanced scorecard |
| (d) Conflicting targets for the four perspectives |

### 23.6.1 The concept of the balanced scorecard

The balanced scorecard approach was developed by Kaplan and Norton in the1990s as an approach to measuring performance in relation to long-term objectives. They argued that for a business entity, the most important objective is a financial objective. However, in order to achieve financial objectives over the long term, it is also necessary to achieve goals or targets that are non-financial in nature, as well as financial.

The concept of the balanced scorecard is that there are several aspects of performance ('perspectives on performance') and targets should be set for each of them. The different 'perspectives' may sometimes appear to be in conflict with

each other, because achieving an objective for one aspect of performance could mean having to make a compromise with other aspects of performance. The aim should be to achieve a satisfactory balance between the targets for each of the different perspectives on performance. These targets, taken together, provide a balanced scorecard, and actual performance should be measured against all the targets in the scorecard.

The reason for having a balanced scorecard is that by setting targets for several key factors, and making compromises between the conflicting demands of each factor, managers will take a more balanced and long-term view about what they should be trying to achieve. A balanced scorecard approach should remove the emphasis on financial targets and short-term results.

However, although a balanced scorecard approach takes a longer-term view of performance, it is possible to set shorter-term targets for each item on the scorecard. In this way it is possible to combine a balanced scorecard approach to measuring performance with the annual budget cycle, and any annual incentive scheme that the entity may operate.

### 23.6.2 The balanced scorecard: four perspectives of performance

In a balanced scorecard, critical success factors are identified for four aspects of performance, or four 'perspectives':

**(a) customer perspective**

**(b) internal perspective**

**(c) innovation and learning perspective**

**(d) financial perspective.**

Of these four perspectives, three are non-financial in nature.

For each perspective, Kaplan and Norton argued that an entity should identify key performance measures and key performance targets. The four perspectives provide a framework for identifying what those measures should be, although the specific measures used by each entity will vary according to the nature of the entity's business.

For each perspective, the key performance measures should be identified by answering a key question. The answer to the question indicates what the most important issues are. Having identified the key issues, performance measures can then be selected, and targets set for each of them.

| Perspective | The key question |
|---|---|
| **Customer perspective** | **What do customers value?**<br><br>By recognising what customers value most, the entity can focus its performance targets on satisfying the customer more effectively. Targets might be developed for several aspects of performance such as cost (value for money), quality or place of delivery. |
| **Internal perspective** | To achieve its financial and customer objectives, what processes must the organisation perform with excellence?<br><br>Management should identify the key aspects of operational performance and seek to achieve or maintain excellence in this area. For example, an entity may consider that customers value the quality of its service, and that a key aspect of providing a quality service is the effectiveness of its operational controls in preventing errors from happening. |
| **Innovation and learning perspective** | How can the organisation continue to improve and create value?<br><br>The focus here is on the ability of the organisation to maintain its competitive position, through the skills and knowledge of its work force and through developing new products and services, or making use of new technology as it develops. |
| **Financial perspective** | How does the organisation create value for its owners?<br><br>Financial measures of performance in a balanced scorecard system might include share price growth, profitability and return on investment. |

Kaplan and Norton argued that although the main objectives of a business are financial, it is essential for long-term success that the organisation should be able to meet the needs of its customers (the customer perspective). In order to satisfy customers, it must have internal processes that are efficient and effective in delivering the goods or services that customers need (the internal perspective). In order to have effective and efficient internal processes, an organisation needs people with knowledge and skills, as well as a capacity to continue innovating (the innovation and learning perspective).

Several measures of performance may be selected for each perspective, or just one. Using a large number of different measures for each perspective adds to the complexity of the performance measurement system.

### 23.6.3 Using the balanced scorecard

With the balanced scorecard approach the focus should be on strategic objectives and the critical success factors necessary for achieving them. The main focus is on what needs to be done now to ensure continued success in the future.

The main performance report for management each month is a balanced scorecard report, not budgetary control reports and variance reports.

Examples of measures of performance for each of the four perspectives are as follows. The list is illustrative only, and organisations will use balanced scorecard measures that are appropriate for their business.

| Perspective | Outcome measures |
|---|---|
| **Critical financial measures** | Return on investment<br>Profitability and profitability growth Revenue growth<br>Productivity and cost control<br>Cash flow and adequate liquidity |
| **Critical customer measures** | Avoiding financial risk: limits to borrowing<br>Market share and market share growth<br>Customer profitability: profit targets for each category of customer<br>Attracting new customers: number of new customers or percentage of total annual revenue obtained from new customers during the year<br>Retaining existing customers<br>Customer satisfaction, although measurements of customer satisfaction may be difficult to obtain |
| **Critical internal measures** | On-time delivery for customer orders<br>Success rate in winning contract orders<br>Effectiveness of operational controls, measured by the number of control failures identified during the period<br>Production cycle time/throughput time Amount of re-working of defective units |
| **Critical innovation and learning measures** | Revenue per employee<br>Employee productivity<br>Employee satisfaction<br>Employee retention or turnover rates |

| | |
|---|---|
| Percentage of total revenue earned from sales of new products | Time to develop new products from design to completion of development and introduction to the market |

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**Example: Balanced scorecard**

Kaplan and Norton described the example of Mobil in the early 1990s, in their book *The Strategy-focussed Organisation*. Mobil, a major supplier of petrol, was competing with other suppliers on the basis of price and the location of petrol stations. Its strategic focus was on cost reduction and productivity, but its return on capital was low.

The company's management re-assessed their strategy, with the aim of increasing market share and obtaining stronger brand recognition of the Mobil brand name. They decided that the company needed to attract high-spending customers who would buy other goods from the petrol station stores, in addition to petrol.

As its high-level financial objective, the company set a target of increasing return on capital employed from its current level of about 6% to 12% within three years.

From a **financial perspective**, it identified such key success factors as productivity and sales growth. Targets were set for productivity (reducing operating costs per gallon of petrol sold) and 'asset intensity' (ratio of operational cash flow to assets employed).

From a **customer perspective**, Mobil carried out market research into who its customers were and what factors influenced their buying decisions. Targets were set for providing petrol to customers in a way that would satisfy the customer and differentiate Mobil's products from rival petrol suppliers. Key issues were found to be having petrol stations that were clean and safe, and offering a good quality branded product and a trusted brand. Targets were set for cleanliness and safety, speedy service at petrol stations, helpful customer service and rewarding customer loyalty.

From an **internal perspective**, Mobil set targets for improving the delivery of its products and services to customers, and making sure that customers could always buy the petrol and other products that they wanted, whenever they visited a Mobil station.

### 23.6.4 Conflicting targets for the four perspectives

A criticism that has been made against the balanced scorecard approach is that the targets for each of the four perspectives might often conflict with each other. When this happens, there might be disagreement about what the priorities should be.

This problem should not be serious, however, if it is remembered that the financial is the most important of the four perspectives for a commercial business entity. The term 'balanced' scorecard indicates that some compromises have to be made between the different perspectives.

A useful sporting analogy was provided in an article in *Financial Management* magazine (Gering and Mntambo, November 2001). They compared the balanced scorecard to the judgements of a football team manager during a football match. The objective is to win the match and the key performance measure is the score.

However, as the match progresses, the manager will look at other important aspects of performance, such as the number of shots at the goal by each side,

the number of corner kicks, the number of tackles and the percentage of possession of the ball enjoyed by the team.

Shots on goal corner kicks, tackles and possession of the ball are all necessary factors in scoring goals, not conceding goals, and winning the match. The manager will therefore use them as indicators of how well or badly the match is progressing. However, the score is ultimately the only thing that matters.

In the same way, targets for four perspectives are useful in helping management to judge progress towards the company's objectives, but ultimately, success in achieving those objectives is measured in financial terms. The financial objective is the most important.

## 23.7 Fitzgerald and moon building block model

**Section overview**

(a) The characteristics of services and service industries
(b) Controllable performance in service industries
(c) Fitzgerald and Moon: Performance measurement in service industries
(d) Applying the Fitzgerald and Moon framework

### 23.7.1 The characteristics of services and service industries

Many organisations provide services rather than products. There are many examples of service industries: hotels, entertainment, the holiday and travel industries, professional services, banking, recruitment services, cleaning services, and so on.

Performance measurement for services may differ from performance measurement in manufacturing in several ways:

(a) **Simultaneity**. With a service, providing the service ('production') and receiving the service ('consumption' by the customer) happen at the same time. With production, the product is sold to the customer after it has been manufactured.

(b) **Perishability**. It is impossible to store a service for future consumption: unlike manufacturing and retailing, there is no stock or inventory of unused services. The service must be provided when the customer wants it.

(c) **Heterogeneity**. A product can be made to a standard specification. With a service provided by humans, there is variability in the standard of performance. Each provision of the service is different. For example, even if they perform the same songs at several concerts, the performance of a rock band at a series of concerts will be different each time. Similarly, a call centre operator answering telephone calls from customers will be unable to deal with each call in exactly the same way.

(d) **Intangibility**. With a service, there are many intangible elements of service that the customer is given, and that individual customers might value. For example, a high quality of service in a restaurant is often intangible, but it is noticed and valued by the customer.

Since services differ to some extent from products, should performance setting and performance measurement be different in service companies, compared with manufacturing companies?

### 23.7.2 Controllable performance in service industries

A starting point for analysing performance measurement in service industries is that companies in a service industry should be able to link their competitive strategy to their operations, to make sure that the services that they are providing will enable the company to achieve its strategic objectives. Performance management systems have an important role, because they can:

(a) show how well or how badly the organisation has performed in achieving its strategic objectives, and

(b) identify where improvements are needed.

Performance management systems have been developed in many organisations that:

(a) link performance measures to objectives
(b) include external as well as internal measures of performance
(c) include non-financial as well as financial performance indicators
(d) recognise that a compromise is often necessary between different performance targets, such as targets for service quality and targets for the cost or the speed of providing the service.

The performance indicators that are used can vary widely between different service industries, and there is no standard set of performance measurements that apply to all services.

However, a framework for analysing performance management systems in service industries was provided by Fitzgerald and Moon.

### 23.7.3 Fitzgerald and Moon: performance measurement in service industries

Fitzgerald and Moon (1996) suggested that a performance management system in a service organisation can be analysed as a combination of three building blocks:

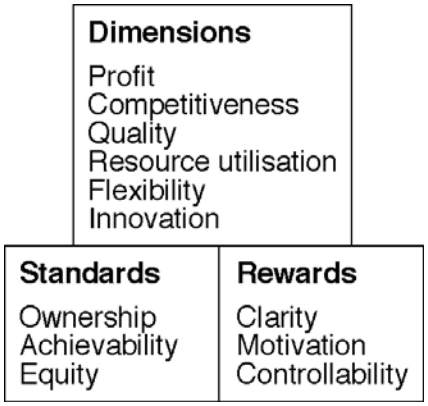
(a) Dimensions

(b) Standards

(c) Rewards.

These are shown in the following diagram.

**Illustration: Building blocks for performance measurement systems**




Dimensions of performance

Dimensions of performance are the aspects of performance that are measured. A critical question is: What are the dimensions of performance that should be measured in order to assess performance?

Research by Fitzgerald and others (1993) and by Fitzgerald and Moon (1996) concluded that there are six dimensions of performance measurement that link performance to corporate strategy. These are:

(a) profit (financial performance)
(b) competitiveness
(c) quality
(d) resource utilization
(e) flexibility
(f) innovation.

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| Dimension of performance | Possible measure of performance |
|---|---|
| *Financial performance* | Profitability<br>Growth in profit, profit/ sales margins<br>Note: Return on capital employed is possibly not so relevant in a service industry, where the company employs fairly small amounts of capital. |
| *Competitiveness* | Growth in sales<br>Retention rate for customers (or percentage of customers who buy regularly: 'repeat sales')<br>Success rate in converting enquiries into sales<br>possibly market share, although this may be difficult to measure |
| *Service quality* | Number of complaints<br>Whether the rate of complaints is increasing or decreasing<br>Customer satisfaction, as revealed by customer opinion surveys |
| *Flexibility* | Possibly the mix of different types off work done by employee, possibly the speed in responding to customers' requests |
| *Resource utilisation* | Efficiency/productivity measures<br>Utilisation rates: percentage of available time utilised in 'productive' activities |
| *Innovation* | Number of new services offered<br>Percentage of sales income that comes from services introduced in the last one or two years |

Other measures of performance might be appropriate for each dimension, depending on the nature of the service industry. However, this framework of six dimensions provides a structure for considering what measures of performance might be suitable.

The dimensions of performance should also distinguish between:
(a) 'results' of actions taken in the past, and
(b) 'determinants' of future performance.

### Performance: results of past actions

Some dimensions of performance measure the results of decisions that were taken in the past, that have now had an effect. Fitzgerald and Moon suggested that results of past actions are measured by:
(a) financial performance; and
(b) competitiveness.

### Determinants of future performance

Other dimensions of performance will not have an immediate effect, and do not measure the effects of decisions taken in the past. Instead they measure progress towards achieving strategic objectives in the future. The 'drivers' or 'determinants' of future performance are:
(a) quality;

(b) resource utilisation;
(c) flexibility; and
(d) innovation.

These are dimensions of competitive success now and in the future, and so are appropriate for measuring the performance of current management. Measuring performance in these dimensions 'is an attempt to address the short-termism criticism frequently levelled at financially-focused reports' (Fitzgerald). This is because they recognise that by achieving targets now, future performance will benefit. Improvements in quality, say, might not affect profitability in the current financial period, but if these quality improvements are valued by customers, this will affect profits in the future.

### Standards

The second part of the framework for performance measurement suggested by Fitzgerald and Moon relates to setting expected standards of performance, once the dimensions of performance have been selected.

There are three aspects to setting standards of performance:

(a) To what extent do individuals feel that they **own** the standards that will be used to assess their performance? Do they accept the standards as their own, or do they feel that the standards have been imposed on them by senior management?

(b) Do the individuals held responsible for achieving the standards of performance consider that these standards are **achievable**, or not?

(c) Are the standards **fair ('equitable')** for all managers in all business units of the entity?

It is recognised that individuals should 'own' the standards that will be used to assess their performance, and managers are more likely to own the standards when they have been involved in the process of setting the standards.

It has also been argued that if an individual accepts or 'owns' the standards of performance, better performance will be achieved when the standard is more demanding and difficult to achieve than when the standard is easy to achieve.

This means that the standards of performance that are likely to motivate individuals the most are standards that will not be achieved successfully all the time. Budget targets should therefore be challenging, but not impossible to achieve.

Finding a balance between standards that the company thinks are achievable and standards that the individual thinks are achievable can be a source of conflict between senior management and their subordinates.

Standards should also be fair for everyone in all business units, and should not be easier to achieve for some managers than others. To achieve fairness or equity, when local conditions for the individual business units can vary, it is often necessary to assess performance by relying on subjective judgement rather than objective financial measurements.

### Rewards

The third aspect of the performance measurement framework of Fitzgerald and

Moon is rewards. This refers to the structure of the rewards system, and how individuals will be rewarded for the successful achievement of performance targets.

One of the main roles of a performance measurement system should be to ensure that strategic objectives are achieved successfully, by linking operational performance with strategic objectives.

According to Fitzgerald and Moon, there are three aspects to consider in the reward system.

(a) The system of setting performance targets and rewarding individuals for achieving those targets must be clear to everyone involved. Provided that managers accept their performance targets, **motivation** to achieve the targets will be greater when the targets are **clear** (and when the managers have participated in the target-setting process).

(b) Employees may be motivated to work harder to achieve performance targets when they are **rewarded for successful achievements**, for example with the payment of a bonus.

(c) Individuals should only be held **responsible for aspects of financial performance that they can control**. This is a basic principle of responsibility accounting. A common problem, however, is that some costs are incurred for the benefit of several divisions or departments of the organisation. The costs of these shared services have to be allocated between the divisions or departments that use them. The principle that costs should be controllable therefore means that the allocation of shared costs between divisions must be fair. In practice, arguments between divisional managers often arise because of disagreements as to how the shared costs should be shared.

### 23.6.4 Applying the Fitzgerald and Moon framework

The actual measures of performance used by companies in service industries will vary according to the nature of the service. Fitzgerald and Moon used case studies, however, to show how their framework can be used to assess performance management systems.

One successful (and large) organisation reported as a case study was a food retailing business with a large number of stores. Applying the Fitzgerald and Moon framework, the performance management system was analysed as follows:

### Dimensions of performance

The company used four of the six dimensions of performance to assess the performance of individual stores and the performance of each region.

| Dimension of performance | Measures used | Comments |
|---|---|---|
| Financial performance | Profit by store and by region. | Profit is seen as a very important measure of performance.<br>The performance of each store and region is publicised within the company, by means of 'league tables', so that each store manager knows how his store has performed in comparison with others. |
| Competitiveness (at company level). | Market share<br>Prices of competitors for each local store.<br>Observation. | The company places great importance on monitoring the prices charged by competitors. Prices are monitored for each store, at the 'local' level.<br>Market share is assessed from published market share statistics.<br>Managers of local stores may visit the stores of competitors to see how full their car park is, and compare this with the number of cars in the car park of their own store. |
| Quality of service on specific transactions<br>Quality of service overall | Letters and other messages from customers.<br>Observation<br>A range of measures for each store and warehouse/depot | The quality of service is monitored by 'mystery shoppers' – individuals hired by the company to visit stores disguised as customers, to observe the quality of service provided.<br>A number of different aspects of service quality are monitored and measured, and a performance league table for stores and warehouses is published internally. |
| Flexibility | No formal performance measurement | However, managers are aware of the need for flexibility. For example, when there are staff shortages due to absenteeism, store managers will telephone part-time staff and ask them to fill the vacancies at short notice. |

| Dimension of performance | Measures used | Comments |
|---|---|---|
| Resource utilisation | Sales per square metre.<br>Wastage rates | |
| Innovation | No formal performance measurement | The need to innovate continually is recognised, however, and innovation is discussed regularly at business planning meetings. |

**Standards of performance**

the research found a significant difference between the level of ownership for:

(a) profit; and

(b) quality of service.

Managers participated in the process of setting profit targets for their store or region, through the formal business planning process. However, standards for quality of service were imposed by central management (head office). The view of senior management was that quality standards must be the same at every store in the country; therefore standards must be decided at head office for the company as a whole.

'Standards' of performance were assessed for both profitability and quality of service.

| Standard | Comment |
|---|---|
| **Profit** | |
| Ownership | Managers were involved in setting profit targets, as part of the discussions with head office about annual targets and business planning. |
| Achievability | The standards/targets were considered achievable by the managers responsible for achieving them. |
| Equity | In setting profit targets for each store, allowance was made for the effect of competition from local competitors to each individual store. |
| **Quality of service** | |
| Ownership | Standards were imposed by head office. |
| Achievability | However, they were seen as achievable. |
| | An aspect of standard-setting was the use of internal benchmarks, and comparisons of quality standards at different stores within the company. |
| Equity | No allowances were made for different local conditions. |

All stores throughout the country were expected to achieve the same standards.

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### Reward mechanisms for achieving standards

The three elements of reward systems within the Fitzgerald and Moon framework are:

(a) clarity of goals and targets;

(b) how managers are motivated to achieve targets; and

(c) whether there are any problems about shared costs and controllability of costs

The research findings were as follows:

| Element | Comments |
|---|---|
| Clarity of goals | Managers were aware of company strategy, and clearly understood how their performance would contribute to the achievement of strategic objectives. |
| Motivation:<br>short-term financial motivation<br>non-financial aspects | Store managers received a bonus for achieving targets. In addition, there were 'team' bonus payments.<br>Managers had pride in their position in the league tables of stores, and were motivated to improve or maintain their position in the league. |
| Controllability | There were no problems with controllability of costs or allocation of shared costs. |

### Conclusions

Conclusions drawn from this case study, based on the Fitzgerald and Moon framework, were as follows:

(a) The company was highly successful.

(b) It had a clear statement of strategy that was well understood by management in regions and local stores.

(c) Performance measures were consistent with that strategy.

(d) Performance measures were reported regularly, covering a range of financial and non-financial aspects of performance.

(e) The performance measurements were clearly defined and communicated to employees at all levels in the company, and there were regular reports on actual achievements.

(f) The driving force for performance targets was the satisfaction of customers' needs.

(g) The performance measurement system was reinforced by a rewards system to motivate managers and by a pride in performance.

## 23.8 CHAPTER REVIEW

### Chapter review

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

(a) Explain the nature of performance and non-performance indicators in a performance management system
(b) Measure and use a range of financial performance indicators
(c) Measure and use a range of non-financial performance indicators
(d) Explain the nature of short-termism in performance measurement
(e) Explain the relevance of sustainability measurements (social and environmental measurements) for an assessment of longer-term performance
(f) Explain the balanced scorecard approach to performance management and apply it in a given scenario
(g) Explain the Fitzgerald and Moon Building Block model and its application to performance measurement in service industries

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**Solution** **1**

Possible performance indicators for a health and safety function include (but are not limited to) the following:

**a.** Number of accidents in period – no injury

**b.** Number of accidents in period – causing injury

**c.** Number of fatalities in a period;

**d.** Number of days since a fatality;

**e.** Days lost through work related illness

**f.** Number of days spent on health and safety training for health and safety officers.

**g.** Number of days spent on health and safety training for employees

Solution 2

**Unit sales**

The number of appliances old has increased by 7.1% (28,000 to 30,000).

At first sight this is very pleasing. However, there is no information about the margins in respect of these sales. If the sales have increased as a result of price reductions there might be a negative impact on the profitability of the company.

Also there is no information about the size of the market. If the market has increased by 10% (say) then the company has lost market share and the performance which looks favourable may not actually be so.

**On-time delivery**

There is a worrying deterioration of the percentage of deliveries made on time.

This could lead to increase costs if the customer contracts include service level agreements calling for compensation for late delivery.

There is also a possibility of loss of custom in the future.

**Sales return**

There is a very worrying increase in the number of units returned. This might be due to the company sending incorrect order or selling defective unit. Either of these could be explained by staff being unable to cope with the increased activity levels. Correction of mistakes has an associated cost including the possible loss of future sales to customers who are dissatisfied.

The increase could also be due to the company allowing its customers to buy goods on a sale or return basis. This makes it more difficult to interpret the increase in sales as still more goods might be returned in the future

The increased sales seem to have caused other areas of performance to suffer.

**Skills level**
**Performance management**

CHAPTER 24

# PERFORMANCE ANALYSIS IN NOT-FOR-PROFIT ORGANISATION

## Chapter Contents


24.0 Learning objective

24.1 Learning outcomes

24.2 Discuss the problems of using non-quantifiable objectives in performance management.

24.3 Explain how performance may be measured in not-for-profit organisations.

24.4 Discuss the problems of having multiple objectives.

24.5 Demonstrate value for money (VFM) as a public sector objective.


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# 24 Performance analysis in not for profit organisation

## 24.0 Learning Objectives

This chapter introduces readers to performance analysis in a not for profit making organisation using a non-quantifiable objectives as well as demonstrate the value for money approach in a public sector organisation.

## 24.1 Learning Outcome

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

(a) Explain how performance might be measured in not-for-profit organisations
(b) Explain the objective of value for money and its application to not-for-profit organisations and the problems of multiple objectives
(c) Analyse and evaluate the strategic aspects of performance relating to profitability, Liquidity and solvency

## 24.2 Performance analysis in Not-For-Profit organisations:

**Section overview**

(a) Problems with having non-quantifiable objectives
(b) Measuring performance in not-for-profit organisations
(c) Problems with multiple objectives

### 24.2.1 Problems of using non-quantifiable objectives

Not-for-profit organisations exist to provide benefits to a targeted group of people or to society as a whole. Government-owned institutions use taxpayers' money to provide services to the public, such as health services, education, policing, the criminal courts system and so on. Some government departments perform administrative tasks on behalf of the government, such as the tax department.

Although they must operate within the constraints of the money (budget) available to them, the main objectives of government and state-owned organisations are non-financial.

Similarly, the objectives of charities are to provide assistance to a targeted group, such as aid for victims of war or natural disasters, assistance for people with certain illnesses or disabilities, assistance for local communities, funding research into disease, care for old people, and so on. They must operate within the constraints of the financial contributions they receive, from the government and individual donations, but their prime objective is non-financial.

A problem with having a non-financial objective is that they can be difficult to quantify. How does a health service quantify the provision of its services; how is the provision of education or policing measured? How is the objective of helping victims of tsunamis or earthquakes measured?

The answer is that these overriding non-financial objectives cannot be properly quantified. Whereas for-profit companies have quantifiable financial objectives, most not-for-profit organisations have non-quantifiable broad objectives.

### 24.2.2 Measuring performance in not-for-profit organisations

Performance management systems rely on the use of quantifiable performance indicators. This is true for not-for-profit organisations as well as for commercial companies.

Not-for-profit organisations can set financial objectives, although these are not their main objective. For example, a government department can set an objective of operating within its allocated budget limits. A charity can set an objective of raising the amount of money it receives from donations.

However, for a performance measurement system to operate effectively, not-for-profit organisations need quantifiable objectives that relate to their main objective. They do this by identifying a number of targets which are considered 'key' to successful performance, and measure performance by comparing actual results with these key targets.

**Example: Quantifiable objectives**

A health service may set targets for the numbers of patients treated each year in hospitals or in doctors' surgeries, the average length of stay of patients in hospitals, targets for reducing the numbers of people suffering from specific diseases or ailments, and so on.

Similarly a police force may set targets for reductions in the number of murders, reductions in the number of burglaries, an increase in successful prosecutions of criminals, and so on.

A state-run education system can set targets for schools for the number of children achieving 'A grades' in their examinations at various ages, and targets for the proportion of children moving on to university or technical college after school.

In other words, not-for-profit organisations can assess performance by comparing actual results against a range of quantifiable targets.

### 24.2.3 Problems with multiple objectives

A problem with having multiple objectives, without an overall quantifiable main objective, is that organisations may perform well when measured against some of their performance targets, but may perform badly in relation to other targets.

When this happens, how do we decide whether the organisation has performed successfully or not?

**Example: Multiple objectives**

A national health service may succeed in treating a larger number of patients in hospital, but average waiting times for hospital treatment might get longer.

A police force may achieve its target of reducing the number of murders each year by 10%, but fail to achieve its target of reducing burglaries by 5% - and the number of burglaries may even have increased.

In the schools system, targets for examination results may be achieved for 11-year old children, but exam results may be poor for 16-year olds.

Problems with multiple performance objectives are that:

(a) It is difficult to assess overall performance when some key targets are met but others are not
(b) The key targets that are selected may not properly represent all the not-for-profit objectives of the organisation: for practical reasons the number of performance targets must be limited to a manageable number.

## 24.3 Demonstrate value for money (VFM) as a public sector objective

**Section overview**

(a) The nature of value for money
(b) VFM as a public sector objective
(c) Quantitative measures of efficiency
(d) Quantitative measures of effectiveness

### 24.3.1 The nature of value for money

The value for money approach to measuring performance in non-for-profit organisations is based on the idea that these organisations must work within financial constraints. Government departments must operate within budget limits. Charities must operate within spending limits set by the amount of donations they receive.

Not-for-profit organisations should therefore aim to make the best use of the money available to them, and create 'value' in what they do. Making the best use of money is described as achieving value for money or VFM.

There are three aspects to achieving value for money, often referred to as the '3Es':

(a) Economy
(b) Efficiency
(c) effectiveness.

The concept of VFM can also be applied in commercial for-profit businesses, but it is more commonly used in performance measurement systems of not-for-profit organisations.

**Economy**

Economy means keeping spending within limits, and avoiding wasteful spending. It can also mean achieving the results but for less cost. A simple example of economy is found in the purchase of supplies. Suppose that an administrative department buys items of stationery from a supplier, and pays ₦2 each for pens. It might be possible to buy pens of the same quality to fulfil exactly the same purpose for ₦1.50 each. Economy would be achieved by switching to buying the

₦1.50 pens, saving ₦0.50 per pen with no loss of operating efficiency or effectiveness.

**Effectiveness**

Effectiveness refers to success in achieving end results or success in achieving objectives. Whereas efficiency is concerned with getting more outputs from

available resources, effectiveness is concerned with achieving outputs that meet the required aims and objectives. For example, the effectiveness of treatment of a particular medical condition will be improved if the proportion of patients who are treated successfully rises from 80% to 90%.

**Efficiency**

Efficiency means getting more output from available resources. Applied to employees, efficiency is often called 'productivity'. Suppose that an employee in the government's tax department processes 20 tax returns each day. Efficiency would be improved if the same individual increases the rate of output, and processes 25 tax returns each day, without any loss of effectiveness.

### 24.3.2 VFM as a public sector objective

Management accounting systems and reporting systems may provide information to management about value for money. Has VFM been achieved, and if so, how much and in what ways?

Value for money audits may be carried out to establish how much value is being achieved within a particular department and whether there have been improvements to value for money. Internal audit departments may carry out occasional VFM audits, and report to senior management and the manager of the department they have audited.

Value for money is an objective that can be applied to any organisation whose main objective is non-financial but which has restrictions on the amount of finance available for spending. It could therefore be appropriate for all organisations within the public sector.

The objective of **economy** focuses on the need to avoid wasteful expenditure on items, and to keep spending within limits. It also helps to ensure that the limited finance available is spent sensibly. Targets could be set for the prices paid for various items from external suppliers. Audits by the government's auditors into departmental spending may be used to identify:

(a) any significant failures to control prices, and
(b) unnecessary expense.

The objective of **efficiency** focuses on the need to make full use of available resources. The objective of **effectiveness** focuses on the need to use resources for their intended purpose and achieve the objectives of the organisation.

Unfortunately, in practice government is often accused of wasteful spending, inefficient operations and failure to get anything done – these are all the 'traditional' faults of an over-sized bureaucracy!

A problem with VFM as a performance measurement system is that it is not easy to apply VFM to **planning and** setting performance targets. An organisation can assess retrospectively whether or not a particular aspect of operations has achieved value for money**, but it is not so easy to plan in advance just how value or money will be achieved.**

**Example: Valu for money audit**

A local authority sets up a project aimed at encouraging more young people in the area into employment, with the objective of increasing the number of 16-24 year olds in the local area who are in employment by 10% over three years.

The project managers were very driven to achieve this target and the project ultimately increased employment rates of this demographic by 12% over the period. However, the enthusiasm with which meeting the set target was embraced did result in higher than expected costs and there was an overspend of 8% on the budget for the project.

The overspend prompted a value for money audit to be carried out. A key finding from this was that the project was marginally less expensive, on an outcome by outcome basis, than similar campaigns run by other local authorities in the country.

**Required**

Determine whether or not you consider the local authority employment project to have delivered value for money by making reference to the economy, efficiency and

**Answer**

**Economy:** For the project to deliver economy it should control its expenditure and make the best use of its resources. The overspend on the budget shows that the cost control could have been better and indicates that economy may not have been achieved for this project.

**Efficiency:** The project will be efficient if it has made full use of its resources in the best possible way to meet the objectives. The comparative data indicates that, on an outcome by outcome basis, the project cost slightly less than similar projects carried out by other local authorities. This suggests that the project was efficient.

**Effectiveness:** The project will be considered effective if it met its objective of increasing employment in the target demographic by 10% over the period. This target was exceeded and an increase in 12% was observed. This indicates that the project was effective.

**Overall:** the project was both efficient and effective. It does not appear that it was economic which implies that overall value for money may not have been achieved. However, it is possible that the cost projections were too ambitious. If this was the case the project may have delivered value for money overall. Further investigation will be needed.

### 24.3.4 Quantitative measures of efficiency

Efficiency relates the quantity of resources to the quantity of output. This can be measured in a variety of ways

(a) Annual output/Maximum output for a given resource × 100%

(b) Minimum input to achieve required level of output/actual input × 100%

(c) Actual output/actual input □ 100% compared to a standard or target

**Example: Quantitative measures of efficiency**

A hospital has an operating theatre which can be utilised for 20 hours per day. The maximum number of operations that can be performed in any day is 40. If on a particular day 35 operations were performed, this represents

35/40 × 100% = 87.5% efficiency

A local authority must ensure that the refuse of all residents is collected each week for re-cycling. This normally requires 1,000 man hours. If in a particular week 900 man hours were used this represents

1,000/900 × 100% = 111.1% efficiency

Schools may have a standard pupil to teacher ratio of 27. If a particular school has 550 pupils and 21 teachers then the actual ratio is 26.2 which represents

### 24.3.5 Quantitative measures of effectiveness

Effectiveness relates what has been achieved to the intended objectives for achievement.

**Example: Quantitative measure of effectiveness**

The operating theatre in a hospital may have a maximum capacity of 40 operations per day and the average utilisation of this capacity may be 87.5%. This is a measure of efficiency in the use of the hospital operating theatre. But the aim of operations in hospitals is to treat patients successfully. The target may be for 95% of operations to be successful, but the actual success rate (measured perhaps by whether patients need further treatment after their operation) may be just 90%. This would be a measure of effectiveness in obtaining value for money.

## 24.5 Chapter Review

**Chapter review**

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

(a) Explain how performance might be measured in not-for-profit organisations

(b) Explain the objective of value for money and its application to not-for-profit organisations and the problems of multiple objectives

(c) Analyse and evaluate the strategic aspects of performance relating to profitability, liquidity and solvency

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**Skills level**
**Performance management**




# DIVISIONAL PERFORMANCE AND TRANSFER PRICING

## Chapter Contents

25.0 Learning objective
25.1 Learning outcomes
25.2 Select and explain suitable divisional measures for a given business using return on investment (ROI) , residual income (RI) and economic value added(EVA) approaches .
25.3 Evaluate the results and advise management.

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# 25 Divisional performance and transfer pricing

## 25.0 Learning objective

This chapter introduces to the candidates the explanation of suitable divisional measures for a given business using return on investment, residual income and economic value added approaches.

## 25.1 Learning outcome

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

(a) Explain and illustrate cost centres, profit centres and investment centres
(b) Define, calculate and interpret return on investment
(c) Define, calculate and interpret residual income
(d) Define, calculate and interpret economic value added

## 25.2 Select and explain divisional Measures for a Given business using ROI, **residual income and EVA approaches**

**Contents**


1 Investment, profit, revenue and cost centres
2 Divisional performance evaluation
3 Return on Investment (ROI)
4 Residual income (RI)
5 Divisional performance and depreciation
6 Economic value added (EVA)
7 Chapter review


### 25.2.1 Investment, profit, revenue and cost centres

**Section overview**

(a) Organisational structure and management responsibilities
(b) Definitions and explanation

### 25.2.2 Organisational structure and management responsibilities

Every business organisation has a management structure with individual managers given responsibility for a particular aspect of operations or activity. The operations or activity for which they are responsible can be called a **responsibility centre**. Within a large organisation, there is a hierarchy of management, with a hierarchy of delegated responsibilities.

A manager might be in charge of a department, such as a warehouse or the buying department. A part of their responsibility should be to ensure that the department operates efficiently and economically, and that costs (expenditures) are kept under control. A departmental manager is likely to be responsible for preparing the annual cost budget for the departments, subject to approval by his superiors. A manager who is made responsible for costs must have some authority over spending in his department (although a large proportion of departmental costs, such as employees' salaries, might be outside his control).

A manager might be responsible for a department or activity that earns revenue, and for the revenue earned by the department. For example a sales manager might be made responsible for the activities of a sales team and the revenue that the sales team earns. Similarly, the manager of a retail store (in a company that operates a chain of stores) might be responsible for the revenues earned by the store. A manager who is made responsible for revenues might have some authority to adjust or decide selling prices; alternatively a manager might be told what the sales prices will be and is them made responsible for the volume of sales at those prices.

When a manager is responsible for both the costs and the revenues of an operation or department, he (or she) is also responsible for the profits that it earns.

In some cases, a manager might have the responsibility to make decisions about capital investment for an operation, with authority to buy new capital equipment or sell off unwanted assets. For example in a large company or a group of companies, there might be operating divisions where the divisional manager has a large amount of autonomy, with authority over capital spending ('capital budgets') as well as revenues, costs and profits.

### 25.2.3 Definitions and explanation

Managers need management accounting information to help them make decisions. Responsibility centres can be divided into four categories:

**Investment centres.**

An investment centre is a division within an organisation where the manager is responsible not only for the costs of the division and the revenues that it earns, but also for decisions relating to the investment in assets for the division. An investment centre manager usually has authority to purchase new assets, such as items of plant or equipment, and so should be responsible for the profit or 'return' that the division makes on the amount that it has invested.

The performance of an investment centre might be measured by calculating the profit as a percentage of the amount invested (the return on investment or ROI).

An investment centre might include a number of different profit centres. For example, a company manufacturing cars and trucks might have two investment centres, (1) car-making and (2) truck-making. Within the truck-making division, there might be several profit centres, each of these a separate location or factory at which trucks are manufactured and assembled.

**Profit centres.**

A profit centre is a department or division within the organisation for which revenues as well as costs are established.

The profit (or loss) that the centre makes is found by measuring the costs of the products or services produced by the centre, and the revenues earned from selling them.

**Example: Summarised profit centre report**

| Example: summarised profit centre report | ₦000 |
|---|---|
| Revenues of the profit centre | 250 |
| Costs of the units sold by the profit centre | (220) |
| Profit (or loss) of the profit centre | 30 |

A profit centre might consist of several cost centres. For example, a factory might be treated as a profit centre, and within the factory, the machining department, assembly department and finishing department might be three cost centres.

**Revenue centres.**

A revenue centre is a department or division within the organisation for which revenues are established. In a revenue centre there is no measurement of cost or profit. Revenue centre managers will only need to have information relating to revenues and will be accountable for revenues only. For example, the income accountant in a hospital is only responsible for recording and controlling the different incomes that are received from funding bodies or other sources (for example, private patients, fundraising and so on).

**Cost centres.**

A cost centre is a department or work group for which costs are established, in order to measure the cost of output produced by the centre. For example, in a factory a group of machines might be a cost centre. The costs of operating the machines would be established, and a cost could then be calculated for each unit of product manufactured by the machines.

In a cost centre, there is no measurement of revenue or profit.

**Example:**

**Responsibility centres**

A media company has several divisions.
One is a magazine publishing division. This division is divided into three operating units: fashion magazines, sports magazines and business magazines, which operate from different offices.
The fashion magazines unit has three main functions: commissioning, editing and printing, and marketing and sales.
The media company might organise its cost and management system as follows:

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### Investment centres

Each of the divisions in the media company, including the magazines division, might be an investment centre. The senior manager of the magazines division might have the authority to incur capital expenditure to acquire new assets for the division. The performance of the magazines division might be measured by its annual return on investment (ROI).

### Profit centres

Within the magazines division, the fashion magazines unit, sports magazines unit and business magazines unit might be profit centres. The manager of each unit might be responsible for the revenues and costs of the unit, and the performance of each unit would be measured by the profit that it makes.

### Cost centres

Within the fashions magazine unit, each of the operating functions (commissioning, editing and printing, and marketing and sales) might be a cost centre. The manager in charge of each cost centre is responsible for costs, and the performance of the cost centre might be measured by comparing the actual costs of the cost centre with its budgeted costs.

### The differing information needs of cost, revenue, profit and investment centre management

Managers of responsibility centres are responsible for the performance of their part of the organisation and its activities. The performance of an organisation is often measured financially, in terms of:

(a) keeping expenditure under control;

(b) earning a sufficient amount of revenue;

(c) making a profit;

(d) making a suitable return on investment.

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Managers therefore need information about the costs of operations for which they are responsible. They will often also need information about revenues and profit. In some cases, they will also need information about the amount of property, plant and equipment, and other 'assets' for which they are responsible. The information they need to make decisions within their area of responsibility depends on the scope of their management authority and responsibilities.

Managers also need financial information to help them make decisions. For example, they might need information about expected costs to make a decision about how much to charge a customer for a job. Similarly, they might need information about costs and revenues to decide whether to invest money in a new project.

Management accounting is concerned with providing information to management to help them with planning and control, and for making other decisions.

The accounting information provided to managers should help them to make decisions, and the information provided should be relevant for the decisions they have to make. Clearly, the nature and content of the accounting information required depends on the nature of the manager's responsibilities (i.e. on the type of responsibility centre).

## 25.2 Divisional performance evaluation

**Section overview**

(a) Decentralisation of authority
(b) Benefits of decentralisation
(c) Disadvantages of decentralisation
(d) Controllable profit and traceable profit

### 25.2.1 Decentralisation of authority

Decentralisation involves the delegation of authority within an organisation. Within a large organisation, authority is delegated to the managers of cost centres, revenue centres, profit centres and investment centres.

A divisionalised structure refers to the organisation of an entity in which each operating unit has its own management team which reports to a head office. Divisions are commonly set up to be responsible for specific geographical areas or product lines within a large organisation.

The term 'decentralised divisionalised structure' means an organisation structure in which authority has been delegated to the managers of each division to decide selling prices, choose suppliers, make output decisions, and so on.

### 25.2.2 Benefits of decentralisation

Decentralisation should provide several benefits for an organisation.

(a) **Decision-making should improve**, because the divisional managers make the tactical and operational decisions, and top management is free to concentrate on strategy and strategic planning.

(b) **Decision-making at a tactical and operational level should improve,** because the divisional managers have better 'local' knowledge.

(c) **Decision-making should improve, because decisions will be made faster.** Divisional managers can make decisions 'on the spot' without referring them to senior management.

(d) **Managers may be more motivated to perform well** if they are empowered to make decisions and rewarded for performing well against fair targets

(e) Divisions **provide useful experience for managers** who will one day become top managers in the organisation.

(f) Within a large multinational group, there can be **tax advantages in creating a divisional** structure, by locating some divisions in countries where tax advantages or subsidies can be obtained.

### 25.2.3 Disadvantages of decentralisation

Decentralisation can lead to problems.

**(a)** The divisional managers might put the interests of their division before the interests of the organisation as a whole. Taking decisions that benefit a division might have adverse consequences for the organisation as a whole. When this happens, there is **a lack of 'goal congruence'.**

(b) **Top management may lose control** over the organisation if they allow decentralisation without accountability. It may be necessary to monitor divisional performance closely. The cost of such a monitoring system might be high.

(c) It is **difficult to find a satisfactory measure of historical performance** for an investment centre that will motivate divisional managers to take the best decisions. For example, measuring divisional performance by Return on Investment (ROI) might encourage managers to make inappropriate long- term investment decisions. This problem is explained in more detail later.

(d) **Economies of scale might be lost.** For example, a company might operate with one finance director. If it divides itself into three investment centres, there might be a need for four finance directors – one at head office and one in each of the investment centres. Similarly there might be a duplication of other systems, such as accounting system and other IT systems.

### 25.2.4 Controllable profit and traceable profit

Profit is a key measure of the financial performance of a division. However, in measuring performance, it is desirable to identify:

(a) costs that are controllable by the manager of the division, and also

(b) costs that are traceable to the division. These are controllable costs plus other costs directly attributable to the division over which the manager does not have control.

There may also be an allocation of general overheads, such as a share of head office costs.

Profit centres and investment centres often trade with each other, buying and selling goods and services. These are internal sales, priced at an internal selling price (a ‘transfer price’). Reporting systems should identify external sales of the division and internal sales as two elements of the total revenue of the division.

Transfer prices were covered in the previous chapter.

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**Example: Controllable profit**

| | ₦ |
|---|---|
| External sales | 600,000 |
| Internal sales | (150,000) |
| Total sales | 750,000 |
| Costs controllable by the divisional manager: | |
| Variable costs | (230,000) |
| Contribution | 420,000 |
| Controllable fixed costs | (140,000) |
| Profit attributable to the manager (controllable profit) (1) | 280,000 |
| Costs traceable to the division but outside the manager's control | (160,000) |
| Profit traceable to the division (2) | 120,000 |
| Share of general overheads (3) | (30,000) |
| Net profit | 90,000 |

Notes:

These profit measures can be used with variance analysis, ratio analysis, return on investment, residual income and non-financial performance measurements to evaluate performance.

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## 25.3 Return on investment (ROI)

**Section overview**

(a) The reason for using ROI as a financial performance indicator
(b) Measuring ROI
(c) ROI and investment decisions
(d) Advantages and disadvantages of ROI for measuring performance

### 25.3.1 The reason for using ROI as a financial performance indicator

Return on investment (ROI) is a measure of the return on capital employed for an investment centre. It is also called the accounting rate of return (ARR).

It is often used as a measure of divisional performance for investment centres because:

(a) the manager of an investment centre is responsible for the profits of the centre and also the assets invested in the centre, and
(b) ROI is a performance measure that relates profit to the size of the investment.

Profit is not a suitable measure of performance for an investment centre. It does not make the manager accountable for his or her use of the net assets employed (the investment in the investment centre).

**Example: Return on investment**

A company has two divisions which are treated as investment centres for the purpose of performance reporting. Centre 1 has net assets of ₦5 million and made a profit of ₦250,000. Centre 2 has net assets of ₦1 million and made a profit of ₦150,000.

If the performance of the centres is compared on the basis of profits, the performance of Centre 1 (₦250,000) is better than the performance of Centre 2 (₦150,000). However Centre 1 employed assets of ₦5 million to earn its profit and its ROI was just 5% (₦250,000/₦5 million). Centre 2 employed assets of just ₦1 million to earn its profit and its ROI was 15% (₦150,000/₦1 million). Comparing performance on the basis of ROI, Centre 2 performed better.

### 25.3.2 Measuring ROI

ROI is the profit of the division as a percentage of capital employed.

However, performance measurement systems should use ROI to evaluate the performance of both the manager and the division.

Although, ROI can be measured in different ways, the recommended measures are as follows:

**Formula: Return on investment – managerial evaluation**

$$ROI = \frac{\text{Controllable profit}}{\text{Division's capital employed (size of investment)}} \times 100\%$$

**Formula: Return on investment – divisional evaluation**

$$ROI = \frac{\text{Traceable profit}}{\text{Division's capital employed (size of investment)}} \times 100\%$$

Profit is usually measured as an accounting profit, after deduction of any depreciation charges on non-current assets.

Capital employed/investment.

(a) This should be the sum of the non-current assets used by the division plus the working capital that it uses. Working capital = current assets minus current liabilities, which for a division will normally consist of inventory plus trade receivables minus trade payables.

(b) Non-current assets could be measured at their initial cost. However, it is more usual to measure non-current assets at their carrying value, which in an examination question is likely to be at cost less accumulated depreciation.

(c) Capital employed may be the capital employed at the beginning of the financial year, the end of the financial year or the average capital employed for the year. Check an examination question carefully to establish which of these is required.

Where possible, the capital employed by the division should be analysed into:

(a) capital (assets less liabilities) controllable by the manager, and

(b) capital (assets and liabilities) traceable to the division.

**Example: Return on investment**

An investment centre has reported the following results.

| | Current year | Previous year |
|---|---|---|
| | ₦000 | ₦000 |
| Sales | 600 | 600 |
| Gross profit | 180 | 210 |
| Net profit | 24 | 30 |
| Net assets at beginning of year | 200 | 180 |

**Required**

Discuss the financial performance of the investment centre. ROI is measured using net assets at the beginning of the year.

**Answer**

ROI should be used to measure the performance of the division, but other financial ratios should also be used if appropriate. In this example, sales revenue growth in the current year has been 0% and we can also measure the gross profit margin and net profit margin.

| | Current year | Previous year |
|---|---|---|
| | ₦000 | ₦000 |
| Gross profit margin (%) | 30% | 35% |
| Net profit margin (%) | 4% | 5% |
| ROI (24/200; 30/180) | 12% | 17% |

ROI has fallen from 17% to 12%, which is a large fall. The total investment has increased from ₦180,000 to ₦200,000 but there has been no increase in sales revenue in spite of the bigger investment.

A reason for the fall in ROI is the fall in gross profit and the gross profit margin, from 35% to 30%. Other costs have been reduced from ₦180,000 in the previous year (₦210,000 - ₦30,000) to ₦156,000 in the current year (₦180,000 -

₦24,000), but in spite of the reduction in these costs, the net profit margin also fell from 5% to 4%.

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The failure to achieve any growth in sales (in spite of an increase in investment) and the fall in gross profit margin are the reasons for the deterioration in financial performance, as measured by ROI. This could be caused by intense competition in the market in the current year (resulting in lower prices but no revenue growth), although there is a possibility that the cost of sales are out of control.

### 25.3.3 ROI and investment decisions

The performance of the manager of an investment centre may be judged on the basis of ROI – whether the division has succeeded or not in achieving a target ROI for the financial year, or whether ROI has improved since the previous year.

If an incentive scheme is in operation, a divisional manager may receive a bonus on the basis of the ROI achieved by the division.

Investment centre managers may therefore have a strong incentive to improve the ROI of their division, and to avoid anything that will reduce the ROI. This can be a serious problem when investment decisions are involved. When an investment centre manager's performance is evaluated by ROI, the manager will probably be motivated to make investment decisions that increase the division's ROI in the current year, and reject investments that would reduce ROI in the current year.

The problem is that investment decisions are made for the longer term, and a new investment that reduces ROI in the first year may increase ROI in subsequent year. An investment centre manager may therefore reject an investment because of its short-term effect on ROI, without giving proper consideration to the longer term.

**Example: ROI and investment decisions**

A division has net assets of ₦800,000 and makes an annual profit of ₦120,000.

It should be assumed that if the investment described below is not undertaken, the division will continue to have net assets of ₦800,000 and an annual profit of ₦120,000 for the next four years.

The division is considering an investment in a new item of equipment that would cost ₦80,000. The estimated life of the equipment is four years with no residual value.

The estimated additional profit before depreciation from the investment is as follows:
The asset will be depreciated on a straight-line basis.

**Required**

What would be the ROI on this investment? ROI should be measured on the basis of the average net assets employed during the year.

Would the investment centre manager decide to undertake this investment or not?

| Year | ₦ |
|---|---|
| 1 | 20,000 |
| 2 | 25,000 |
| 3 | 35,000 |
| 4 | 40,000 |

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Answer

The annual profit from the investment, allowing for depreciation of ₦20,000 per year, and the annual ROI of the division would be as follows:

| Year | Profit without the investment | Extra profit from the investment | Total profit | Net assets | ROI |
|---|---|---|---|---|---|
| | ₦ | ₦ | ₦ | ₦ | |
| 1 | 120,000 | 00 | 120,000 | 870,000 | 13.8 % |
| 2 | 120,000 | 5,000 | 125,000 | 850,000 | 14.7 % |
| 3 | 120,000 | 15,000 | 135,000 | 830,000 | 16.3 % |
| 4 | 120,000 | 20,000 | 140,000 | 810,000 | 17.3 % |

Note: Net assets are ₦800,000 plus the net assets for the new investment. The net asset value of the new investment is ₦80,000 at the beginning of Year 1,

₦60,000 at the beginning of Year 2 and so on down to ₦0 at the end of Year 4Average net assets are therefore ₦70,000 in Year 1, ₦50,000 in Year 2,

₦30,000 in Year 3 and ₦10,000 in Year 4.

Without the new investment, the annual ROI would be 15% (=

₦120,000/₦800,000).

The new investment would therefore reduce ROI in the first and second years, and increase ROI in Year 3 and Year 4. It is therefore probable that the divisional manager, if he is more concerned about financial performance in the short term, will decide that the investment should not be undertaken, even though over a four-year period the investment may be worthwhile.

Note. Investment decisions should not be taken on the basis of ROI, even though divisional managers are often tempted to do so. We can, however, calculate the average ROI from this proposed investment:

| | |
|---|---|
| Total 4-year profits before depreciation | 120,000 |
| Depreciation over four years | 80,000 |
| Total profit over 4 years | 40,000 |
| Average annual profit from the investment | 10,000 |
| Average asset carrying value over 4years:<br>Average ROI | |
| 80000 = $40,000<br>2 | |
| ₦10000 = 25%<br>40000 | |

This is higher than the ROI of 15% achieved from the division's other assets.

25.3.4 Advantages and disadvantages of ROI for measuring performance

**Advantages of using ROI**

There are several advantages in using ROI as a measure of the performance of an investment centre.

(a) It relates the profit of the division to the capital employed, and the division manager is responsible for both profit and capital employed.
(b) ROI is a percentage measure and can be used to compare the performance of divisions of different sizes.
(c) It is an easily understood measure of financial performance.
(d) It focuses attention on capital as well as profit, and encourages managers to sell off unused assets and avoid excessive working capital (inventory and receivables).

**Disadvantages of using ROI**

There are also disadvantages in using ROI as a measure of the performance of an investment centre.

(a) As explained above, investment decisions might be affected by the effect they would have on the division's ROI in the short term, and this is inappropriate for making investment decisions.
(b) There are different ways of measuring capital employed. ROI might be based on the net book value (carrying value) of the division at the beginning of the year, or at the end of the year, or the average for the year. Comparison of performance between different organisations is therefore difficult.
(c) When assets are depreciated, ROI will increase each year provided that annual

profits are constant. The division's manager might not want to get rid of ageing assets, because ROI will fall if new (replacement) assets are purchased. This point is explained in a later section of this chapter.

(d) ROI is an accounting measure of performance. An alternative system of performance measurement that includes non-financial performance indicators, such as a balanced scorecard approach, might be more appropriate.

**Section overview**

(a) Measuring residual income
(b) Imputed interest (notional interest) and the cost of capital
(c) Residual income and investment decisions
(d) Advantages and disadvantages of residual income

## 25.4 Residual Income (RI)

### 25.4.1 Measuring residual income

Residual income (RI) is another way of measuring the performance of an investment centre. It is an alternative to using ROI.

Residual income is measured in either of the following ways:

**Illustration: Residual income – Managerial evaluation**

| | ₦ |
|---|---|
| Controllable profit | X |
| Less notional interest on average controllable investment | (X |
| Controllable residual income | X) |

**Illustration: Residual income – Divisional evaluation**

| | ₦ |
|---|---|
| Traceable profit | X |
| Less notional interest on average traceable investment | (X) |
| Divisional residual income | Y |

### 25.4.2 Imputed interest (notional interest) and the cost of capital

Residual income is calculated by deducting an amount for imputed interest (also called notional interest) from the accounting profit for the division.

The **interest charge** is calculated by applying a cost of capital to the division's net investment (net assets). The most appropriate measure of net investment is the average investment during the period, although an exam question may instruct you to calculate the interest charge on net assets at the beginning of the year.

Imputed interest (notional interest) is the division's capital employed multiplied by:

(a) the organisation's cost of borrowing; or

(b) the weighted average cost of capital of the organisation; or

(c) a special risk-weighted cost of capital to allow for the special business risk characteristics of the division. A higher interest rate would be applied to divisions with higher business risk.

**Example: Residual income**

The same example that was used in the previous section to illustrate ROI will be used here to illustrate residual income.

An investment centre has reported the following results.

| | **Current year** | **Previous year** |
|---|---|---|
| | ₦000 | ₦000 |
| Sales | 600 | 600 |
| Gross profit | 180 | 210 |
| Net profit | 24 | 30 |
| Net assets at beginning of year | 200 | 180 |

**Answer**

The residual income of the division in each year is calculated as follows.

| | **Current year** | | **Previous year** |
|---|---|---|---|
| | | ₦000 | ₦000 |
| Profit | | 24,000 | 30,000 |
| Notional interest | (10% □ ₦200,000) | (20,000) | (10% □ ₦180,000)(18,000) |
| Residual | | | |
| income | | 4,000 | 12,000 |

Residual income has fallen from ₦12,000 in the previous year to ₦4,000 in the current year. This indicates deterioration in divisional performance, although the residual income is still positive. This means that the division's profits exceed its cost of capital.

An analysis of gross profit margin, net profit margin and sales growth (0%) will indicate the causes of the fall in residual income.

### 25.4.3 Residual income and investment decisions

One reason for using residual income instead of ROI to measure a division's financial performance is that residual income has a money value, whereas ROI is a percentage value. A company may prefer to measure performance in money terms. In most other respects, however, residual income is similar to ROI as a measure of divisional performance.

**Example: Residual income and investment decisions**

The difference between ROI and residual income can be illustrated by returning to the previous example that was used to illustrate the effect of ROI on investment decision-making.

A division has net assets of ₦800,000 and makes an annual profit of ₦120,000. It should be assumed that if the investment described below is not undertaken, the division will continue to have net assets of ₦800,000 and an annual profit of

₦120,000 for the next four years. The division's financial performance is measured using residual income, and the division's cost of capital is 12%.

The division is considering an investment in a new item of equipment that would cost ₦80,000. The estimated life of the equipment is four years with no residual value. The estimated additional profit before depreciation from the investment is as follows:

| Year | ₦ |
|---|---|
| 1 | 20,000 |
| 2 | 25,000 |
| 3 | 35,000 |
| 4 | 40,000 |

The asset will be depreciated on a straight-line basis. **Required**

What would be the annual residual income on this investment? Notional interest should be calculated on the basis of the average net assets employed during the year.

Would the investment centre manager decide to undertake this investment or not?

**Answer**

| **Calculation of residual income** | ₦ | ₦ | ₦ | ₦ |
|---|---|---|---|---|
| Profit without investment | 120,000 | 120,000 | 120,000 | 120,000 |
| Additional profit before depreciation | 20,000 | 25,000 | 35,000 | 40,000 |
| Additional depreciation | (20,000) | (20,000) | (20,000) | (20,000) |
| Divisional profit | 120,000 | 125,000 | 135,000 | 140,000 |

If the investment is not undertaken, the residual income in each year would be:

| | |
|---|---|
| Profit without investment | 120,000 |
| Notional interest (12% □ ₦800,000) | (96,000) |
| Residual income | 24,000 |

If the investment is undertaken, residual income would fall in Year 1 and Year 2, but increase in Year 3 and Year 4. If the divisional manager is most concerned about short-term financial performance, he would decide that the investment should not be undertaken, in spite of the longer-term addition to residual income.

| **Workings:** | **Year 1** ₦ | **Year 2** ₦ | **Year 3** ₦ | **Year 4** ₦ |
|---|---|---|---|---|
| **Notional interest** | | | | |
| Average investment | 870,000 | 850,000 | 830,000 | 810,000 |
| Notional interest at 12% | 104,400 | 102,000 | 99,600 | 97,200 |

### 25.4.4 Advantages and disadvantages of residual income

Advantages of residual income

There are several advantages in using residual income as a measure of the performance of an investment centre.

(a) It relates the profit of the division to the capital employed, by charging an amount of notional interest on capital employed, and the division manager is responsible for both profit and capital employed.
(b) Residual income is a flexible measure of performance, because a different

cost of capital can be applied to investments with different risk characteristics.

**Disadvantages of residual income**

There are also disadvantages in using residual income as a measure of the performance of an investment centre.

(a) Residual income is an accounting-based measure, and suffers from the same problem as ROI in defining capital employed and profit.
(b) Its main weakness is that it is difficult to compare the performance of different divisions using residual income. Larger divisions should earn a bigger residual income than smaller divisions. A small division making residual income of ₦50,000 might actually perform much better than a much larger division whose residual income is ₦100,000, if performance ismeasured by ROI. This point is illustrated in the example below.
(c) Residual income is not easily understood by management, especially managers with little accounting knowledge

**Practice question** **1**

A company has two divisions, Small and Big. Big Division has net assets of

₦8 million and makes an annual profit of ₦900,000. Small Division has netassets of ₦400,000 and makes an annual profit of ₦90,000. The cost of capital for both divisions is10%.

(a) ROI

(b) Residual

### 25.4.5 Divisional Performance and Depreciation

**Section overview**

- ROI or RI: the problem with depreciation

**ROI or RI: the problem with depreciation**

If straight-line depreciation is used and capital employed is based on carrying values (net book values) the annual ROI and residual income will increase over time if:

(a) annual profits are constant, and

(b) assets are not replaced, and existing assets remain in use as they get older.

In the early years of an investment, the ROI or residual income may be very low. If a divisional manager is concerned about the effect that this would have on the division's ROI or residual income for the next year or two, the manager may refuse to invest in the project. This is because performance in the next year or so might

be much worse, even though the project might be expected to earn a high return over its full economic life.

The tendency for ROI and residual income to increase over time if assets are not replaced means that divisional managers may prefer to keep old and ageing assets in operation as long as possible – even though it might be preferable in the longer term to replace the assets sooner.

These effects can be seen in the following practice question.

**Practice question 2**

A company has just opened a new division that will operate as an investment centre. The following estimates of future performance have been made.

The division requires an investment of ₦5 million. This consists entirely of new non-current assets. Non-current assets will be depreciated at the rate of 25% of cost each year, and there will be no residual value after four years.

Sales revenue in the first year will be ₦10.8 million, but in subsequent years will change as follows:

(1) There will be no change in selling prices in Year 2, but prices will be reduced by 5% in Year 3 and by a further 5% in Year 4.

(2) Sales volume will increase by 10% in Year 2 and a further 10% in Year 3, but sales volume in Year 4 will be the same as in Year 3.

Costs estimates are as follows.

(1) Gross profit will be 40% in Year 1, but will change as prices are reduced in Years 3 and 4.

(2) There will be no change in the cost of sales per unit sold: prices per unit for cost of goods sold will remain stable.

(3) Annual overheads including depreciation will be ₦3.5 million in Year 1 and Year 2 and ₦4 million in Years 3 and 4.

**Required**

Calculate for each of years 1 – 4:

(b) Sales revenue

(c) Gross profit

(d) Net profit

(e) ROI, assuming that capital employed is the net book value of the investment in the division as at the beginning of the year.

Comment on the figures.

## 25.5 Economic value added (EVA)

**Section overview**

(a) Profits and adding value to a business
(b) The potential benefits of EVA
(c) Measuring economic value added (EVA)
(d) Using EVA
(e) Possible problems with EVA

### 25.5.1 Profits and adding value to a business

In theory, if a company makes a profit, the value of its shares ought to increase by the amount of the profit (less any dividends paid to shareholders). In practice, this does not happen.

One reason for this is that in order to make a profit, capital is invested. Capital is a resource which has a cost. The actual creation of extra value should therefore be the profit less the cost of capital invested. Residual income is the accounting profit earned by a division less a notional charge for capital employed. In theory, there is a connection between residual income and the expected increase in the value of a business.

Peter Drucker once wrote that: 'until a business returns a profit that is greater than its cost of capital, it operates at a loss.'

**Example: Profit and capital**

A company has ₦10 million in cash and keeps it in a bank deposit account earning 2% per year interest.

The cash will earn interest of ₦200,000 less tax in one year, and this will be reported as income. However although keeping money in a low-interest account adds to accounting profit, it does not 'add value' to the company (or 'create value'), because the cost of capital needed to finance the cash is probably higher than 2%.

There is a second – and more important – reason why profits are not a good measure of the expected increase in the value of a business. This is that profit measured by accounting conventions is not a proper measure of 'real' economic profit.

It can be argued that using **economic profit** instead of accounting profit would lead to better measurement of the increase in the value of a business during a given period of time.

Stern Stewart (a management consultancy firm) devised a method of measuring economic profit, which they have called economic value added or EVA. The term 'EVA' is a trademark of the Stern Stewart organisation.

### 25.5.2 The potential benefits of EVA

EVA is a measure of performance that is a close approximation of 'economic profit'. Economic profit is measured in terms of the addition of economic value. An entity earns an economic profit only if it creates economic value through its activities. By creating economic value, a company should add to the wealth of its owners, the shareholders.

Using EVA to measure performance could therefore have the following benefits:

(a) It measures the creation of value by a company, and is a more 'accurate' measurement of performance than accounting profit.

(b) Economic value can be created when expectations of future profitability improve, because economic value can be measured as the net present value of future profits. EVA therefore recognises the benefit of activities, such as new investments, that add to longer-term profitability. Unlike accounting measures of profitability, EVA is not focused exclusively on the short-term.

(c) Management is encouraged to focus on the creation of value (EVA), which is in the long-term interests of shareholders.

(d) Management reward schemes based on EVA are likely to align the interests of management and shareholders more closely than a bonus system linked to annual accounting profits.

(e) It is a simple measure, like profit, and so one that line managers (including those with limited financial understanding) can understand.

### 25.5.3 Measuring economic value added (EVA)

Economic value added (EVA) for a financial period is the economic profit after deducting a cost for the value of capital employed.

The formula for EVA is as follows:

**Formula: Economic value added (EVA)**

EVA = Net operating profit after tax – (Capital employed × Cost of capital)

or

EVA = NOPAT – (Capital employed × WACC)

**Where:**

In practice the computation of EVA involves making adjustments to accounting profit and the accounting value (book value) of assets. These adjustments can be complex and although you are not required to know them in detail, an examination question may ask you to calculate EVA from a given set of simplified data.

### 25.5.4 NOPAT

The net operating profit after tax is calculated by making adjustments to the accounting profit in order to arrive at an estimate of economic profit. NOPAT is similar to 'free cash flow' and is an estimate of economic profit before deducting a cost for the capital employed. The calculation of NOPAT requires a number of different adjustments to the figure for accounting profit.

(a) **Interest costs**. In calculating NOPAT, interest costs of debt capital should not be deducted from profit. This is because debt capital is included in the capital employed. NOPAT should be the profit before deducting interest costs but after deducting tax. There is tax relief on interest, so to reach a figure for NOPAT the amount of interest charges in the period less relief on the interest cost should be added back to the figure for profit after tax.

| NOPAT = Profit after tax + [Interest costs less tax relief on the interest] |
|---|

(b) **Depreciation**. Non-cash expenses should not be deducted from profit. The main item of non-cash expense is usually depreciation of non-current assets. However, there should be a charge for non-current assets, to allow for the economic consumption of value that occurs when the assets are used.

NOPAT = Profit after tax + Post-tax interest cost + [Accounting depreciation – Economic depreciation]

If it can be assumed that accounting depreciation charges are similar to the loss of economic value in non-current assets, the two items cancel out, and:

(c) **Other non-cash expenses**. Other non-cash expenses should also be

| NOPAT = Profit after tax + [Interest costs less tax relief on the interest] |
|---|

added back in order to measure NOPAT. These include additional provisions for irrecoverable debts and other provisions.

(d) **Investments in intangible items**. Investments in intangible items include spending on promotion activities, investing in a brand name, research and development spending and spending on employee training (to increase the economic value of the work force). In conventional accounting systems, these items of expense are usually written off as expenses in the year that they occur. However, they are items of discretionary spending by management that add to the value of the business.

To measure NOPAT, these items of expense that have been written off in the conventional accounts should be added back.

(They should also be added to the value of the company's capital. Economic depreciation charges will be applied as appropriate to this economic capital, in subsequent years.)

### 25.5.5 Charge for capital

EVA is NOPAT minus a charge to represent the cost of capital employed. There are two elements to the capital charge:

(a) the value of the company's assets; and

(b) the cost of capital.

### 25.5.6 Capital employed.

The valuation of capital employed should be based on economic values of the capital employed. In most cases, this means that non-current assets should be valued close to their current value, rather than at a value based on historical cost.

In a simplified system for measuring the economic value of a company's capital employed, the starting point is the book value of the company's net assets. This is:

(a) book value of non-current assets at the beginning of the year; plus

(b) book value of net current assets at the beginning of the year.

Some adjustments should then be made for:

(a) **Investments in intangibles**. Spending on intangible items should be added back in calculating NOPAT, as explained earlier. In addition, the net book value of intangible items should be included in capital employed, and so an estimate of the net book value of the intangibles should be added to the accounting value of the company's net assets.

(b) **Provisions and allowances**. Additions during the year to allowances for irrecoverable debts and additions to provisions should be added back to profit in calculating NOPAT. The total amount of allowances for irrecoverable debts, provisions for deferred tax and other provisions should also be added to capital employed.

(c) **Off-balance sheet financing and operational leases**. Some companies keep items of capital off their balance sheet (statement of financial position). A notable example is assets held on operating leases. The acquisition of leased assets is a form of debt finance, because the lessor (provider of the leased asset) has provided the financing for the assets that the company is leasing. The estimated value of assets held under operating lease agreements (and the value of any other assets financed 'off balance sheet') should be added to capital employed.

### 25.5.7 Cost of capital

The capital charge is calculated by applying the weighted average cost of capital (WACC) to the value of capital employed.

WACC is the weighted average of equity capital and debt capital **in the company's target debt structure**.

(a) If the current debt structure of the company is close to the long-term target debt structure of the company, the weighted average cost of capital can be calculated from the current value of equity and debt capital.

(b) However if the target capital structure is different from the current capital structure, the weighted average cost of capital is calculated using the target proportions of equity and debt.

(c) The cost of equity and the cost of debt can vary from one year to the next. A new WACC may therefore be calculated each year, with appropriate costs for equity and debt in each year.

**Example: WACC**

A company currently has equity capital valued at ₦800 million and debt capital of ₦400 million. Its target is to achieve 50% equity and 50% debt in its capital structure.

In the current year the cost of equity was 15% and the cost of debt was 10%. The rate of tax is 30%.

The WACC for the purpose of calculating EVA is therefore:

$(15\% \times 50\%) + [10\% (1 - 0.30) \times 50\%] = 11\%$.

The following example shows the calculation of EVA, at a level of complexity that you may meet in the examination.

**Example: EVA**

Owerri Distribution Limited's income statement and statement of financial position for the year just ended are (year 1) as follows.

| **Income statement** | **Year 1** |
|---|---|
| | ₦000 |
| Profit before interest and tax | 62,000 |
| Interest cost | 6,000 |
| Profit before tax | 56,000 |
| Tax at 25% | 14,000 |
| Profit after tax | 42,000 |
| Dividends paid | 24,000 |
| Retained profit | 18,000 |

| **Statement of financial position** | **Year 1** |
|---|---|
| | ₦000 |
| Non-current assets | 265,000 |
| Net current assets | 170,000 |
| | 435,000 |
| Shareholders' funds | 345,000 |
| Long-term and medium-term debt | 90,000 |
| | 435,000 |

**Notes**

1 Capital employed at the beginning of the year was ₦410 million.
2 The company had non-capitalised leased assets of ₦18 million in the year. These assets are not subject to depreciation.
3 The estimated cost of equity in the year 1 was 10% and the cost of debt was 7%.
4 The company's target capital structure is 50% equity and 50% debt.
5 Accounting depreciation was equal to economic depreciation so there is no need to make an adjustment to get from accounting depreciation to economic depreciation.
6 Other non-cash expenses were ₦14 million.

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**Example (continued): EVA** EVAs calculated as follows.

| **Net operating profit after tax (NOPAT)** | **Year 1** ₦000 |
|---|---|
| Profit after tax | 42,000 |
| Add: Interest cost less tax: (6,000 less 25%) | 4,500 |
| Add: Non-cash expenses | 14,000 |
| NOPAT | 60,500 |

| **Capital employed** | **Year 1** ₦000 |
|---|---|
| Book value of total assets less current liabilities | 410,000 |
| Non-capitalised leased assets | 18,000 |
| | 428,000 |

**WACC = (Equity rate x 0.5) + (Debt rate (1-tax rate) x 0.5)**

**WACC** (10% × 50%) + [7% (1 – 0.25) × 50%] = 7.625%

| **EVA Calculated:** | **Year 1** ₦000 |
|---|---|
| NOPAT | 60,500 |
| Capital charge: (428,000 × 7.625%) | 32,635 |
| | 27,865 |

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**Practice question 3**

Owerri Distribution Limited's income statement and statement of financial position for the year just ended (year 2).

| **Income statement** | **Year 2** |
|---|---|
| | ₦000 |
| Profit before interest and tax | 80,000 |
| Interest cost | 8,000 |
| Profit before tax | 72,000 |
| Tax at 25% | 18,000 |
| Profit after tax | 54,000 |
| Dividends paid | 29,000 |
| Retained profit | 25,000 |

| **Statement of financial position** | **Year 2** |
|---|---|
| | ₦000 |
| Non-current assets | 280,000 |
| Net current assets | 200,000 |
| | 480,000 |
| Shareholders' funds | 370,000 |
| Long-term and medium-term debt | 110,000 |
| | 480,000 |

**Notes**

1 Capital employed at the beginning of Year 2 was ₦435 million.
2 The company had non-capitalised leased assets of ₦18 million in the year. These assets are not subject to depreciation.
3 The estimated cost of equity in Year 2 was 12% and the cost of debt was 8%.
4 The company's target capital structure is 50% equity and 50% debt.
5 Accounting depreciation was equal to economic depreciation during the year.
**6** Other non-cash expenses were ₦16 million. **Required**

Calculate EVA for the year and comment on the results for year 1 (see the previous example) and year 2.

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**In summary, computation of EVA can be achieved thus:**

**A. Calculating Net operating profit after tax (NOPAT):**

In calculating Net operating Profit (NOPAT), the following adjustments are very important on Profit after Tax:

Add Capitalized research and development for the year.

Add Net interest (1-t) (where t =tax rate)

Add capitalized Promotion for the year.

Add training cost capitalized for the year.

Add marketing cost capitalized for the year.

Add Financial depreciation for the year.

Less Economic depreciation for the year.

Add Provisions and allowances for Bad debt, inventories for the year.

Add deferred tax provision.

Less Cash tax

Add Non- cash expenses

= Net Operating Profits after Tax (NOPAT)

**B. Computation of Finance Charge (WACC) on Capital structure:**

WACC = [ke × E/E+D] + [kd (1 – t) × D/ E + D]

Where ke = Required return on Equity (E)

Kd(1 – t) = After tax return on debt (D).

**C. Computation of Opening Capital Employed:**

Capital Employed (Opening Capital employed)

Add capitalized cost relating to opening capital invested.

Add provision/allowances relating to opening capital invested.

Add Non cash expenses to capital employed

Add capitalized cost of operating leases to capital employed.

**D. Computation of EVA**

Net Operating Profits after Tax (NOPAT)

Less WACC of Computed opening capital employed

Economic value Added

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### 25.5.8 Using EVA

If it is measured with reasonable accuracy, EVA should be a measure, in economic terms, of how much extra value or wealth has been created by a business operation during a period.

It can therefore be argued that EVA would be a much more useful measure of divisional performance – and company performance – than traditional accounting measures of ROCE and profit.

The problem with EVA however is its complexity. To arrive at an estimate of EVA, it is necessary to make many adjustments to accounting values for profit and asset values, and there might be some uncertainty about the reliability of the figure that is calculated as EVA. It might also be questioned whether the extra cost of calculating EVA (compared with ROCE or ROI/residual income) is justified.

**EVA and measuring the performance of divisions**

EVA can be used as an alternative to ROI or residual income as a method of measuring the performance of operating divisions. However, using EVA for performance measurement of operating divisions might make little sense unless the company as a whole also measured its total performance in terms of EVA.

### 25.5.9 Possible problems with EVA

There are several potential problems with the use of EVA.

(a) It is not easy to use EVA for inter-firm comparisons or inter-divisional performance comparisons, because it is an absolute measure (in ₦) rather than a comparative measure (such as a ratio).
(b) The adjustments required to get from accounting profit to NOPAT and from accounting capital employed to economic capital employed can be complex. In particular, it may be very difficult to estimate economic depreciation.

### 25.5.10 Interpretation of EVA

EVA measures a company's true economic profit by subtracting the cost of capital from
its operating profit after taxes. A **positive EVA** indicates value creation by generating returns exceeding its cost of capital, while a **negative EVA** Suggests that the company's returns are falling short of its cost of capital, indicating non-creation of value which potentially destroys shareholder wealth.

## SOLUTIONS TO PRACTICE QUESTIONS

| **Solution** | | | **1** |
|---|---|---|---|
| | **Big** | | **Small** |
| Profit | ₦900,000 | | ₦90,000 |
| Net assets | ₦8 million | | ₦400,000 |
| ROI | 11.25% | | 22.5% |
| Profit | ₦ 900,000 | | ₦ 90,000 |
| Notional interest | 800,000 | | 40,000 |
| Residual income | 100,000 | | 50,000 |
| | | | |

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**Solution** **2**

| | Year 1 | Year 2 | Year 3 | Year 4 |
|---|---|---|---|---|
| | ₦m | ₦m | ₦m | ₦m |
| Sales revenue (working 1) | 10.800 | 11.880 | 12.415 | 11.794 |
| Cost of sales (working 2) | (6.480 | (7.128 | (7.841 | (7.841) |
| Gross profit | 4.320 | 4.752 | 4.574 | 3.953 |
| Overheads | (3.500) | (3.500) | (4.000) | (4.000) |
| Net profit/(loss) | 0.820 | 1.252 | 0.574 | (0.047) |
| Net assets at beginning of year | 5.00 | 3.75 | 2.50 | 1.25 |

**Workings**

(1) **Sales revenue** = Revenue in previous year □ Price change □ Sales volume change Year 2: ₦10.8 million □ 100% □ 1.10 = ₦11.88 million

Year 3: ₦11.88 million □ 95% □ 1.10 = ₦12.4146 million, say ₦12.415 million

Year 4: ₦12.4146 million □ 95% □ 1.0 = ₦11.79387 million, say ₦11.794 million.

(2) **Cost of sales** = 60% of sales in Year 1. The total cost of sales will then vary each year with changes in sales volume.

Year 1: Cost of sales = 60% □ ₦10.8 million = ₦6.48 million

Year 2: Cost of sales = ₦6.48 million □ 1.10 = ₦7.128 million

Year 3: Cost of sales = ₦7.128 million □ 1.10 = ₦7.8408 million, say ₦7.841 million.

Year 4: Same as Year 3 (no change in sales volume).

(3) **Net assets**: ₦5 million at the beginning of Year 1, reducing by (25%) ₦1.25 million in each subsequent year.

**Analysis**

There is a tendency for ROI to increase as non-current assets get older. This is most apparent in Year 2, when ROI increases from 16.4% to 33.4%, largely because of the reduction in the value of the investment in the division. ROI would also increase in Year 3 and Year 4, but the effect of changes in selling prices and overhead costs mean that the net effect is a reduction in ROI in those years (and also in the gross profit and net profit margins).

ROI is affected in Year 3 by the first 5% fall in sales and the increase in overhead costs by ₦500,000. In Year 4, performance gets worse, in spite of the fall in net assets to

₦1.25 million, because of the further fall in sales prices and gross profit margin. In year 4 there is even a small net loss.

**Solution** **3**

| **Net operating profit after tax** | **Year 1** |
|---|---|
| | ₦000 |
| Profit after tax | 54,000 |
| Add: Interest cost less tax: (8,000 less 25%) | 6,000 |
| Add: Non-cash expenses | 16,000 |
| NOPAT | |

| **Capital employed** | **Year 1** |
|---|---|
| | ₦000 |
| Book value of total assets less current liabilities | 435,000 |
| | 18,000 |

**WACC** = (12% × 50%) + [8% (1 – 0.25) × 50%] = 9%.

| **EVA** | **Year 1** |
|---|---|
| | ₦000 |
| NOPAT | 76,000 |
| Capital charge: (453,000 × 9%) | 40,770 |

These figures suggest that in each year the company created value, because the EVA was positive.

Financial performance in Year 2 was better than in Year 1 because the EVA is higher.

## 25.6 Transfer Pricing: Purpose , objectives and methods of setting transfer prices and evaluation of the suitability of each method.

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## Section overview

(a) Introduction
(b) Transfers at marginal cost
(c) Transfers at full cost
(d) Transfer pricing at cost plus
(e) Transfer pricing at market price
(f) The objectives of transfer pricing

### 25.6.1 Introduction

When a company has a divisionalised structure, some of the divisions might supply goods or services to other divisions in the same company.

(a) One division sells the goods or services. This will be referred to as the 'selling division'.

(b) Another division buys the goods or services. This will be referred to as the 'buying division'.

For accounting purposes, these internal transfers of goods or services are given a value. Transfers could be recorded at cost. However, when the selling division is a profit centre or investment centre, it will expect to make some profit on the sale.

### 25.6.2 Transfer price

A transfer price is the price at which goods or services are sold by one division within a company to another division in the same company. Internal sales are referred to as transfers, so the internal selling and buying price is the transfer price.

When goods are sold or transferred by one division to another, the sale for one division is matched by a purchase by the other division, and total profit of the company as a whole is unaffected. It is an internal transaction within the company, and a company cannot make a profit from internal transfers.

A decision has to be made about what the transfer price should be. A transfer price may be:

(a) the cost of the item (to the selling division); or

(b) a price that is higher than the cost to the selling division, which may be cost plus a profit margin or related to the external market price of the item transferred.

Possible methods include:

(a) marginal cost;

(b) full cost;

(c) cost plus;

(d) market price

These will be considered in turn

### 25.6.3 Transfers at marginal cost

The transfer price may be the cost of making the item (goods) or cost of provision (services) to the selling division.

A transfer at cost may be at either:

(a) marginal cost (variable cost); or

(b) full cost.

**Example: Transfers at marginal cost**

An entity has two divisions, Division A and Division B.

Division A makes a component X which is transferred to Division B.

Division B uses component X to make end-product Y.

| | Division A | Division B |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The budgeted annual profit for each division if the units of component X are transferred from Division A to Division B at marginal cost are as follows.

**Example (continued): Transfers at marginal cost (budgeted performance)**

| | Division A | Division B | as a whole |
|---|---|---|---|
| Units produced/sold | 1,000 | 1,000 | 1,000 |
| | ₦ | ₦ | ₦ |
| External sales of final product | - | 350,000 | 350,000 |
| Internal transfers (1,000 □ ₦70) | 70,000 | - | 0 |
| Total sales | 70,000 | 350,000 | 350,000 |
| Costs of production | | | |
| Internal transfers (1,000 □ ₦70) | - | 70,000 | 0 |
| Other variable costs | 70,000 | 30,000 | 100,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 150,000 | 190,000 | 270,000 |
| Profit/(net cost or loss) | (80,000) | 160,000 | 80,000 |

**Company**

For the company as a whole, the internal transfers are not included in sales and costs. The transfers affect the financial results of the divisions.

By transferring goods at variable cost, the transferring division earns revenue equal to its variable cost of production. It therefore bears the full cost of its fixed costs, and its records a loss (or a net cost) equal to its fixed costs.

On the other hand, the buying division (Division B) reports a profit. Because the fixed costs of Division A are not included in the transfer price, the profit of Division B exceeds the total profit of the company as a whole.

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### 25.6.3 Transfers at marginal cost: actual sales higher than budget

The same situation occurs if actual output and sales differ from budget. If production and sales are 1,100 units, the profits of Division B will increase, but Division A still makes a loss equal to its fixed costs. The total company profits increase by the same amount as the increase in the profits of Division B

**Example: Transfers at marginal cost with actual sales higher than budget**

Following on from the previous example.

| | Division A | Division B |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The reported profit if actual sales prices, actual variables costs per unit and total fixed costs were as budgeted, but units sold are 10% more than budget is as follows.

| | Division A | Division B | as a whole |
|---|---|---|---|
| Units produced/sold | 1,100 | 1,100 | 1,100 |
| | ₦ | ₦ | ₦ |
| External sales of final product | - | 385,000 | 385,000 |
| Internal transfers (1,100 □ ₦70) | 77,000 | - | 0 |
| Total sales | 77,000 | 385,000 | 385,000 |
| Costs of production | | | |
| Internal transfers (1,100 □ ₦70) | - | 77,000 | 0 |
| Other variable costs | 77,000 | 33,000 | 110,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 157,000 | 200,000 | 280,000 |
| Profit/(net cost or loss) | (80,000) | 185,000 | 105,000 |

### 25.6.4 Transfers at full cost

### 25.6.4 Transfers at full cost: budgeted performance:

In this example, the full cost per unit produced in Division A is ₦150, with an absorption rate for fixed overheads of ₦80 per unit produced and transferred.

**Example: Transfers at full cost**

An entity has two divisions, Division A and Division B.

Division A makes a component X which is transferred to Division B. Division B uses component X to make end-product Y.

| | Division A | Division B |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The budgeted annual profit for each division if the units of component X are transferred from Division A to Division B at full cost are as follows.

| | Division A | Division B | Company as a whole |
|---|---|---|---|
| Units produced/sold | 1,000 | 1,000 | 1,000 |
| External sales of final product | ₦ - | ₦ 350,000 | ₦ 350,000 |
| Internal transfers (1,000 □ ₦150) | 150,000 | - | 0 |
| Total sales | 150,000 | 350,000 | 350,000 |
| Costs of production | | | |
| Internal transfers (1,000 □ ₦150) | - | 150,000 | 0 |
| Other variable costs | 70,000 | 30,000 | 100,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 150,000 | 270,000 | 270,000 |
| Profit/(net cost or loss) | 0 | 80,000 | 80,000 |

Since the transfer price includes the fixed costs of the selling division, Division A is able to cover all its costs, but it reports neither a profit nor a loss. It covers its costs exactly.

The buying division (Division B) has to pay for the fixed costs of division A in the transfer price. It still reports a profit, but this profit is now equal to the profit earned by the company as a whole.

### 25.6.5 Transfers at full cost: actual sales higher than budget

A similar situation occurs if actual output and sales differ from budget. If production and sales are 1,100 units, the profits of Division B will increase. However, Division A will make some 'profit', but this is simply the amount by which its fixed overhead costs are over-absorbed.

### Example: Transfers at full cost

Following on from the previous example.

| | Division A | Division B |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The reported profit if actual sales prices, actual variables costs per unit and total fixed costs were as budgeted, but units sold are 10% more than budget is as follows

| | Division A | Division B | as a whole |
|---|---|---|---|
| Units produced/sold | 1,100 | 1,100 | 1,100 |
| | ₦ | ₦ | ₦ |
| External sales of final product | - | 385,000 | 385,000 |
| Internal transfers (1,100 □ ₦150) | 165,000 | - | 0 |
| Total sales | 165,000 | 385,000 | 385,000 |
| Costs of production: | | | |
| Internal transfers (1,100 □ ₦150) | - | 165,000 | 0 |
| Other variable costs | 77,000 | 33,000 | 110,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 157,000 | 288,000 | 280,000 |
| Profit/(net cost or loss) | 8,000 | 97,000 | 105,000 |

These examples should illustrate that if transfers are at cost, the selling division has no real incentive, because it will earn little or no profit from the transactions. In effect, the selling division is a cost centre rather than a profit centre or investment centre.

### 25.6.6 Transfer pricing at cost plus

For the purpose of performance measurement and performance evaluation in a company with profit centres or investment centres, it is appropriate that:

(a) the selling division should earn some profit or return on its transfer sales to other divisions and

(b) the buying division should pay a fair transfer price for the goods or services that it buys from other divisions.

One way of arranging for each division to make a profit on transfers is to set the transfer price at an amount above cost, to provide the selling division with a profit margin. However the transfer price should not be so high that the buying division makes a loss on the items it obtains from the selling

division.

**Example: Transfer pricing at cost plus**

An entity has two divisions, Division C and Division D.

Division C makes a component Y which is transferred to Division D. Division D uses component Y to make end-product Z.

| | Division C | Division D |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

| | Division C | Division D | as a whole |
|---|---|---|---|
| Units produced/sold | 1,000 | 1,000 | 1,000 |
| External sales of final product | ₦ - | ₦ 350,000 | ₦ 350,000 |
| Internal transfers (1,000 ₦180) | 180,000 | - | 0 |
| Total sales | 180,000 | 350,000 | 350,000 |
| Costs of production | | | |
| Internal transfers (1,000 ₦180) | - | 180,000 | 0 |
| Other variable costs | 70,000 | 30,000 | 100,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 150,000 | 300,000 | 270,000 |
| Profit | 30,000 | 50,000 | 80,000 |

The budgeted annual profit for each division if the units of component Y are transferred from Division C to Division D at full cost plus 20% are as follows.

**Example: Transfer pricing at cost plus**

An entity has two divisions, Division C and Division D.

Division C makes a component Y which is transferred to Division D. Division D uses component Y to make end-product Z.

Details of budgeted annual sales and costs in each division are as follows:

| | Division C | Division D |
|---|---|---|
| Units produced/sold | 1,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | - | 350,000 |
| Costs of production | | |
| Variable costs | 70,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The budgeted annual profit for each division if the units of component Y are transferred from Division C to Division D at full cost plus 20% are as follows:

**Example (continued): Transfer pricing at cost plus**

The full cost per unit produced in Division C is ₦150, and the transfer price (full cost plus 20%) is ₦180.

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| | Division C | Division D | as a whole |
|---|---|---|---|
| Units produced/sold | 1,000 | 1,000 | 1,000 |
| | ₦ | ₦ | ₦ |
| External sales of final product | - | 350,000 | 350,000 |
| Internal transfers (1,000 □ ₦180) | 180,000 | - | 0 |
| Total sales | 180,000 | 350,000 | 350,000 |
| Costs of production | | | |
| Internal transfers (1,000 □ ₦180) | - | 180,000 | 0 |
| Other variable costs | 70,000 | 30,000 | 100,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 150,000 | 300,000 | 270,000 |
| Profit | 30,000 | 50,000 | 80,000 |

A cost plus transfer price succeeds in sharing the total company profit between the two divisions. However, the transfer price is arbitrary, because the profit margin of 20% is arbitrary. If the transfer price lacks commercial reality, the reported profits of each division are not satisfactory measures of performance.

**25.6.6 Transfer pricing at market price**

It would be more realistic to set the transfer price at or close to a market price for the item transferred, but this is only possible if an external market exists for the item.

**Example: Transfer pricing at market price**

An entity has two divisions, Division G and Division K. Division G makes a component P which is transferred to Division K. Division K uses component P to make end-product Q.

Division G budgets to sell one half of its output to Division K and the other half to external customers. The market price for component P is ₦160 per unit and it has been agreed that transfers between the two divisions should be at market price.

Details of budgeted annual sales and costs in each division are as follows
The budgeted annual profit for each division if the units of component Y are transferred from Division G to Division K at market price are as follows:

| c | Division G | Division K |
|---|---|---|
| Units produced/sold | 2,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | 160,000 | 350,000 |
| Costs of production | | |
| Variable costs | 140,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

**Example: Transfer pricing at market price**

An entity has two divisions, Division G and Division K. Division G makes a component P which is transferred to Division K. Division K uses component P to make end-product Q.

Division G budgets to sell one half of its output to Division K and the other half to external customers. The market price for component P is ₦160 per unit and it has been agreed that transfers between the two divisions should be at market price.

Details of budgeted annual sales and costs in each division are as follows:

| c | Division G | Division K |
|---|---|---|
| Units produced/sold | 2,000 | 1,000 |
| | ₦ | ₦ |
| Sales of final product | 160,000 | 350,000 |
| Costs of production | | |
| Variable costs | 140,000 | 30,000 |
| Fixed costs | 80,000 | 90,000 |
| Total costs | 150,000 | 120,000 |

The budgeted annual profit for each division if the units of component Y are transferred from Division G to Division K at market price are as follows:

| | Division G | Division K | as a whole |
|---|---|---|---|
| Units produced/sold | 2,000 | 1,000 | 1,000 |
| | ₦ | ₦ | ₦ |
| External sales of product Q | - | 350,000 | 350,000 |
| External sales of component P | 160,000 | - | 160,000 |
| Internal transfers (1,000 □ ₦160) | 160,000 | - | 0 |
| Total sales | 320,000 | 350,000 | 510,000 |
| Costs of production | | | |
| Internal transfers (1,000 □ ₦160) | - | 160,000 | 0 |
| Other variable costs (2,000 □ ₦70) | 140,000 | 30,000 | 170,000 |
| Fixed costs | 80,000 | 90,000 | 170,000 |
| Total costs | 220,000 | 280,000 | 340,000 |
| Profit | 100,000 | 70,000 | 170,000 |

### 25.6.7 The objectives of transfer pricing

Transfer prices are decided by management. When authority is delegated to divisional managers, the managers of the selling and buying divisions should be given the authority to negotiate and agree the transfer prices for any goods or services 'sold' by one division to the other.

The objectives of transfer pricing should be to make it possible for divisionalisation to operate successfully within a company, and:

(a) give autonomy (freedom to make decisions) to the managers of the profit

centres or investment centres; and

(b) enable the company to measure the performance of each division in a fair way.

### 25.6.7 Divisional autonomy

Autonomy is freedom of action and freedom to make decisions. Divisional managers should be free to make their own decisions. Autonomy should improve motivation of divisional managers.

For example, when transfer prices have been decided, the managers of all divisions within the entity should be free to decide:

(a) whether to sell their output to other divisions (internal transfers) or whether to sell them to external customers, if an external market exists for the output; and

(b) whether to buy their goods from another division (internal transfers) or whether to buy them from external suppliers, if an external market exists.

### 25.6.8 Acting in the best interests of the company

In addition, divisional managers should be expected to make decisions that are in the best interest s of the company as a whole.

Unfortunately, divisional managers often put the interests of their own division before the interests of the company as a whole, particularly if they are rewarded (for example with an annual cash bonus) on the basis of the profits or ROI achieved by the division.

In certain circumstances, the personal objectives of divisional managers may be in conflict with the interests of the company as a whole. A division may take action that maximises its own profit, but reduces the profits of another division. As a result, the profits of the entity as a whole may also be reduced.

## 25.7 Problems with transfer pricing

**Section overview**

(a) External intermediate markets

(b) Market-based and cost-based transfer prices, and transfer prices based on opportunity cost

(c) The opportunity cost of transfers

(d) Identifying the ideal transfer price

(e) Finding the ideal transfer price: No external intermediate market

(f) Finding the ideal transfer price: An external intermediate market and no production limitations

(g) Finding the ideal transfer price: An external intermediate market and production limitations

### 25.7.1 External intermediate markets

A system of transfer pricing should allow the divisional managers the freedom to make their own decisions, without having to be told by head office what they must

do. At the same time, the system should not encourage divisional managers to take decisions that do harm to the company.

The main problems arise when there is an external market for the goods (or services) that one division transfers to another. When an external market exists for goods or services that are also transferred internally, the market might be called an **external intermediate market**.

(a) The selling division can sell its goods into this market, instead of transferring them internally.

(b) Similarly the buying division can buy its goods from other suppliers in this market, instead of buying them internally from another division.

Divisional managers will put the interests of their division before the interests of the company. When there is an external intermediate market, divisional managers will decide between internal transfers and using the external market in a way that maximises the profits of their division.

### 25.7.2 Market-based and cost-based transfer prices, and transfer prices based on opportunity cost

As a general rule:

(a) When an external intermediate market does not exist for transferred goods, the transfer price will be based on cost.

(b) When an external intermediate market does exist for transferred goods, the transfer price will be based on the external market price.

However, the situation is more complicated when:

(a) there is a limit to production capacity in the selling division; or

(b) there is a limit to sales demand in the external intermediate market.

In these circumstances, we need to consider the ***opportunity costs*** for the selling division of transferring goods internally instead of selling them externally.

### 25.7.3 The opportunity cost of transfers

The selling division and the buying division have opportunity costs of transferring goods internally when there is an intermediate external market.

(a) For the selling division, the opportunity cost of transferring goods internally to another division might include a loss of contribution and profit from not being able to sell goods externally in the intermediate market.

(b) For the buying division, the opportunity cost of buying internally from another division is the price that it would have to pay for purchasing the items from external suppliers in the intermediate market.

The ideal transfer price is a price at which both the selling division and the buying division will want to do what is in the best interests of the company as a whole, because it is also in the best interests of their divisions.

Ideal transfer prices must therefore take opportunity costs into consideration.

### 25.6.4 Identifying the ideal transfer price

In identifying the ideal transfer price there are three scenarios that need to be considered when handling transfer pricing mechanisms:

(a) **When there is no spare capacity.** This simply means that the selling division

is operating at full capacity and can not increase output beyond what is produced and sold. The optimal transfer price here is marginal cost plus opportunity cost of making the transfer.

(b) **Where there is spare capacity** , that is selling division not operating at full capacity, the transfer price is the marginal cost of producing the transferred item.

(c) **Where there is limited spare capacity.** This is a variant of b above. Under this scenario , the selling division Needs to beef up additional product from external suppliers to meet the limited requirements for the buyer. The optimal transfer price is computed in the same mode as b above. That is

(a) **Step 1**. Begin by identifying the arrangement for transferring goods internally that would maximise the profits of the company as a whole. In other words, what solution is best for the company?

(b) **Step 2**. Having identified the plan that is in the best interests of the company as a whole, identify the transfer price, or range of transfer prices, that will make the manager of the buying division want to work towards this plan. The transfer price must ensure that, given this transfer price, the profits of the division will be maximised by doing what is in the best interests of the company as a whole.

(c) **Step 3**.- In the same way, having identified the plan that is in the best interests of the company as a whole, identify the transfer price, or range of transfer prices, that will make the manager of the selling division want to work towards the same plan. Again, the transfer price must ensure that, given the transfer price, the profits of the division will be maximised by doing what is in the best interests of the company as a whole.

These rules will be illustrated with a number of different examples and different situations.

### 25.7.5 Finding the ideal transfer price: No external intermediate market

When there is no external intermediate market, the ideal transfer price is either:

(a) cost; or

(b) cost plus a contribution margin or profit margin for the selling division.

Transfers at cost do not provide any profit for the selling division; therefore transfer prices at cost are inappropriate for a divisional structure where the selling division is a profit centre or an investment centre, with responsibility for making profits. Transfers at cost are appropriate only if the selling division is treated as a cost centre, with responsibility for controlling its costs but not for making profit.

If the selling division is a profit centre or an investment centre, and there is no external intermediate market for the transferred item, transfers should therefore be at a negotiated 'cost plus' price, to provide some profit to the selling division.

**Example: Ideal transfer price with no external intermediate market** A

company has two divisions, Division A and Division B.

Division A makes a component X which is transferred to Division B. Division B uses component X to make end-product Y.

Both divisions are profit centres within the company. Details of costs and selling price are as follows

| **Division A** | **₦** |
|---|---|
| Cost of component X | |
| Variable cost | 100 |
| Fixed cost | 80 |
| **Division B** | |
| Further processing costs | 40 |
| Variable cost | 70 |
| Selling price per unit of product Y | 400 |

The further processing costs of Division B do not include the cost of buying component X from Division A. One unit of component X goes into the production of one unit of Product Y. Fixed costs in both divisions will be the same, regardless of the volume of production and sales.

**Required**

What is the ideal transfer price, or what is a range of prices that would be ideal for the transfer price?

**Answer Step 1**

What is in the best interests of the company as a whole?

The total variable cost of one unit of the end product, product Y, is ₦140 (₦100 + ₦40). The sales price of product Y is ₦400.

The entity therefore makes additional contribution of ₦260 for every unit of product Y that it sells. It is therefore in the best interests of the company to maximise production and sales of product Y.

**Step 2**

What will motivate the buying division to buy as many units of component X as possible?

Division B will want to buy more units of component X provided that the division earns additional contribution from every unit of the component that it buys.

| **Division B** | **₦** |
|---|---|
| Selling price of Product Y, per unit | 400 |
| Variable further processing costs in Division B | 40 |
| | 360 |

The opportunity cost of not buying units of component X, ignoring the transfer price, is ₦360 per unit.

Division B should therefore be willing to pay up to ₦360 per unit for component X. Any transfer price below ₦360 but above ₦40 per unit will increase its contribution and profit

**Step 3**

What will motivate the selling division to make and transfer as many units of component X as possible?

Division A will want to make and sell more units of component X provided that

the division earns additional contribution from every unit of the component that it sells.

The marginal cost of making and transferring a unit of component X is ₦100. Division A should therefore be willing to transfer as many units of component X as it can make (or Division B has the capacity to buy) if the transfer price is at least ₦100.

**Ideal transfer price**

The ideal transfer price is anywhere in the range ₦100 to ₦360. A price somewhere within this range may be negotiated, which will provide profit to both divisions and the company as a whole, for each additional unit of product Y that is made and sold.

### 25.7.6 Finding the ideal transfer price: An external intermediate market and no production limitations

When there is an external intermediate market for the transferred item, a different situation applies. If there are no production limitations in the selling division, the ideal transfer price is usually the external market price.

**Example: Ideal transfer price with an external intermediate market**

A company has two divisions P and Q. Division P makes a component X which it either transfers to Division Q or sells in an external market.

The costs of making one unit of component X are:

| **Component X** | **₦** |
|---|---|
| Variable cost | 600 |
| Fixed cost | 300 |
| Total cost | 900 |

Division Q uses one unit of component X to make one unit of product Y, which it sells for ₦2,000 after incurring variable further processing costs of ₦250 per unit.

The ideal transfer price or range of transfer prices, if the price of component X in the external intermediate market is ₦1,400 can be found as follows.

**Step 1:** What is in the best interests of the company as a whole?

The company will benefit by maximising the total contribution from the total external sales of component X and product Y.

If component X is not transferred by Division P to Division Q, Division Q will have to buy units of component X in the external market. Every unit of component X transferred internally therefore reduces the need to purchase a unit externally.

The additional contribution for the company from making and selling one unit of product Y is ₦1,150 (₦2,000 – ₦600 – ₦205).

The additional contribution from making one unit of component X and selling it externally is ₦800 (₦1,400 – ₦600).

A profit-maximising plan is therefore to maximise the sales of Division Q, and transfer component X from Division P to Division Q rather than sell component X externally.

**Step 2:** What will motivate the buying division (Division Q) to buy as many units of component X as possible from Division P?

Division Q will be prepared to buy component X from Division P as long as it is not more expensive than buying in the external market from another supplier. Division Q will be willing to buy internally if the transfer price is not more than ₦1,400 when the external market price is ₦1,400.

If the external market price and transfer price are both ₦1,400, Division Q will make an incremental contribution of ₦350 (₦2,000 – ₦1,400 – ₦250) for each unit of component X that it buys and uses to make and sell a unit of product Y.

It the transfer price is higher than the external market price, Division Q will choose to buy component X in the external market, which would not be in the best interests of the company as a whole.

**Example (continued): Ideal transfer price with an external intermediate market**

**Step 3:** What will motivate the selling division to make and transfer to Division Q as many units of component X as possible?

Division P should be prepared to transfer as many units of component X as possible to Division Q provided that its profit is no less than it would be if it sold component X externally.

Units transferred to division Q are lost sales to the external market; therefore there is an opportunity cost of transfer that Division P will wish to include in the transfer price.

**Example: Ideal transfer price with an external intermediate market**

A company has two divisions P and Q. Division P makes a component X which it either transfers to Division Q or sells in an external market.

The costs of making one unit of component X are:

| **Component X: market price ₦1,400** | **₦** |
|---|---|
| Variable cost | 600 |
| Opportunity cost of lost external sale (1,400 – 600) | 800 |
| Total cost = minimum transfer price | 1,400 |

Division Q uses one unit of component X to make one unit of product Y, which it sells for ₦2,000 after incurring variable further processing costs of ₦250 per unit.

The ideal transfer price or range of transfer prices, if the price of component X in the external intermediate market is ₦580 can be found as follows.

(Assume that the selling division cannot be closed down).

**Example (continued): Ideal transfer price with an external intermediate market**

**Step 1:** What is in the best interests of the company as a whole company will benefit by maximising the total contribution from the total external sales of component X and product Y.

If component X is not transferred by Division P to Division Q, Division Q will have to buy units of component X in the external market. Every unit of component X transferred internally therefore reduces the need to purchase a unit externally.

The additional contribution for the company from making and selling one unit of product Y is ₦1,150 (₦2,000 – ₦600 – ₦250).

When the external market price is ₦580 for component X, Division Pwould make an incremental loss of ₦20 per unit (₦580 – ₦600) by selling the component externally.

A profit-maximising plan is therefore to maximise the sales of Division Q, and transfer component X from Division P to Division Q rather than sell component X externally.

**Step 2:** What will motivate the buying division (Division Q) to buy as many units of component X as possible from Division P?

Division Q will be prepared to buy component X from Division P as long as it is not more expensive than buying in the external market from another supplier. Division Q will be willing to buy internally if the transfer price is not more than ₦580.

If the external market price and transfer price are both ₦580, Division Q will make an incremental contribution of ₦1,170 (₦2,000 – ₦580–
₦250) from each unit of component X that it buys and uses to make and sell a unit of product Y.

It the transfer price is higher than the external market price, Division Q will choose to buy component X in the external market, which would not be in the best interests of the company as a whole.

**Step 3:** What will motivate the selling division to make and transfer to Division Q as many units of component X as possible?

Division P should be prepared to transfer as many units of component X as possible to Division Q provided that its profit is no less than it would be if it sold component X externally.

Units transferred to division Q are lost sales to the external market; therefore there is an opportunity cost of transfer that Division P will wish to include in the transfer price.

| **Component X: market price ₦58** | **₦** |
|---|---|
| Variable cost | 600 |
| Opportunity cost of lost external sale (580 – 600) | (20) |
| Total cost = minimum transfer price | 580 |

If the variable cost of making a component is greater than the price on an external market, the company would be better off closing the selling company and buying externally.

**Example: Ideal transfer price with an external intermediate market**

A company has two divisions P and Q. Division P makes a component X which it either transfers to Division Q or sells in an external market.

The costs of making one unit of component X are:

| **Component X** | **₦** |
|---|---|
| Variable cost | 600 |
| Fixed cost | 300 |
| Total cost | 900 |

Division Q uses one unit of component X to make one unit of product Y, which it sells for ₦2,000 after incurring variable further processing costs of ₦250 per unit.

The price of component X in the external intermediate market is ₦580.

Contribution made by the company with an without internal transfer is as follows:

| **Contribution** | **Internally** ₦ | **Externally** ₦ |
|---|---|---|
| Selling price | 2,000 | 2,000 |
| Variable cost of manufacture | 600 | |
| Price on external market | | 580 |
| Further processing cost | 250 | 250 |
| Total cost | 850 | 830 |
| Contribution | 1,150 | 1,170 |

When the external market price is ₦580 Division P is losing contribution by selling component X externally. It would also be cheaper for the entity as a whole to buy the component externally for ₦580rather than make internally for a marginal cost of ₦600 Division P should consider ending its operations to produce component X.

### 25.7.7 Finding the ideal transfer price: An external intermediate market and production limitations

When there is an external intermediate market for the transferred item, and the selling division has a limitation on the number of units it can produce, the ideal transfer price should allow for the opportunity cost of the selling division. Every unit transferred means one less external sale.

I some situations there is no ideal transfer price as the company would be better off sourcing the component externally

**Example:**

A company consists of two divisions, Division A and Division B. Division A is working at full capacity on its machines, and can make either Product Y or Product Z, up to its capacity limitation. Both of these products have an external market.

Division B buys Product Y, which it uses to make an end product which can be sold to earn excellent margins.

The costs and selling prices of Product Y and Product Z are:

| | **Product Y** ₦ | **Product Z** ₦ |
|---|---|---|
| Selling price (price on the external market) | 150 | 170 |
| Variable cost of production | 100 | 90 |
| Contribution per unit | 50 | 80 |

The variable cost of sale is incurred on external sales of the division's products. This selling cost is not incurred for internal sales/transfers from Division A to Division B.

To make one unit of Product Y takes exactly the same machine time as one unit of Product Z.

**Required**

What is the ideal transfer price or range of transfer prices

**Answer**

**Step 1:** What is in the best interests of the company as a whole?

The company would want to maximise contribution.

It wants to make and sell as many units of the end product of Division B as possible. It is not clear, however, whether it is better for Division B to buy Product Y externally or to buy internally from Division A.

If Division A does not make Product Y, it can make and sell Product Z instead. Product Z earns a higher contribution per unit of machine time, the limiting factor in Division A.

**Step 2:** What would motivate the buying division to buy as many units of Product Y as possible from Division A?

Division B will be prepared to buy Product Y from Division A as long as it is not more expensive than buying in the external market from another supplier.

Division B will be willing to buy Product Y internally if the transfer price is ₦150 or less.

**Step 3:** What would motivate the selling division to make and transfer as many units of Product Y as possible?

The selling division will only be willing to make Product Y instead of Product Z if it earns at least as much contribution as it would from making Z and selling it externally. (In this situation, the division can make as many units of Z as it can make of Y, and Product Z earns a higher contribution).

| Product Y | ₦ |
|---|---|
| Variable cost of making Product Y | 100 |
| Opportunity cost of lost external sale of Product Z (170– 90) | 80 |
| Total cost = minimum transfer price | 180 |

**Ideal transfer price/ideal production and selling plan**

Division B will not want to pay more than ₦150 for transfers of Product Y; otherwise it will buy Product Y externally.

Division A will want to receive at least ₦180 for transfers of Product Y; otherwise it will prefer to make and sell Product Z, not Product Y.

The ideal solution is for Division B to buy Product Y externally at ₦150 and for Division A to make and sell Product Z.

**Practice questions**

A company consists of two divisions, Division A and Division B. Division A is operating at full capacity making Product X, for which there is an external market.

The variable cost of making one unit of Product X is ₦700, and the sale price of Product X in the external market is ₦1,000 per unit.

Division B needs one unit of Product X to manufacture another product, Product Y. The variable conversion costs and further processing costs in Division B are ₦290 per unit of Product Y. The external selling price of Product Y is ₦1,400 per unit.

An external supplier has offered to sell units of Product Y to Division B for ₦1,030 per unit.

**Required**

(a) Identify the ideal transfer price.

(b) Calculate the contribution per unit for each Division and for the company as a whole if this transfer price is used.

(c) Suggest with reasons whether this transfer price provides a fair measure of divisional performance.

## 25.8 Transfer pricing in practice

| Section overview |
| --- |
| (a) Transfer price at market price<br>(b) Transfer price at full cost plus<br>(c) Transfer price at variable cost plus or incremental cost plus<br>(d) Two-part transfer prices<br>(e) Dual pricing<br>(f) Negotiated transfer prices |

Transfer prices might be decided by head office and imposed on each division. Alternatively, the managers of each division might have the autonomy to negotiate transfer prices with each other.

In practice, transfer prices may be agreed and expressed in one of the following ways.

### 25.8.1 Transfer price at market price

A transfer price may be the external selling/buying price for the item in an external intermediate market. This price is only possible when an external market exists.

If the selling division would incur some extra costs if it sold its output externally rather than transferred it internally to another division, the transfer price may be reduced below market price, to allow for the variable costs that would be saved by the selling division. This is very common as the selling division may save costs of packaging and warranties or guarantees. Distribution costs may also be cheaper and there will be no need for advertising.

**Advantages of market price as the transfer price**

Market price is the ideal transfer price when there is an external market. A transfer price below this amount will make the manager of the selling division want to sell externally, and a price above this amount will make the manager of the buying division want to buy externally.

Transferring at market price also encourages efficiency in the supplying division,

which must compete with the external competition.

**Disadvantages of market price as the transfer price**

The current market price is not appropriate as a transfer price when:

(a) the current market price is only temporary, and caused by short-term conditions in the market, or

(b) the selling price in the external market would fall if the selling division sold more of its output into the market. The opportunity cost of transferring output internally would not be the current market price, because the selling price would have to be reduced in order to sell the extra units.

It may also be difficult to identify exactly what the external market price is. Products from rival companies may be different in quality, availability may not be so certain and there may be different levels of service back-up.

### 25.8.2 Transfer price at full cost plus

A transfer price may be the full cost of production plus a margin for profit for the selling division.

**Standard full costs** should be used, **not actual full costs**. This will prevent the selling division from increasing its profit by incurring higher costs per unit.

Full cost plus might be suitable when there is no external intermediate market.

However, there are disadvantages in using full cost rather than variable cost to decide a transfer price.

(a) The fixed costs of the selling division become variable costs in the transfer price of the buying division. This might lead to decisions by the buying division manager that are against the best interests of the company as a whole. This is because a higher variable cost may lead to the buying division choosing to set price at a higher level which would lose sales volume.

(b) The size of the profit margin or mark-up is likely to be arbitrary.

#### 25.8.3 Transfer price at variable cost plus or incremental cost plus

A transfer price might be expressed as the variable cost of production plus a margin for profit for the selling division.

**Standard variable costs** should be used, **not actual variable costs**. This will prevent the selling division from increasing its profit by incurring higher variable costs per unit.

Variable cost plus might be suitable when there is no external intermediate market. It is probably more suitable in these circumstances than full cost plus, because variable cost is a better measure of opportunity cost. However, as stated earlier, when transfers are at cot, the transferring division should be a cost centre, and not a profit centre.

Other methods that may be used to agree transfer prices include:

(a) Two-part transfer prices

(b) Dual pricing

### 25.8.4 Two-part transfer prices

With two-part transfer prices, the selling division charges the buying division for units transferred in two ways:

(a) a standard variable cost per unit transferred, plus

(b) a fixed charge in each period.

The fixed charge is a lump sum charge at the end of each period. The fixed charge would represent a share of the contribution from selling the end product, which the selling/transferring division has helped to earn. Alternatively, the charge could be seen as a charge to the buying division for a share of the fixed costs of the selling division in the period.

The fixed charge could be set at an amount that provides a 'fair' profit for each division, although it is an arbitrary amount.

### 25.8.5 Dual pricing

In some situations, two divisions may not be able to agree a transfer price, because there is no transfer price at which the selling division will want to transfer internally or the buying division will want to buy internally. However, the profits of the entity as a whole would be increased if transfers did occur.

These situations are rare. However, when they occur, head office might find a solution to the problem by agreeing to dual transfer prices.

(a) the selling division sells at one transfer price, and

(b) the buying division buys at a lower transfer price.

There are two different transfer prices. The transfer price for the selling division should be high enough to motivate the divisional manager to transfer more units to the buying division. Similarly, the transfer price for the buying division should be low enough to motivate the divisional manager to buy more units from the selling division.

In the accounts of the company, the transferred goods are:

(a) sold by the selling division to head office and

(b) bought by the buying division from head office.

The loss from the dual pricing is a cost for head office, and treated as a head office overhead expense.

However, dual pricing can be complicated and confusing. It also requires the intervention of head office and therefore detracts from divisional autonomy.

### 25.8.6 Negotiated transfer prices

A negotiated transfer price is a price that is negotiated between the managers of the profit centres.

The divisional managers are given the autonomy to agree on transfer prices. Negotiation might be a method of identifying the ideal transfer price in situations where an external intermediate market does not exist.

An **advantage** of negotiation is that if the negotiations are honest and fair, the divisions should be willing to trade with each other on the basis of the transfer price they have agreed.

**Disadvantages** of negotiation are as follows:

(a) The divisional managers might be unable to reach agreement. When this happens, management from head office will have to act as judge or arbitrator

in the case.

(b) The transfer prices that are negotiated might not be fair, but a reflection of the bargaining strength or bargaining skills of each divisional manager.

### 25.8.7 Benefits and limitations of transfer pricing methods:

Generally, transfer pricing method like cost plus, resale price, market price despite individual advantages and limitations, offer the following benefits:

(a) Flexibility through to applicability to wide range of transactions.
(b) They offer transparent method of implementation especially using the cost based methods.
(c) The market and resale methods reflects actual market conditions.
(d) The various methods promotes fairness in allocation of profit especially the negotiated pricing method.
(e) Negotiated transfer pricing method and market based method help companies reduce their tax burden through strategically allocating profits to independent divisions and subsidiaries in low tax jurisdiction.
(f) Tax savings and enhancing of financial efficiency.

The limitations include

(a) The transfer pricing methods like the resale price method, and negotiated pricing methods are complex in implementation as it requires extensive data processing.
(b) Data required to handle seamlessly the process may be difficult to generate
(c) Some of the methods of transfer pricing lacks transparency and data accuracy.
(d) Most cost based methods do not reflect realistic data accuracy as they are not market based.

## 25.9 Impact of taxation and repatriation of funds in international transfer pricing

**Section overview**

(a) Corporate objectives and the relevance of tax and transfer pricing
(b) Transfer pricing and tax rules

### 25.9.1 Corporate objectives and the relevance of tax and transfer pricing

The corporate objective of a multinational company, as for any other company, is linked to profitability and returns for shareholders. Multinational companies operate in different countries, and are therefore subject to differing tax regulations and systems. MNCs will try to improve earnings for shareholders by minimising their worldwide tax liabilities.

(a) Multinational companies will seek to invest in countries where the taxation system is more favourable. For example, companies might seek relief from taxation for making capital investments in a country, and will choose one country in preference to another on the basis of the tax advantages offered

(b) Some MNCs have been accused of using transfer pricing to minimise their tax liabilities. Transfer prices are used to charge for goods and services transferred between companies in the group. Transfer prices can be charged in such a way

that:

(c) transfers from a subsidiary in a high-tax country to a subsidiary in a low-tax country are fixed at high levels, and

(d) low transfer prices are set for transfers from a low-tax to a high-tax country.

In this way, profits in the high-tax subsidiaries are reduced, and more profits are earned in the low-tax countries.

### 25.9.2 Transfer pricing and tax rules

Transfer prices are prices charged internally within a group, and have no effect on the total pre-tax profit of the group. Transfer prices are simply a way of sharing the profit between the two companies concerned.

Transfer prices between a company and a foreign subsidiary have implications for taxation, and the aim of a group of companies should be to minimise total tax payable on the group profits. Issues to consider are:

(a) the rate of taxation on profits in the two countries
(b) the existence of a double taxation agreement
(c) the existence of any withholding tax in the country of the foreign subsidiary
(d) tax rules on transfer pricing.

### 25.9.3 Tax rates

The rate of taxation on profits will vary between the two countries and two companies concerned. As a general principle, the aim of a group should be to set a transfer price that shares the profits in a way that reduces the profits of the company in the higher-tax country.

For example, suppose that a parent company in country A sells goods to its 100%-owned subsidiary in country B, and the rate of tax is 20% in country A and 30% in country B. The transfer price should be set as high as the tax rules permit, because this will increase profits of the parent company in lower-tax country A and reduce the profits of the subsidiary in higher-tax country B.

### 25.9.4 Double taxation agreement

There should usually be a double taxation agreement between the two countries. From the point of view of the parent company, this means that:

(a) If the rate of tax on profits is higher in the country of the foreign subsidiary than in the parent company's country, the subsidiary pays tax in its own country on its profits at the rate applicable in that country. No further tax is payable in the parent company's country on the profits of the foreign subsidiary.

(b) If the rate of tax on profits is lower in the country of the foreign subsidiary than in the parent company's country, the subsidiary pays tax in its own country on its profits at the rate applicable in that country. However, tax is also payable by the parent company in its own country. The tax payable is the difference between tax on profits at the rate in the parent company and the tax payable by the subsidiary in its own country.

### 25.9.5 Withholding tax

Withholding tax is additional tax that is 'withheld' when a company pays interest or dividends to a foreign investor. It affects international groups where foreign subsidiaries are located in a country where withholding tax is charged. Payments

of interest or dividends by a subsidiary to the parent company will be subject to the withholding tax.

### 25.9.6 Tax rules on transfer prices

The tax rules in a country are likely to make it difficult for an international group to charge inter-company transfer prices that are significantly different from market prices (where these exist). This is because the tax authorities recognise that transfer prices might be set artificially so as to minimise the total tax burden for the group.

These various tax aspects of transfer pricing are illustrated by the following example.

**Example: Transfer pricing at market price**

A Nigerian company has recently acquired a foreign subsidiary in another country, Outland.

A part of the operating arrangements of the new group is that the parent company will export a component to the subsidiary, and the subsidiary will use this component to make a product that it will sell in Outland.

LC (local currency) is the currency in Outland.

The following information is available:

**Nigerian Company**

| | |
|---|---|
| Sales (components transferred to Outland)<br>Variable cost per unit | 100,000<br>₦15 |
| Fixed costs | ₦900,000 |
| Tax rate | 30% |
| **Outland Company** | |
| Units of product sold (based on components transferred in) | 100,000 |
| Sales price per unit | LC 150 |
| Local variable cost per unit (in addition to transfer cost) | LC 40 |
| Fixed costs | LC 600,000 |
| Tax rate | 30% |

The exchange rate is ₦1 = LC4.

Withholding tax of 10% is charged on all remittances of interest and dividends from Outland.

The Nigerian parent company intends to remit all available profits from Outland to Nigeria.

There is a double taxation agreement between Nigeria and Outland. Tax on income and distributions in one country may be credited against a tax liability on the same income in the other country.

Tax on profits in Outland will be 25%, but there will be an additional withholding tax of 10% since all available profits will be remitted to Nigeria. The total tax payable on income in Outland is therefore 35% which is higher than the rate of Nigerian tax. This means that profits earned in Outland will not be taxed at all in Nigeria.

The management of the Nigerian parent company have to decide what the transfer price for the component should be and is considering two different transfer pricing scenarios.

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**Example (continued): Transfer pricing at market price**

**Transfer pricing scenario 1:** Transfer price set at the market price (₦26 per unit).

The results of using this transfer price are as follows:

| | ₦ | ₦ |
|---|---|---|
| **Parent company (Nigeria)** | | |
| Component sales (₦26 per unit) | 2,600,000 | |
| Variable costs (₦15 per unit) | 1,500,000 | |
| Fixed costs | 900,000 | |
| | (2,400,000) | |
| Profit before tax | 200,000 | |
| Tax at 30% | (60,000) | |
| Profit after tax | | 140,000 |
| **Subsidiary company (Outland)** Product sales (LC150 per unit) | LC 15,000,000 | |
| Transfer costs (LC104 per unit) | 10,400,000 | |
| Local variable costs (LC40 per unit) | 1,500,000 | |
| Local fixed costs | 600,000 | |
| | (12,500,000) | |
| Profit before tax | 2,500,000 | |
| Tax at 25% | (625,000) | |
| Profit after tax | 1,875,000 | |
| Withholding tax at 10% | (187,500) | |
| Remitted to the Nigeria Exchange rate | 1,687,500 ÷4 | |
| Received in Nigeria | | 421,875 |
| Profit in Nigeria after tax | | 561,875 |

**Example (continued): Transfer pricing at market price**

**Transfer pricing scenario 1:** Transfer price set at cost plus 25%.

Total Nigerian costs are ₦2,400,000 or ₦24 per unit. Cost plus 25% = ₦30 per unit.

The transfer price will therefore be ₦30, which is LC120 per unit. The results of using this transfer price are as follows:

| | | |
|---|---|---|
| **Parent company (Nigeria)** | ₦ | ₦ |
| Component sales (₦30 per unit) | 3,000,000 | |
| Variable costs (₦15 per unit) | 1,500,000 | |
| Fixed costs | 900,000 | |
| | (2,400,000) | |
| Profit before tax | 600,000 | |
| Tax at 30% | (180,000) | |
| Profit after tax | | 420,000 |
| **Subsidiary company (Outland)** Product sales (LC150 per unit) | LC 15,000,000 | |
| Transfer costs (LC120 per unit) | 12,000,000 | |
| Local variable costs (LC40 per unit) | 1,500,000 | |
| Local fixed costs | 600,000 | |
| | (14,100,000) | |
| Profit before tax | 900,000 | |
| Tax at 25% | (225,000) | |
| Profit after tax | 675,000 | |
| Withholding tax at 10% | (67,500) | |
| Remitted to the Nigeria Exchange rate | 607,500 ÷4 | |
| Received in Nigeria | | 151,875 |
| Profit in Nigeria after tax | | 571,875 |

**Conclusion**

The higher transfer price results in a bigger after-tax profit for the group. This is because it has the effect of reducing profits in Outland (where the group pays tax at 35% into Nigeria (where the group pays tax at 25%).

The tax authorities in Outland might not agree to accept a transfer price of LC 120 as this is LC 26 above the market price of LC 104.

## 25.10 CHAPTER REVIEW

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

(a) Explain the meaning of decentralization and concepts like

(b) explain suitable divisional measures for a given business using return on investment (ROI) , residual income (RI) and economic value added(EVA) approaches

(c) Explain suitable bases for transfer pricing

(d) Select suitable bases for transfer pricing marginal cost based, market based , two part based and dual based pricing, full cost based , negotiated transfer pricing

(e) Set optimal transfer prices

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## SOLUTIONS TO PRACTICE QUESTIONS

### Solution 1

**Step 1:** What is in the best interests of the company as a whole?

For each additional unit of Product Y that Division B makes and sells, the additional contribution for the company is ₦410 (₦1,400 – ₦700 – ₦290).

The contribution from selling one unit of Product Y in the intermediate market is ₦300 (₦1,000 – ₦700).

The company therefore makes more contribution and profit from making and selling Product Y than from selling Product X externally.

The production plan that will optimise the profit for the company as a whole is for Division A to make units of Product X and transfer them to Division B.

**Step 2:** What would motivate the buying division to buy as many units of Product X as possible from Division A?

Division B will not want to pay more to Division A for Product X than the price it has been offered by an external supplier, ₦1,030. However, Division B can presumably find another supplier who is willing to offer the current market price of ₦1,000, and the maximum price that Division B should pay ought to be ₦1,000.

**Step 3:** What would motivate the selling division to make and transfer as many units of Product X as possible?

| **Product Y** | **₦** |
|---|---|
| Variable cost | 700 |
| Opportunity cost of lost external sale (1,000 – 700) | 300 |
| Total cost = minimum transfer price | 1,000 |

**Ideal transfer price**

The ideal transfer price is ₦100 per unit of Product X. **Contribution per u**

| | **Division A** ₦/unit | | **Division B** ₦/unit | | **Entity as a whole** ₦/unit |
|---|---|---|---|---|---|
| External sale | - | | | | 1,400 |
| Internal sale | 1,000 | | - | | - |
| Sales revenue | 1,000 | | 1,400 | | 1,400 |
| Transfer: purchase cost | - | | 1,000 | | - |
| Other variable costs | 700 | | 290 | | 990 |
| Total variable costs | 700 | | 1,290 | | 990 |
| Contribution per unit | 300 | | 110 | | 410 |

**Skills level**
**Performance management**




# VALUE CHAIN ANALYSIS

## Chapter Content


26.0 Learning objective
26.1 Learning outcomes
26.2 Creating value and competitive advantage
26.3 The value chain
26.4 A value chain for a company handling physical resources


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# 26 VALUE CHAIN ANALYSIS

## 26.0 Learning objective

This chapter introduces candidates to value chain analysis which the organisation to creating value and competitive advantage.

## 26.1 Learning outcomes

By the end of this chapter, candidates should be able toexplain and illustrate all those activities as well as strategies that help management to create values and competitive advantage in an organisation

## 26.2 Creating value and competitive advantage

A business is often organised into a series of departments or divisions each of which might undertake a different function. In practice value is added by a series of activities and processes which occur in a coordinated way. These activities and processes must be linked effectively to add value.

Value chain analysis is a model that gives insight into such business integration.

Value relates to the benefit that a customer obtains from a product or service. Value is provided by the attributes of the product or service. Customers are willing to pay money to obtain goods or services because of the benefits they receive. The price they are willing to pay puts a value on those benefits.

(a) A customer will often be willing to pay more for something that provides more value.

(b) Given a choice between two competing products or services, a customer will select the one that provides more value (in terms of value for money, quality, reliability, functions, convenience, and so on).

Business entities create added value when they make goods and provide services. For example, if a business entity buys a quantity of components for ₦1,000 and converts them into a wrist watch that it sells for ₦10,000, it hascreated value of ₦9,000.

In a competitive market, the most successful companies are those that are best at creating value. Michael Porter has argued that companies in a competitive market must seek competitive advantage over their rivals. They do this by creating more value and by creating value more effectively, more efficiently or at less cost.

Porter suggested that an entity can adopt either of two competitive strategies:

(a) a cost leadership strategy, where its aim is to create the same value as its competitors in the products it makes or the services it provides, but at a lower cost;

(b) a differentiation strategy, where its aim is to create more value than its competitors, for a competing product or service, so that customers are willing to pay more to buy it.

### 26.2.1 The value chain

Porter (**Competitive Strategy**) developed the concept of the value chain. A **value chain** refers to inter-connected activities that create value. He argued that activities within an organisation can be analysed into different categories.

(a) Value can be created by any of these activities.

(b) Management should analyse these value-creating activities to identify where the organisation was most effective at creating value, and where it was least effective.

(c) Similarly, management can identify which activities give them a competitive advantage over rivals

By analysing value-creating activities, decisions can be made about:

(a) how the creation of value can be improved

(b) how to improve a competitive advantage over rivals, and

(c) whether some activities should be stopped because they cost more than the value they create.

### 26.2.2 A value chain for a company handling physical resources

Porter's value chain is most commonly associated with the analysis of value creation in a company that handles physical resources, such as a manufacturing company or a retailing company.

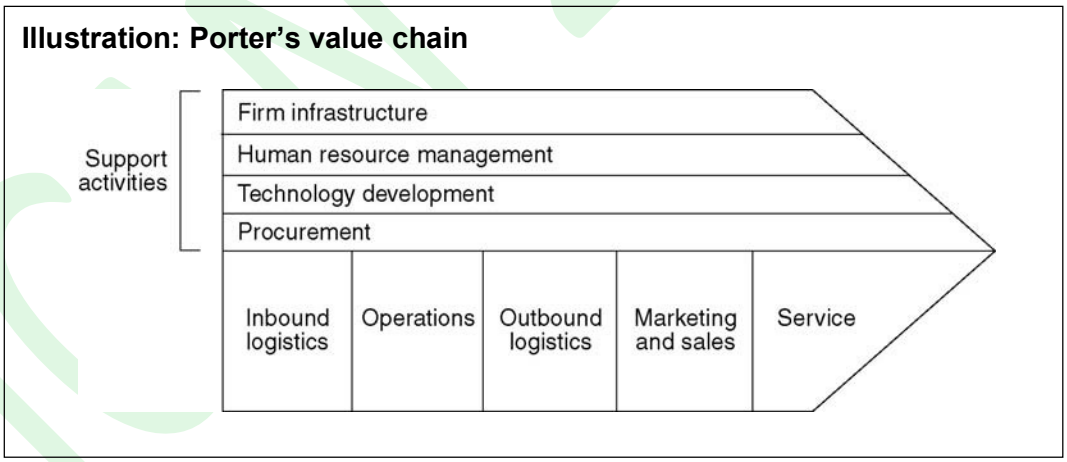
Value-creating activities are grouped into two broad categories:

(a) primary activities; and

(b) support activities.

These are divided into five primary activities and four support activities.

**Illustration: Porter's value chain**




Most value is usually created in the primary value chain.

(a) **Inbound logistics**. These are the activities concerned with receiving and handling purchased materials and components, and storing them until needed.

(b) **Operations**. These are the activities concerned with converting the purchased materials into an item that customers will buy. In a manufacturing company, operations might include machining, assembly, packing, testing and equipment maintenance.

(c) **Outbound logistics**. These are activities concerned with the storage of finished goods before sale, and the distribution and delivery of goods (or services) to the customers.

### 26.2.1 Marketing and sales.

(a) **Service**. These are all the activities that occur after the point of sale, such as installation, repairs and maintenance, and after-sales service.

The nature of the activities in the value chain varies from one industry to another, and there are also differences between the value chain of manufacturers, retailers and other service industries. However, the concept of the primary value chain is valid for all types of business entity.

It is important to recognise that value is added by all the activities on the primary value chain, including logistics. Customers might be willing to pay more for a product or a service if it is delivered to them in a more convenient way. For example, customers might be willing to pay more for household shopping items if the items are delivered to their home, so that they do not have to go out to a supermarket or a store to get them.

### 26.2.2 Secondary value chain activities: support activities

In addition to the primary value chain activities, there are also secondary activities or support activities. Porter identified these as:

(a) **Procurement**. These are activities concerned with buying the resources for the entity – materials, plant, equipment and other assets.

(b) **Technology development**. These are activities related to any development in the technological systems of the entity, such as product design (research and development) and IT systems.

(c) **Human resources management**. These are the activities concerned with recruiting, training, developing and rewarding people in the organisation.

(d) **Corporate infrastructure**. This relates to the organisation structure and its management systems, including planning and finance management.

(e) Support activities are often seen as necessary 'overheads' to support the primary value chain, but value can also be created by support activities. For example:

(f) procurement can add value by identifying a cheaper source of materials or equipment

(g) technology development can add value to operations with the introduction of a new IT system

(h) human resources management can add value by improving the skills of employees through training.

| Primary activities | Examples |
|---|---|
| Inbound logistics | Delivery systems for materials and components, warehouses for accepting deliveries |
| Operations | For a manufacturing company, manufacturing operations and methods: total quality management methods, just-in-time production methods and so on. |
| Outbound logistics | Warehousing for finished goods, methods of delivering goods to customers |
| Marketing and sales | Advertising and sales promotion methods, taking and processing sales orders, pricing |
| Service | After-sales service, handling customer queries and complaints |

| Support activities | Examples |
|---|---|
| Firm infrastructure | Centralised/decentralised management structure, size of head office, head office services, size of management hierarchy, decision-making processes |
| Human relations management | Recruitment policies, training policies, incentive (bonus) pay arrangements, employee skill levels |

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| | |
|---|---|
| Technology development | Use of IT and IT systems, age of IT systems, use of e-commerce |
| Procurement | Choice of suppliers, arrangements with suppliers, just-in-time purchasing, negotiation of prices, credit terms and discounts with suppliers. |

For each individual activity listed within each of these categories of activity, it should be possible to analyse what the company does well (creating value) and what it does less effectively.

It is also possible to use value chain analysis to identify the **information requirements** for each activity, to ensure that it can create value.

## 26.3 Chapter Review

Before moving on to the next chapter readers are encouraged to check that they now know how to:

Explain the concept of value chain analysis applying various strategies and techniques in an organisation to determine activities that will create value as well as ensure organisation competitive advantage.

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**Skills level**
**Performance management**




# ANALYSE AND EVALUATE SUITABLE PERFORMANCE MEASURES FOR PROFITABILITY, LIQUIDITY AND SOLVENCY

## Chapter contents

27.0 Learning objective
27.1 Learning outcome
27.2 Other measures of financial performance indicators (FPIS)
27.3 Chapter review

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## 27 Analyse and evaluate suitable performance measures for profitability, **liquidity and solvency.**

### 27.0 Learning objective

This chapter introduces readers to analysis and evaluation of other suitable performance measures for profitability, liquidity and solvency.

### 27.1 Learning outcome

At the completion of this chapter, candidates should understand the process of analysing and evaluating suitable performance measures for profitability, liquidity and solvency of an organisation.

### 27.2 Other measures of financial performance indicators (FPIS)

#### 27.2.1 Performance indicators: definition

A performance indicator is a performance measurement that is used to evaluate the success of an organisation or of a particular activity. A financial performance indicator is an indicator that relates to an aspect of financial performance that is measured quantitatively and in financial terms.

#### 27.2.2 Aspects of financial performance

There a variety of financial performance indicators that could be used by the management of a business. These include:

(a) Absolute measures, such as sales turnover, costs and profit;

(b) Financial ratios;

(c) Variances (differences between actual and expected performance).

Performance is assessed by comparing indicators of actual performance with indicators of budgeted or expected performance, or with indicators of past performance. Comparisons with past performance indicate whether performance is improving or getting worse.

This chapter focuses on the use of ratios for performance measurement.

#### 27.2.3 Ratio analysis

Ratio analysis is a common method of analysing and measuring the financial performance of an organisation. Although profitability is a very important aspect of business performance, it is not the only aspect of financial performance that should be monitored. The main aspects of financial performance in a for-profit organisation are usually:

(a) profitability;

(b) liquidity; and

(c) financial risk.

Information for measuring financial performance is obtained largely from internal sources – financial statements produced by the accounting systems of the organisation.

Each financial ratio should be a potential significance. Remember that it is not good enough simply to know how to calculate a ratio. You need to understand what the ratio might tell you about financial performance.

### 27.2.4 Using ratios: comparisons

Financial ratios can be used as indicators to make comparisons of performance:

(a) Over a number of years or months. By looking at the ratios of a business entity over a number of years or months, it may be possible to detect improvements or a deterioration in the financial performance or financial position. For example, changes over time can be used to measure rates of growth or decline in sales or profits. Ratios can therefore be used to make comparisons over time, to identify changes or trends, and (perhaps) to assess whether the rate of change is 'good' or 'bad'.

(b) With similar ratios of other, similar companies for the same period.

(c) With target ratios or budgeted ratios of financial performance

(d) In some cases, perhaps, with 'industry average' ratios.

### 27.2.5 FPIs for measuring profitability

Profitability depends on sales revenues and costs. Financial performance indicators that may be relevant for assessing performance include ratios for sales and costs, as well as profit.

Profitability may also be assessed by relating profit to the amount of capital employed by the business. Return on investment (ROI) and other similar financial ratios are explained in the later chapter on divisional performance.

### 27.2.6 Percentage annual growth in sales

Business entities will monitor their annual growth (or decline) in sales, measured as a percentage of sales in the previous year.

For example, if sales in the year just ended were ₦5,800,000 and sales in the previous year were ₦5,500,000, the annual growth in sales has been (₦300,000/₦5,500,000) × 100% = 5.45%.

Sales growth can be a very important measure of financial performance for a number of reasons.

(a) If a company wishes to increase its annual profits, it will probably want to increase its annual sales revenue. Sales growth is usually necessary for achieving a sustained growth in profits over time.

(b) The rate of growth can be significant. For example, suppose that the annual rate of growth in a particular market is 7%. If a company achieves sales growth in the year of 15%, it will probably consider this to be a good performance. If sales growth is 3%, this would probably be considered poor performance – although sales have increased, they have not increased in line with growth in the market.

(c) The period of time over which growth is achieved can also be important. For example, if a company achieves growth in sales of 20% during one year, this

might be considered a good performance. However, performance

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would be even better if the company achieves annual growth in sales of 20% over a five-year period. Sustained growth would indicate that performance has been improving over the long term and might therefore be expected to continue in the future.

Sales growth (or a decline in sales) can usually be attributed to two causes:

(a) sales prices; and

(b) sales volume.

Any growth in sales should be analysed to identify whether it has been caused by changes in sales prices, changes in sales volume or a combination of both.

(Note: In some cases, a company may introduce new products, or cease producing some of its products; in such cases, growth or decline in sales will also be attributable to changes in the number of products sold).

**Example: Sales performance**

Laffco sells orange juice in standard-sized cartons. The market for orange juice is very competitive and there are several larger competitors in the market. Sales data for the previous three years are as follows.

| | **Current year (just ended)** | **Year – 1 (previous year)** | **Year – 2** |
|---|---|---|---|
| Sales revenue | ₦15 million | ₦13.5 million | ₦12 million |
| Cartons sold (millions) | 6 million | 5 million | 4 million |

**Required:** Analyse sales performance.

**Answer**

Sales growth in the current year was ₦(15 million – 13.5 million)/₦13.5 million = 11.1%.

Sales growth in the previous year was ₦(13.5 million – 12 million)/₦12 million = 12.5%.

The growth ratios are easy to calculate, but how should they be interpreted?

In a competitive market, achieving growth in revenue of 12.5% in one year followed by 11.1% the next should probably be considered very good performance.

The average sales price per carton was ₦3 two years ago, ₦2.70 one year ago and ₦2.50 in the current year. This may suggest that sales growth has been achieved by cutting the sales price: lower sales prices often result in a higher volume of sales.

The volume of sales (cartons sold) rose by 25% two years ago and 20% in the current year. This strong growth in sales may be due to excellent marketing activity by the company, or to the reductions in the selling price.

On the basis of the limited information available, it seems possible that the company has succeeded in increasing sales within a competitive market by reducing its selling prices.

### 27.2.7 Profit margin

Profit margin is the profit as a percentage of sales revenue. It is therefore the ratio of the profit that has been achieved for every ₦1 of sales

**Formula: Profit margin**

$$\frac{\text{Profit}}{\text{Sales}} \times 100$$

It is wrong to conclude, without further analysis, that a high profit margin means 'good performance' and a low profit margin means 'bad performance'. To assess performance by looking at profit margins, it is necessary to look at the circumstances in which the profit margin has been achieved.

(a) Some companies operate in an industry or market where profit margins are high, although sales volume may be low. Other companies may operate in a market where profit margins are low but sales volumes are much higher. For example, the profit margin earned on high-fashion clothes should be much higher than the profit margin on low-priced clothing sold in large supermarkets or stores.

(b) Changes in the profit margin from one year to the next should be monitored; improvements may be a sign of 'good performance' and falling profit margins may be a cause for concern.

(c) There are several ways of measuring profit margin. If you are required to measure profit margin in your examination, the most suitable ratio is likely to be:

(d) Gross profit margin (= gross profit/sales). Gross profit is sales revenue minus the cost of sales.

(e) Net profit margin (= net profit/sales). Net profit = gross profit minus all other costs, such as administration costs and selling and distribution costs.

(f) In some industries, particularly service industries, companies do not measure a cost of sales, and so do not measure a gross profit and gross profit/sales ratio.

(g) Any change in profit margin from one year to the next will be caused by:

(h) changes in selling prices, or

(i) changes in costs as a percentage of sales, or

(j) a combination of both.

Changes in costs as a percentage of sales may be caused by a growth or fall in sales volumes, where there are fixed costs in the entity's cost structure.

**Example: Profitability analysis**

Sobco makes and sells footwear. Its profits and sales revenue for the past three years are as follows

| | Current year (just ended) | Year – 1 (previous year) | Year – 2 |
|---|---|---|---|
| Sales revenue | ₦20 million | ₦22 million | ₦24 million |
| Items sold | 1 million | 1.1 million | 1.2 million |
| Gross profit | ₦5.8 million | ₦6.6million | ₦6.8 million |
| Net profit | ₦0.4 million | ₦1.2 million | ₦1.4 million |

**Required**

Analyse profitability and costs.

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**Answer**

Profit margins are as follows:

| | 20X9 (year just ended | 20X8 | 20X7 |
|---|---|---|---|
| Gross profit margin (%) | 29.0% | 30.0% | 28.3% |
| Net profit margin (%) | 2.0% | 5.5% | 5.8% |

The gross profit margin has fallen slightly in the current year, but is higher than the gross profit margin two years ago. There is insufficient information to assess performance, except to conclude that the gross profit margin has been fairly stable over the three-year period.

(This means that the ratio of cost of sales as a percentage of sales has also been fairly constant. The cost of sales/sales ratio is simply 100% minus the gross profit margin.)

The net profit margin has fallen from 5.8% two years ago to 2.0% in the current year. The actual net profit has fallen from ₦1.4 million to ₦0.4 million. The reason for the fall in net profit margin is attributable to either changes in selling prices or changes in costs (as a percentage of sales).

The average selling price per unit has been ₦20 in each of the three years, suggesting that the fall in net profit margin is not caused by changes in selling prices.

The fall in net profit margin is therefore due to changes in costs. Although there has been some variability in the ratio of cost of sales to sales revenue, the main problem appears to be changes in 'other costs' as a percentage of sales.

Other costs = the difference between gross profit and net profit. Two years ago these were ₦5.4 million (= ₦6.8 million - ₦1.4 million), one year ago they were ₦5.4 million (= ₦6.6 million - ₦1.2 million) and in the current year they were also ₦5.4 million (= ₦5.8 million - ₦0.4 million). This suggests that other costs are all fixed costs.

**Answer (continued)**

Fixed costs have remained constant each year, but sales revenue has fallen due to falling sales volume. The reduction in the net profit margin can therefore be attributed mainly to the higher ratio of other fixed costs to sales revenue – in other words, to falling sales.

### 27.2.8 Cost/sales ratios

Profitability may also be measured by cost/sales ratios, such as ratios of:

(a) cost of sales/sales;

(b) administration costs/sales;

(c) sales and distribution costs/sales; and

(d) total labour costs/sales.

Performance may be assessed by looking at changes in these ratios over time. A large increase or reduction in any of these ratios would have a significant effect on profit margin. For example, if the ratio of administration cost/sales increases from 15% to 18%, it should be expected that the net profit margin will fall by 3% (three percentage points)

FPIs for measuring liquidity

Liquidity for a business entity means having enough cash, or having ready access to additional cash, to meet liabilities when they fall due for payment. The most important sources of liquidity for non-bank companies are:

(a) operational cash flows (cash from sales);

(b) liquid investments, such as cash held on deposit or readily-marketable shares in other companies;

(c) a bank overdraft arrangement or a similar readily-available borrowing facility from a bank.

Cash may also come from other sources, such as the sale of a valuable non-current asset (such as land and buildings), although obtaining cash from these sources may need some time.

Liquidity is important for a business entity because without it, the entity may become insolvent even though it is operating at a profit. If the entity is unable to settle its liabilities when they fall due, there is a risk that a creditor will take legal action and this action could lead on to insolvency proceedings.

On the other hand, a business entity may have too much liquidity, when it is holding much more cash than it needs, so that the cash is 'idle', earning little or no interest. Managing liquidity is often a matter of ensuring that there is sufficient liquidity, but without having too much.

### 27.2.9 Changes in the cash balance or bank overdraft balance

A simple method of monitoring liquidity is to keep the cash balance at the bank under continual review and look for any deterioration (or improvement) in the cash position. If the entity has a bank overdraft facility, the cash position should be monitored to make sure that the overdraft does not get too close to the limit.

When there is a big change in the cash position, it is important to investigate the reason for the change and judge whether liquidity has become a matter for concern. If you are familiar with statements of cash flows, you should be aware of the various sources of cash and reasons for payments of cash. A large fall in cash (or a big increase in the bank overdraft) may be caused by:

(a) operating losses;

(b) increases in working capital (inventory plus receivables, minus trade payables);

(c) expenditures on investments, such as purchases of new non-current assets; and

(d) repayments of debt capital (bank loans) or payments of dividends.

A reduction in cash caused by operating losses would be the most serious reason for a loss of liquidity, but when a business entity is short of liquidity anything that uses up cash may be significant.

Liquidity ratios

Liquidity may also be monitored by looking at changes in liquidity ratios over time. There are two ratios for measuring liquidity that could be used:

(a) current ratio; and

(b) quick ratio, also called the acid test ratio.

The more suitable ratio for use depends on whether inventory is considered a liquid asset that will soon be used or sold and converted into cash from sales.

The **current ratio** is the ratio of current assets to current liabilities.

Formula: Current ratio

$$\text{Current ratio} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

It is sometimes suggested that there is an 'ideal' current ratio of 2.0 times (2:1). However, this is not necessarily true and in some industries, much lower current ratios are normal. It is important to assess a current ratio by considering:

(a) changes in the ratio over time; and

(b) the liquidity ratios of other companies in the same industry.

The **quick ratio or acid test ratio** is the ratio of 'current assets excluding inventory' to current liabilities. Inventory is excluded from current assets on the assumption that it is not a very liquid item.

Formula: Quick ratio

$$\text{Quick ratio} = \frac{\text{Current assets excluding inventory}}{\text{Current liabilities}}$$

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This ratio is a better measurement of liquidity than the current ratio when inventory turnover times are very slow, and inventory is not a liquid asset.

It is sometimes suggested that there is an 'ideal' quick ratio of 1.0 times (1:1). However, this is not necessarily true, and in some industries much lower quick ratios are normal. As indicated earlier, it is important to assess liquidity by looking at changes in the ratio over time, and comparisons with other companies and the industry norm.

When there is a significant change in liquidity, the reason should be investigated. Liquidity ratios will deteriorate (i.e. get smaller) when:

(a) there is an increase in current liabilities without an increase in current assets; or

(b) there is a reduction in current assets without a reduction in current liabilities (for example, writing off inventory or bad debts).

Examples of reasons for a reduction in liquidity are:

(c) operating losses; and

(d) using cash to purchase new non-current assets.

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**Example: Quick and current ratios**

The following data relates to Noms and independent café and delicatessen

| | **20X6** ₦ | **20X7** ₦ | 20X8 ₦ |
|---|---|---|---|
| *Current assets* | | | |
| Inventories | 2,985 | 3,028 | 3,211 |
| Other current assets | 9.594 | 9,652 | 7,660 |
| Total current assets | 12,579 | 12,680 | 10,871 |
| *Current liabilities* | | | |
| Creditors | 19,021 | 18,604 | 19,523 |
| Other current liabilities | 4,566 | 4,306 | 4,414 |
| Total current liabilities | 23,587 | 22,910 | 23,937 |
| | | | |

**Required:**

Calculate the current and quick ratios for Noms and comment on the results.

**Answer**

The current and quick ratios are as follows

| **Current ratio** | | | |
|---|---|---|---|
| | | | |
| Total current assets | 12,579 | 12,680 | 10,871 |
| Total current liabilities | ÷23,587 | ÷22,910 | ÷23,937 |
| Current ratio | 0.53 | 0.55 | 0.45 |
| **Quick ratio** | | | |
| Total current assets | 9,594 | 9,652 | 7,660 |
| Total current liabilities | ÷23,587 | ÷22,910 | ÷23,937 |
| Quick ratio | 0.41 | 0.42 | 0.32 |

Both the current and quick ratios are stable between 20X6 and 20X7 with a current ratio of around 0.54 and a quick ratio of around 0.41.

Whether the ratios are at an acceptable value or are cause for concern depends on what is normal for the industry.

A business like a café/delicatessen might be able to take credit from its suppliers but is making sales for cash. This allows it to operate with ratios that might appear more worrying in another type of business.

The difference between the current and quick ratios is not really important in this case. The inventory of this sort of business can be turned into cash in a very short time frame and might be considered almost as good as cash in terms of enabling the business to pay its debts as and when they fall due.

Both the current and quick ratios decrease in 20X8 and this sudden

deterioration after a period of stability might be might be cause for concern.

### 27.2.2 FPIs for measuring financial risk

Financial risk is the risk to a business entity that arises for reasons related to its financial structure or financial arrangements. There are several major sources of financial risk, such as credit risk (the risk of bad debts because customers who are given credit will fail to pay what they owe) and foreign exchange for companies that import or export goods or services (the risk of an adverse movement in an important currency exchange rate).

A significant risk is the risk that could arise through borrowing. If an entity borrows money, it will have to pay the money back at some time and will also have to pay interest. The risk is that if an entity borrows very large amounts of money, it might fail to generate enough cash from its business operations to pay the interest or repay the debt principal.

**Example: Financial risk**

Zapco is an advertising agency. Next year it expects to make a profit before interest of ₦300,000. The company has a bank loan of ₦3 million, which is repayable in one year's time and on which the rate of interest is 8%.

What are the financial risks for Zapco?

**Answer**

The annual cost of interest on the bank loan is ₦240,000 (= 8% × ₦3,000,000). The profit is enough to cover the interest, but with only ₦60,000 to spare.

A financial risk for Zapco is that if profit next year is more than ₦60,000 below expectation, it will make a loss after interest.

Another risk is that it may be unable to meet the interest payments on the loan, unless it has spare cash that it can use or other sources of liquidity such as extra bank borrowing.

A third risk is that when the bank loan has to be repaid in one year's time, Zapco may need to borrow more money in order to repay the loan. This is often referred to as 'renewing' a loan. However the bank might refuse to re-lend the money and might insist on repayment in full and on time. If Zapco can't do this, it will be faced with the risk of insolvency.

Financial risk depends to a large extent on conditions in the financial markets. There have been times when 'credit' has been easy to obtain, and a company wishing to borrow more money could do so quite easily. However, a 'credit bubble' can turn into a 'credit squeeze', when banks cut their lending and are reluctant to renew loans. A global credit squeeze began in 2007, and for many companies with large amounts of borrowing, the risks of insolvency became much greater.

#### Debt ratios

Debt ratios can be used to assess whether the total debts of the entity are within control and are not excessive.

(a) the equity capital in the company, or

(b) the total capital of the company.

**Formula: Gearing ratio**

$$\text{Gearing ratio} = \frac{\text{Long term debt}}{\text{Share capital + reserves + long term debt}} \times 100$$

Alternatively:

**Formula: Debt to equity ratio**

$$\frac{\text{Long term debt}}{} \times 100$$

When there are preference shares, it is usual to include the preference shares within long-term debt, not share capital.

A company is said to be **high-geared** or **highly-leveraged** when its debt capital exceeds its share capital and reserves. This means that a company is high-geared when the gearing ratio is above either 50% or 100%, depending on which method is used to calculate the ratio.

A company is said to be **low-geared** when the amount of its debt capital is less than its share capital and reserves. This means that a company is low-geared when the gearing ratio is less than either 50% or 100%, depending on which method is used to calculate the ratio.

The gearing ratio can be used to monitor changes in the amount of debt of a company over time. It can also be used to make comparisons with the gearing levels of other, similar companies, to judge whether the company has too much debt, or perhaps too little, in its capital structure.

### Example: Gearing

Company A and Company B are identical in all respects except their gearing.

Both have assets of ₦30,000 and both make the same operating profit (PBIT).

Company A is financed purely by equity, and Company B is financed by a mixture of debt and equity as follows.

| Assets | Company A<br>30,000 | Company B<br>30,000 |
|---|---|---|
| Ordinary shares of ₦1 | 30,000 | 20,000 |
| 10% bonds | | 10,000 |
| | 30,000 | 30,000 |

Company B has to make a profit of at least ₦1,000 in order to be able to pay the interest on the 10% bond.

Company A has no debt, so does not need to cover the interest payments and so does not have any minimum PBIT requirement.

Company B is therefore riskier than company A.

Lower geared companies are less risky than higher geared companies as there is a greater likelihood that its PBIT will be high enough to cover interest charges and make a profit for the shareholders

**Interest cover ratio**

Interest cover measures the ability of the company to meet its obligations to pay interest.

**Formula: Interest cover**

$$\text{Interest cover} = \frac{\text{Profit before interest and tax}}{\text{Interest charges in the year}}$$

An interest cover ratio of less than 3.0 times is considered very low, suggesting that the company could be at risk from too much debt in relation to the amount of profits it is earning.

The risk is that a significant fall in profitability could mean that profits are insufficient to cover interest charges, and the entity will therefore be at risk from any legal action or other action that lenders might take.

**Example: Gearing and interest cover**

The following data relates to All Stores, a large chain of supermarkets

| *Current liabilities* | **20X6** **₦**'000 | **20X7** **₦**'000 | 20X8 **₦**'000 |
|---|---|---|---|
| Short-term debt (at 5%) | 11,773 | 6,402 | 5,453 |
| *Non-current liabilities* | | | |
| Long-term debt (2%) | 41,771 | 41,086 | 38,214 |
| *Capital and reserves* Total shareholders' equity (share capital plus reserves) | 79,209 | 81,394 | 80,546 |
| **Earnings before interest and tax (EBIT)** | 27,260 | 21,638 | 20,497 |

**Required**

Calculate the gearing and interest cover ratios for All Stores and comment on the results

**Answer Gearing**

Gearing is calculated using the formula:

| | **20X6** | **20X7** | 20X8 | |
|---|---|---|---|---|
| | **₦**'000 | **₦**'000 | **₦**'000 | |
| Long-term debt | 41,771 | 41,086 | 38,214 | **(1)** |
| Total shareholders' equity (share capital plus reserves) | 79,209 | 81,394 | 80,546 | |
| | 120,980 | 122,480 | 118,760 | **(2)** |
| Gearing ratio (1) as a percentage of (2) | 34.53% | 33.55% | 32.18% | |

The gearing level has decreased over the 3 year period.

This shows that All Stores is less reliant on debt to fund its business.

The interest cover at All Store over the three years is as follows:

| | 20X6 | 20X7 | 20X8 |
|---|---|---|---|
| | ₦'000 | ₦'000 | ₦'000 |
| **EBIT** | 27,260 | 21,638 | 20,497 |
| Interest | | | |
| Short-term debt | 11,773 | 6,402 | 5,453 |
| Interest at 5% | 539 | 320 | 273 |
| Long-term debt | 41,771 | 41,086 | 38,214 |
| Interest at 2% | 835 | 822 | 764 |
| Total interest in the year | 1,374 | 1,140 | 1,037 |

**The limitations of financial ratios as performance indicators**

There are several limitations or weaknesses in the use of financial ratios for analysing the performance of companies.

(a) Ratios can only indicate **possible** strengths or weaknesses in financial position and financial performance. They might raise questions about performance, but do not provide answers. They are not easy to interpret, and changes in financial ratios over time might not be easy to explain.

(b) Using financial ratios to measure performance can sometimes lead managers to focus on the short-term rather than the long-term success of the business.

(c) There is some risk that managers may decide to 'manipulate' financial performance, for example by delaying a large item of expenditure or bringing forward the date of a major business transaction, in order to increase or reduce profitability in one period (and so reduce or increase the profit for the next financial period). The risk of manipulating financial results is particularly significant when managers are paid annual bonuses on the basis of financial performance.

### 27.3.9 Industry specific ratios

Many of the above financial ratios can be used to analyse performance of different types of company.

There are some financial performance measures which might be used in specific industries. For example:

(a) annual sales revenue per cubic metre of shelf space (a ratio used by supermarkets and other stores);

(b) cost per tonne-mile carried (road haulage companies);

(c) cost per passenger-mile carried (transport companies);

(d) average income per consultant day (management consultancy company);

(e) add-on revenue per guest night (hotels).

## 27.4 Chapter Review

Before moving on to the next chapter readers are encouraged to check that they now
understand the process of identify, analyse and evaluate suitable performance measures for profitability, liquidity and solvency of an organisation.

**Example: Industry specific ratios**
A company transports grain from the countryside to the capital city. The following information has been gathered for a period:

| | |
|---|---|
| Load per lorry<br>Distance per trip Cost per km | 20 tonnes<br>300 km |
| Distance per trip | 300km |
| Trip cost per km | ₦500 |
| Total cost (300 km □ ₦500) | ₦150,000 |
| Tonnes per km (300 km □ 20 tonne) | ÷6,000 tonnes |
| Cost per tonne per km | ₦25 |

Note: Tonnes per km – Carrying 20 tonnes for 30 km is the equivalent of carrying 6,000 tonnes for 1 km.

**PART F**
**PERFORMANCE EVALUATION AND CORPORATE FAILURES**

1. Strategic Performance Issues in complex business structure
2. Alternative views of Performance Measurements
3. Predicting and Preventing corporate failures

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

(a) explain, perform and interpret c analysis
(b) explain and apply porter's five forces model to identify industry attractiveness
(c) explain and apply the boston consulting group model to identify categories of product (business) in a company's portfolio
(d) use ansoff's grid to identify possible strategic directions
(e) explain and apply benchmarking to compare performance against information provided (for example, about a competitor)
(f) construct and interpret a swot analysis

**Skills level**
**Performance management**

CHAPTER 28

# STRATEGIC PERFORMANCE ISSUES IN COMPLEX BUSINESS STRUCTURES

## Chapter Contents


28.0 Learning objective
28.1 Learning outcomes
28.2 Evaluate the problems in strategic planning and control and levels of strategic planning
28.3 Definition of strategic planning and control
28.4 Advantages of formal strategic planning
28.5 Overview of a formal strategic planning process
28.6 Strategic analysis
28.7 Corporate appraisal
28.8 Strategic choice
28.9 Evaluation of strategic options
28.10 Other issues
28.11 Chapter review


ICAN 2025

## 28.0 Learning objective

This chapter introduces candidates to the concept of strategic performance issues in complex business structures with emphasis on strategic planning, and control, strategic analysis, corporate appraisal and strategic choice and the evaluation the process.

## 28.1 Learning outcome

Following the completion of this chapter, candidates will be able to understand the concept of strategic performance issues in a complex business structure including strategic analysis, corporate appraisal,

(a) strategic choices and their evaluation.

(b) Equally , candidates should be able to

(c) Explain, perform and interpret C analysis

(d) Explain and apply Porter's five forces model to identify industry attractiveness

(e) Explain and apply the Boston Consulting Group model to identify categories of product (business) in a company's portfolio

(f) Use Ansoff's grid to identify possible strategic directions

(g) Explain and apply benchmarking to compare performance against information provided (for example, about a competitor)

(h) Construct and interpret a SWOT analysis

## 28.2 Levels of strategic planning and control and evaluation of associated problems

Planning is a hierarchical activity, linking strategic planning at the top with detailed operational planning at the bottom. Strategic plans set a framework and guidelines within which more detailed plans, and shorter-term planning decisions, can be made.

R N Anthony identified three levels of planning: within an organisation:

(a) **Strategic planning**. This involves identifying the objectives of the entity, and plans for achieving those objectives, mostly over the longer term. Strategic plans include corporate strategy plans, business strategy plans and functional strategy plans.

(b) **Tactical planning**. These are shorter-term plans for achieving medium- term objectives. An example of tactical planning is the annual budget. Budgets and other tactical plans can be seen as steps towards the achievement of longer-term strategic objectives.

(c) **Operational planning**. This is detailed planning of activities, often at a supervisor level or junior management level, for the achievement of short- term goals and targets. For example, a supervisor might divide the workload between several employees in order to complete all the work before the end of the day.

### 28.2.1 Definition of strategic planning and control

Strategic planning and control' within an entity is the continuous process of:

(a) identifying the goals and objectives of the entity

(b) planning strategies that will enable these goals and objectives to be achieved

(c) setting targets for each strategic objective (performance targets)

(d) converting strategies into shorter-term operational plans

(e) implementing the strategy

(f) monitoring actual performance (performance measurement and review)

(g) taking control measures where appropriate when actual performance is below the target.

Other aspects of strategic planning and control are:

(a) re-assessing plans and strategies when circumstances in the business environment change

(b) where necessary, changing strategies and plans.

### 28.2.2 Advantages of formal strategic planning

Companies often have a formal strategic planning process, because a formal system of planning:

(a) clarifies objectives

(b) helps management to make strategic decisions. Strategic planning forces managers to think about the future: companies are unlikely to survive unless they plan ahead

(c) establishes targets for achievement

(d) co-ordinates objectives and targets throughout the organisation, from the mission statement and strategic objectives at the top of a hierarchy of objectives, down to operational targets

(e) provides a system for checking progress towards the objectives.

However, planning must also be flexible. Plans and targets might need to change in response to changes in the business environment, for example, a new initiative by a rival company.

### 28.2.3 Changes in strategic plans

Strategic plans often cover a period of several years, typically five years or longer. They are prepared on the basis of the best information available at the time, using assumptions about the nature of the business environment – competitive conditions, market conditions, available technology, the economic, social and political climate, and so on.

However, the business environment can change very quickly, in unexpected ways. Changes can create new threats to a company, or they can create new business opportunities. Whenever changes occur, a company should be able to respond – taking measures to deal with new threats, or to exploit new opportunities.

The response of a company to changes in its environment could mean having to develop new strategies and abandon old ones. When changes are made, the original strategic plan will no longer be entirely valid, although large parts of it might be unaffected.

Strategic planning in practice is therefore often a mixture of:

(a) formal planning, and

(b) developing new strategies and making new plans whenever significant

changes occur in its business environment.

Responding to unexpected changes by doing something that is not in the formal plan is sometimes called 'freewheeling opportunism'. It means making unplanned decisions, to take advantages of opportunities as they arise, or to deal with unexpected threats.

### 28.2.4 Overview of a formal strategic process

Different methods and approaches may be used to develop strategic plans. A basic approach to strategic planning is shown in the following diagram.

**Illustration: Overview of a formal strategic process**




#### Mission and objectives

The entity exists for a purpose, which may be expressed formally in a mission statement.

The entity must develop clear objectives, such as the maximisation of shareholder wealth. These objectives should be consistent with the mission statement. Targets can be established for the achievement of objectives within the planning period.

Objectives should take into account the interest and power of stakeholders. Stakeholder mapping is a useful tool in this regard.

### 28.2.5 Strategic analysis

#### Environmental analysis

Environmental analysis involves an analysis of developments outside the organisation that are already affecting the organisation or could affect the organisation in the future. These are external factors that might affect the achievement of objectives and strategy selection.

An external analysis might consider:

(a) the political situation in each country where it has operating subsidiaries

(b) changes in the law, and how these affect the organisation

(c) changes in economic conditions

(d) social factors and cultural factors, such as an increasing average age in the population

(e) technology changes: the development of the internet and e-commerce, for example, have had enormous consequences for business within the past few years

(f) the competitive environment, such as the entry of a new competitor into the market, or the 'globalisation' of the market.

An external analysis should identify opportunities and threats that face the organisation. Strategies might be developed to exploit opportunities or take counter-measures to deal with threats.

Models that might be used include:

(a) PESTEL analysis; and

(b) Porter's 5 forces;

These are covered in more detail later.

**Position audit**

Internal analysis looks at the strengths and weaknesses within the organisation – its products, existing customers, management, employees, technical skills and 'know-how', its operational systems and procedures, its reputation for quality, the quality of its suppliers, its liquidity and cash flows, and so on.

Strategies should seek to make full use of any strengths within the entity and to reduce or remove significant weaknesses.

Models that might be used include:

(a) 9Ms (Men, Management, Money, Make-up, Machinery, Methods, Markets, Materials, Management information);

(b) Financial analysis;

(c) Benchmarking;

(d) Product life cycle;

(e) Boston consulting grid;

(f) Value chain analysis;

Some of these are covered in more detail later.

### 28.2.6 Corporate appraisal

**SWOT analysis**

The mission statement and objectives of the entity, together with the results from the environmental analysis and position audit, should lead on to a formal appraisal of strategy and what the entity might be capable of achieving.

SWOT analysis is the analysis of the strengths and weaknesses of an organisation, and the opportunities and threats in its environment. This method of strategic analysis is often used by organisations as a starting point for strategic planning.

Strategic management accounting can assist with SWOT analysis by trying to put costs or benefits to particular strengths, weaknesses, opportunities and threats, so that strategic managers are able to assess their importance.

SWOT analysis is explained in more detail later.

### Gap analysis

A strategic plan should set out the ways in which an organisation intends to achieve its objectives. One way of doing this is to prepare a forecast of what is likely to happen if the company carries on with its current plans and policies, and does not take any new strategic initiatives.

Gap analysis involves:

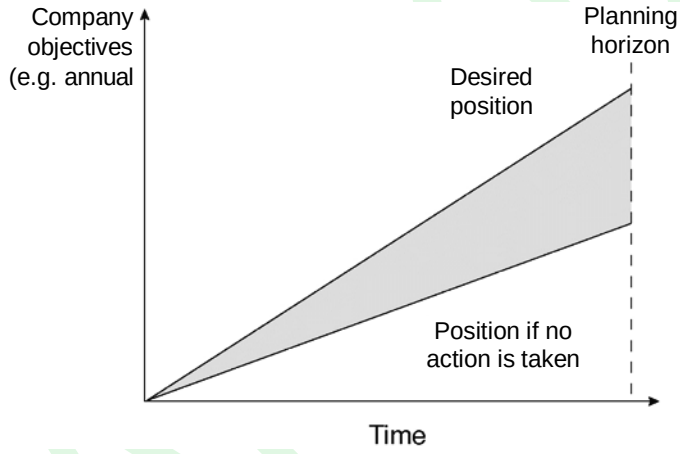
(a) identifying the corporate objectives for the organisation, and what strategic management wants the organisation to achieve each year over the planning period

(b) comparing these strategic targets with the expected actual results, if there are no changes in strategy and no new planning initiatives.

The gap is the difference between these two and is known as is a planning gap.

(Gap analysis is sometimes described as an analysis of the difference between 'Where we are' and 'Where we want to be'.)

**Illustration: Gap analysis**




Strategies should be developed to close the gap, so that expected performance is in line with the strategic aims and objectives.

## 28.2.7 Strategic choice

There are choices to made in three areas

### Basis of strategy

This is about how to compete. The work of Michael Porter is influential in this area.

According to Porter, a successful competitive strategy must be based on either:

(a) cost leadership, or

(b) differentiation.

**Cost leadership** means becoming the lowest-cost producer in the market. A company that can make products or provide services at a lower cost than competitors will succeed, by selling at lower prices and winning the biggest share of the market.

**Differentiation** means making products or services that are considered by customers to be different from those of competitors, and because they are different they are better. A company that is not the least-cost producer can therefore succeed by offering product or service that customers will pay a higher price (than the least-cost producer's price) to obtain.

Either of these strategies might be pursued with a broad focus or in a niche market.

### Strategic direction

This concerns which products should be sold to which markets. A useful model here is Ansoff's Grid which is covered in more detail later. It identifies four possible alternatives:

(a) Sell existing products in existing markets – **Market penetration strategy**.

**(b)** Sell existing products in new markets – **Market development strategy**

(c) Sell new products in existing markets – **Product development strategy**.

(d) Sell new products in new markets – **Diversification strategy**.

### Strategic method

This concerns the question of how to grow? Growth can be achieved through:

(a) Internal growth (also called organic growth)

(b) Acquisitions and mergers

(c) Joint ventures or strategic alliances

## 28.2.8 Evaluation of strategic options

Strategies should be evaluated to decide whether they might be appropriate. Johnson and Scholes have suggested that strategies should be assessed for:

(a) suitability;

(b) feasibility;

(c) acceptability

### Suitability

A strategy must be suitable for achieving the strategic aims and requirements of the company. This must be assessed in terms of resources and competences.

A strategy must enable the company to take advantage of its core competences and unique resources, in order to gain competitive advantage

Suitability relates to the strategic logic and strategic fit of the strategy

The strategy must fit the company's operational circumstances and strategic position.

Key questions include does the strategy:

(a) Exploit company strengths and distinctive competences?

(b) Rectify company weaknesses?

(c) Neutralise or deflect environmental threats?

(d) Help the firm to seize opportunities?

(e) Satisfy the goals of the organisation?

(f) Fill the gap identified by gap analysis?

(g) Generate/maintain competitive advantage?

**Feasibility**

Questions that might be asked to assess feasibility are:

(a) Can we afford it?

(b) Will we have the labour skills needed?

(c) Can we achieve the necessary product quality?

(d) Can we produce at the cost that will be necessary?

(e) Do we have the marketing skills needed?

(f) Can we obtain the raw materials needed?

**Acceptability**

A strategy must be acceptable to the key stakeholders affected by it. A strategy is inappropriate if it is unacceptable to any key stakeholders.

### 28.2.9 Problems of Measuring of strategic Performance levels:

Measuring strategic performance can be challenging due to factors like aligning metrics with strategic goals, ensuring data accuracy and relevance, and managing resistance to change, which can lead to misaligned focus and ultimately hinder organisational success.
Some of the critical metrics used in strategic performance include productivity metrics, quality of service and production, and of course profitability indices.
The problems of measuring strategic performance levels can be detailed as follow:

(a) Alignment and Relevance problem associated with lack of linkage , focus on real input and output relationship , high numbers of metrics creating problem of selection and use of poorly defined key performance indicators (KPIs) .

(b) Secondly, available data for evaluation may be poor in quality and inaccurate .

(c) Poor leadership which lead to resistance to change and sometimes misalignment of focus where such focus is to short term advantages rather than long term objective.

(d) Lack of resources and poor innovation as a result of failed focus on short term goal

### 2.8.10 Other issues

**Strategic implementation**

The selected strategies should then be implemented.

The implementation of strategies should be monitored. Changes and adjustments should be made where these become necessary.

Areas of importance here are change management and project management. These are covered in more detail later

### Review and control

This is a key area. An entity will have management information systems in place to monitor the progress of the business. These are particularly important to the introduction of a new strategy where timing and achievement of progress points might be vital to its success. This is covered in more detail later.

## 28.3 Models for environmental analysis

### 28.3.1 The nature of environmental analysis

A business entity cannot exist in isolation from its environment. It inter-relates with its environment, and its survival and strategic success depend on how well it responds to the threats and opportunities that the environment provides.

An entity's environment is anything that is not a part of the entity itself. For a business organisation, the environment includes customers, potential customers, markets, competitors, suppliers, governments and potential sources of new employees. It also includes the social, political and economic environment in which the entity exists and operates.

The term '**macro-environment**' is used to mean general factors in the business environment of an entity, rather than specific customers, suppliers and competitors.

Environmental influences on an organisation vary with the size of the organisation, and the industry and the countries in which it operates.

The importance of environmental factors for strategic management arises because:

(a) organisations operate within their environment and interact with it

(b) changes in the environment can be large and significant – and continually happening

(c) future changes can be very difficult to predict.

### 28.3.2 The purpose of environmental analysis

Environmental analysis is a part of the process of assessing strategic position. In order to make strategic choices about the future, the management of an entity need to understand:

(a) the factors in the environment that have a significant effect on the entity and what it does

(b) the key drivers of change: these are the factors in the environment that will have the greatest effect on the entity, and force the entity to change its strategies in order to survive and succeed

(c) the difference in impact that key drivers of change in the environment will have on different industries or different markets, or how changes in the environment might affect one particular entity more or less than other entities.

It is also important to consider the **future impact** of factors in the environment. The future impact might be different from the impact that they have had in the past. Some factors might grow in significance; others might become less significant.

Environmental analysis is the process of:

(a) studying the environment in which an entity operates

(b) identifying significant factors in the environment, particularly those that will be significant in the future.

The purpose of the analysis is to assess the environment, to **analyse the position of an entity in relation to its environment** and to judge how the entity's strategies should be developed to take advantage of opportunities and deal with any potential threats. It is a first step towards formulating a business strategy.

### 28.3.3 Two models for environmental analysis

In your examination, you may be required to carry out an environmental analysis. You might be required to use any 'model' of your choice. Alternatively you might be asked specifically to use PESTEL analysis or Porter's Diamond.

(a) The PESTEL model is used to identify significant factors in the macro-environment of an entity.

(b) Porter's Diamond model is used to analyse reasons why entities in particular countries, or regions within a country, appear to have a significant competitive advantage over similar entities in the same industry, but operating in other countries or other regions.

## 28.4 PESTEL analysis

### 24.8.1 The nature of PESTEL analysis

PESTEL analysis is a structured approach to analysing the external environment of an entity. The influences (current influences and possible future influences) of the environment on the entity are grouped into categories. For each category of environmental influence, the main influences are identified.

There are six categories of environmental influence:

(a) P – Political environment

(b) E – Economic environment

(c) S – Social and cultural environment

(d) T – Technological environment

(e) E – Ecological influences

(f) L – Legal environment

The purpose of dividing environmental influences into categories is simply to make it easier to organise the environmental analysis and ensure that some key influences are not over-looked. It provides a **useful framework** for analysis.

You might also see reference to SLEPT analysis and PEST analysis. These are similar to PESTEL analysis in concept, but use a smaller number of environmental categories.

(a) SLEPT analysis uses the same categories of environmental influence as PESTEL analysis, without 'Ecological influences'.

(b) PEST analysis is the same as SLEPT analysis, but includes 'Political influences' and 'Legal environment' in the same category.

### 28..4.2 Social and cultural environment

An entity is affected by social and cultural influences in the countries or regions in which it operates, and by social customs and attitudes. Some influences are more significant than others.

Factors in the social and cultural environment include the following:

(a) The values, attitudes and beliefs of customers, employees and the general public.

(b) Patterns of work and leisure, such as the length of the working week and popular views about what to do during leisure time

(c) The ethnic structure of society

(d) The influence of religion and religious attitudes in society

(e) The relative proportions of different age groups in society.

### 28.4.3 Legal environment

The legal environment consists of the laws and regulations affecting an entity, and the possibility of major new laws or regulations in the future.

Laws and regulations vary between different countries, although international regulation is accepted in certain areas of commercial activity, such as banking.

Strategic decisions by an entity might be affected by legal considerations. For example:

(a) an international company might locate some operations, for tax reasons, in a country with a favourable tax system

(b) decisions to relocate operations from one country to another could be affected by the differences in employment law in the two countries, or by new employment legislation

(c) in many industries, companies are faced with environmental legislation or health and safety legislation, affecting the ways in which they operate, as well as the design of the products they make and sell.

### 28.4.4 Economic environment

The economic environment consists of the economic influences on an entity and the effect of possible changes in economic factors on future business prospects. Factors in the economic environment include:

(a) the rate of growth in the economy;

(b) the rate of inflation;

(c) the level of interest rates, and whether interest rates may go up or fall;

(d) foreign exchange rates, and whether particular currencies are likely to get weaker or stronger;

(e) unemployment levels and the availability of skilled or unskilled workers;

(f) government tax rates and government subsidies to industry;

(g) the existence or non-existence of free trade between countries, and whether trade barriers may be removed

(h) the existence of trading blocs of countries, such as the European Community, Economic Community of West African States (ECOWAS), etc.

Economic factors could affect a decision by a company about where to invest. Tax incentives, the availability of skilled labour, a good transport infrastructure, a stable currency and other factors can all influence strategic choices.

### 28.4.5 Political environment

The political environment consists of political factors that can have a strong influence on business entities and other organisations.

Investment decisions by companies will be influenced by factors such as:

(a) the stability of the political system in particular countries

(b) the threat of government action to nationalise the industry and seize ownership from private business

(c) wars and civil unrest

(d) the threat of terrorist activity.

Political considerations are particularly important for business entities operating in countries with an unstable political regime, or a dictatorship.

### 28.4.6 Technological environment

The technological environment consists of the science and technology available to an organisation (and its competitors), and changes and developments in science and technology.

Some aspects of technology and technological change affect virtually all organisations. Developments in IT and computer technology, including the Internet, are the most obvious example. Business entities that do not respond to changes in IT and computerisation risk losing their share of the market to competitors.

However, technological change might also affect particular industries. Scientific developments in food and drugs, for example, are having a continual impact on companies in these industries.

For strategic planning, companies need to be aware of current technological changes and the possible nature of changes in the future. Technology could have an important influence, for example, on investment decisions in research and development, and investment in new technology.

### 28.4.7 Ecological influences

For business entities in some industries, environmental factors have an important influence on strategic planning and decision-making. They are particularly important for industries that are:

(a) subject to strict environmental legislation, or the risk of stricter legislation in the future (for example, legislation to cut levels of atmospheric pollution)

(b) faced with the risk that their sources of raw materials will be used up (for example, parts of the fishing industry and timber production industry)

(c) at the leading edge of technological research, such as producers of genetically modified foods.

In some countries, companies have seen a commercial advantage in presenting themselves as ‘environment-friendly’, by improving their reputation with the general public. Several companies have adopted a policy of becoming ‘carbon neutral’ so that they remove as much carbon dioxide from the atmosphere as they add to carbon dioxide with emissions from their operating activities. (It was reported in the UK in 2007 that the demand from UK companies to acquire energy from renewable

energy sources was far in excess of the capacity of the energy companies to supply energy from those sources.)

Major oil companies are investing in the development of energy from renewable energy sources, such as the sea and wind.

### 28.4.8 Limitations of PESTEL analysis

PESTEL analysis is a useful framework for identifying environmental influences on an entity. However, there are limitations to the technique.

(a) It is easier to use PESTEL analysis to identify environmental influences in the past and present. It is not so easy to identify the environmental influences that will have the biggest influence in the future.

(b) It is a method of identifying environmental influences, by providing a framework for analysis. It does not provide an assessment of environmental influences. It is used for qualitative analysis, but not for quantification. A manager using PESTEL analysis might need to use his (subjective) judgement to decide which environmental factors are more important than others.

## 28.5 Five forces model

### 28.5.1 Competitive strength and the five forces

Michael Porter (in *Competitive Strategy*) developed a model for analysing the competitive nature of markets and the competitive position of companies. It is also a model for assessing the problems that a company faces in establishing a strong competitive position in a market.

The model should be used to analyse a 'strategic business unit', rather than a company as a whole. A strategic business unit (or SBU) is a part of a company's operations for which there is a separate and distinct market.

The model is called the Five Forces model, because Porter suggests that there are five factors or 'forces' that affect the competitive position of a company in a market. These five forces are:

(a) existing competitors and the rivalry between existing competitors

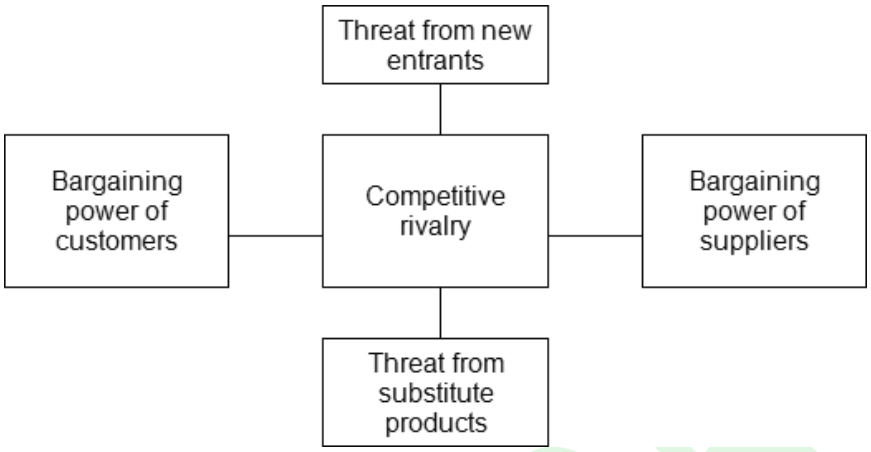
(b) the threat from new entrants to the market

(c) the bargaining power of suppliers

(d) the bargaining power of customers

(e) the **threat from substitute products**.

**Illustration: Five forces**




A management information system should be able to provide measures relating to each of these five forces, to assist management in making decisions about competitive strategy.

### 28.5.2 Existing competitors and competitive rivalry

The strength of competition varies between different markets. Some markets have several rival companies competing for customers. Other markets are dominated by a single company, although there may be some small and weak competitors.

When competition is strong, companies are likely to pursue active competitive strategies to retain existing customers and win new customers from their rivals. They might compete by offering lower prices, a wider range of products or products with a superior design or quality. For example, in the UK the retail market for food products is dominated by four large supermarket chains (Tesco, Sainsbury's, Asda and Morrisons), which compete with each other mainly on the basis of price, product range and location (convenience).

In a competitive market, an initiative by one company – such as a decision to reduce prices of some goods – is often copied quickly by its rivals. Gains in market share might therefore be short-lived.

Companies in a competitive market try to retain or increase their share of the market, and important information for management is therefore information about:

(a) growth in the total market, and

(b) the market share of each competitor in the market.

If a company is losing market share, or if a competitor is gaining market share, this might indicate a weakness with the company's existing strategies.

#### Switching costs

Switching costs might affect the strength of competition in a market. Switching costs are the costs that a customer would incur by switching from one supplier to another. In some industries and markets, switching costs might be high. For example, it might be necessary to train employees in a different technology of the new supplier.

Switching costs might be high, for example, if a customer is considering a switch to a new supplier of software. All the existing data files would have to be converted to a format suitable for the new software and employees would have to be trained to

use the new system.

### 28.5.3 Threat from new entrants

In some markets, it is difficult for new competitors to enter the market. (The 'barriers to entry' are high.) This may be because entry to the market would require a large capital investment, and any company entering the market would therefore be taking a big risk.

The strength of the threat from new entrants depends on the strength of the barriers to entry. Barriers to entry may not prevent competitors entering the market eventually, but they can delay the entry of new competitors.

#### The nature of barriers to entry

A variety of factors might create strong barriers to entry.

(a) **Economies of scale**. Economies of scale refer to the ability of an entity to reduce the average cost per unit of sales by producing and selling a larger quantity of the product. They occur for a variety of reasons:

(b) By making and selling more units, fixed costs are spread over a larger quantity and fixed costs per unit fall.

(c) An entity might be able to use larger machines that can produce larger quantities more efficiently than smaller machines.

(d) An entity might be able to buy materials at a lower cost, by purchasing in larger quantities.

(e) **Capital investment**. Entering a new market might require a large capital investment. This might deter a new entrant, because the investment could be high-risk.

(f) **Customer loyalty**. Entities already operating in the market might have strong customer loyalty and a strong brand name. This would make it difficult for a new entrant to win market share.

(g) A barrier to entry might exist in the form of **legal or political protection**. For example, the products made by a company already in the market might be protected by patent. Government protection might be provided in the form of an import ban or by law. An example in 2006 was the failure of European online gambling firms to enter the US market, because of US legislation against online gambling. This legislation protected companies that operated casinos in the US.

#### Weak barriers to entry

In some markets, barriers to entry might be low, and it might be fairly easy for new competitors to enter the market. This is often the case with markets for services, where the service relies on the skill or expertise of the service provider. For example, it is often fairly easy for a professional person, such as an architect or a solicitor to set up in business.

Occasionally, technological changes might reduce barriers to entry and make it easier for new companies to enter. For example, the Internet has made it possible for some companies to enter a market by offering goods or services for sale on the Internet. Selling through a web site avoids the need for large investments in retail stores or office property.

Barriers to entry would be lowered if the government offered a subsidy or grant to companies that invested in a particular industry.

A management information system should be able to provide information about any new entrants to the market, the type of product or service they are providing, the prices they are charging and the success they seem to be having in attracting customers.

### 28.5.4 Bargaining power of suppliers

The competitive position of a company in its market might be affected by the ability of one or more key suppliers to influence the market. Suppliers can have a very strong influence when:

(a) there are very few suppliers to the market, and

(b) there are a large number of companies in the market, buying from the same suppliers.

An example is the influence of producers of oil and natural gas over the energy markets.

Powerful suppliers might be able to increase prices or control the supply of their product to the market. Companies in the market are exposed to the risk that the cost or the supply of a key resource could be changed by their supplier's decision.

Companies in a market should try to:

(a) avoid reliance on a single supplier, if possible, and try to use several different suppliers, or

(b) develop close strategic relationships with key suppliers.

When suppliers have a strong influence over a market, a company's management information system should provide information about:

(a) the number and identity of suppliers in the market

(b) their prices

(c) the proportion of total purchases of key products that are obtained from each supplier.

### 28.5.6 Bargaining power of customers

The competitive position of a company might also be affected by reliance on one or a small number of customers. An entire market might be dominated by a small number of potential customers. For example, the market for sophisticated weapons systems is influenced by the power of the rich governments that can afford to buy them. Similarly, the market for large passenger aircraft is strongly influenced by the bargaining power of the fairly small number of airline companies that might buy them.

The bargaining power of customers is particularly strong in markets where there is a large number of suppliers but only a few customers. The UK retail market for food was referred to earlier. In this market, there are only four major supermarket chains, which buy a large proportion of all food products sold in the UK, but there are large numbers of small suppliers. The powerful buyers are often able to dictate terms to the suppliers, and can threaten to switch to different suppliers if they do not get what they want.

When customers have a strong influence over a market, a company's management information system should provide information about:

(a) the number and identity of the major customers in the market

(b) what these customers are asking for, in terms of product or service quality

and price

(c) the proportion of the company's total sales that are made to each major customer.

### 28.5.7 Threat from substitute products

The competitive strength of a company might also be affected by the existence of substitute products. The company needs to be aware that its competitive strategy could result in a switch of customer demand to or from a substitute product.

For example, an increase in the worldwide price of tea could lead to a switch in demand from tea to coffee. Similarly, higher prices for travel by railway could lead to a switch by customers to alternative forms of transport, such as air or road.

When there are close substitutes for a company's products or services, management should be provided with market information about these substitutes. For example, a company that supplies tea should monitor the market for coffee and other drink products.

## 28.6 Boston consulting group (BCG) model

### 28.6.1 The BCG matrix: market growth (potential) and market share (profitability)

In competitive markets, management need information to evaluate their products (or services) in terms of their:

(a) market potential, and

(b) ability to generate profits and cash flows for the business.

The Boston Consulting Group matrix (or BCG matrix) is a model that can be used to assess which products should be developed for future growth, and whether a business entity has an appropriate mix of products for achieving future growth. It incorporates the concept of the product life cycle. It is useful for companies that provide a number of different products (or services) for different markets.

The BCG matrix can be drawn as a 2 × 2 matrix, which 'maps' each product that a company sells, in terms of:

(a) the expected growth in the market as a whole, and

(b) the share of the total market that is currently held by the company's product.

### 28.6.2 Categories of product in the BCG matrix

Products are categorised into four types:

(a) Stars

(b) cash cows

(c) dogs

(d) question marks.

#### Stars

Stars are products where the market is growing at a fast rate, and the product enjoys a large share of the total market. They are normally new products. Stars might not yet be profitable, but new investment in the product should provide high financial returns in the future. Entities need 'stars' in order to succeed in the future, and so should invest in them.

Because the market is strong and growing, there are no problems with over-capacity in production and over-supply to the market. This means that the company has some control over prices that it can charge. (It may choose between a pricing strategy of 'market penetration' or 'market skimming'. These pricing strategies are explained in another chapter.)

A 'star' product has more potential for profits, and it is worthwhile to invest more money in the product, to increase sales.

Eventually when the growth in sales slows down, a star will become a cash cow. In other words, a product that is a star early in its life cycle will become a cash cow during the mature stage of the product's life.

**Cash cows**

Cash cows are products where the market is growing slowly, or is not growing at all, and the product enjoys a large share of the total market. These products are very profitable and provide large cash inflows for the entity. Every company needs cash cows to survive in the long-term. The cash from cash cows helps to finance investment in stars. Eventually, cash cows must be replaced when the product reaches the end of its economic life.

The strategy for a cash cow should be maintaining and protecting the position of the product in its market, and to keep costs under control (or reduce costs). The strategy should not be to seek more sales growth, because the product has no further growth potential (or very little further growth potential).

**Dogs**

Dogs are products where the market is growing slowly, or is not growing at all, and the product has only a small share of the total market. These products are often (but not always) losing money. The correct strategic decision is usually to withdraw the product from the market.

**Question marks**

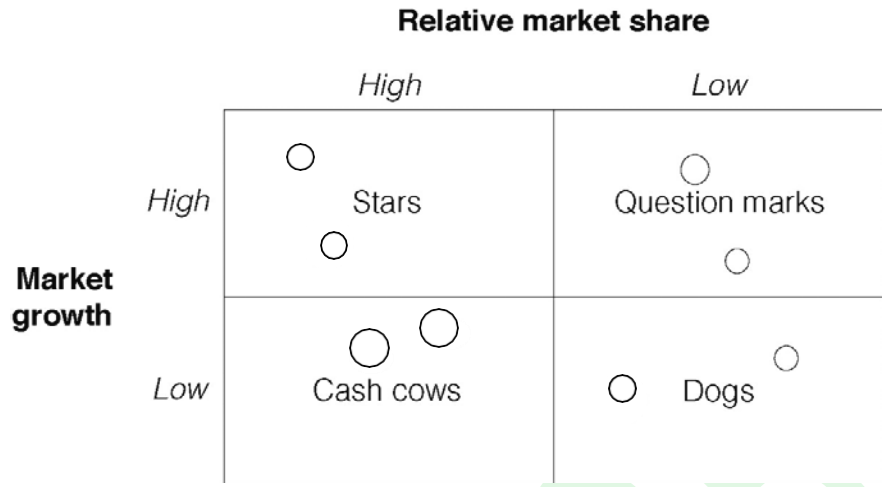
Question marks (also called 'problem children') are products where the market is growing at a fast rate, but the company's product has only a small share of the total market. These products are currently losing money. New investment in 'dogs' (for example, more investment in research and development or marketing) might turn a 'question mark' into a 'star', but there is also a risk that it will become a 'dog' when the growth in the market slows down. Investing in these products will be a strategic gamble.

### 28.6.3 Structure of the BCG matrix

A BCG matrix is shown below. The individual products (or business units) can be plotted in the matrix as a circle. The size of the circle shows the relative money value of sales for the product. A large circle represents a product with large annual sales.

The position of the products in each quadrant also shows the relative rate of growth in the total market, and the relative share that the company's product has in the total market.

**Illustration: BCG matrix**




### 28.6.4 Using the BCG matrix for planning and performance measurement

Companies can use the BCG matrix to analyse the range of products that it sells, and to plan its future investment in products. The aim should be to ensure that there is a sufficient investment in 'stars', and that cash cows will generate enough cash flow to finance most or all of this investment.

To carry out an analysis, information is needed for each product about:

(a) Total market size

(b) Rate of growth in the total market

(c) The company's share of the total market

(d) Changes in the company's share of the total market.

Example: BCG matrix

A company produces five different products, and sells each product in a different market.

The management accountant has obtained the following information about market size and market share for each product. It consists of actual data for each of the last three years and forecasts for the next two years.

Next

| | Year - 2 | Last year Year - 1 | Current year | Year+ 1 | Year + 2 |
|---|---|---|---|---|---|
| | **Actual** | **Actual** | **Actual** | **Forecast** | **Forecast** |
| **Product 1** | | | | | |
| Total market size (₦ million) | 50 | 58 | 65 | 75 | 84 |
| Product 1 sales | 2 | 2 | 2.5 | 3 | 3.5 |
| **Product 2** | | | | | |
| Total market size (₦ million) | 150 | 152 | 149 | 153 | 154 |
| Product 2 sales | 78 | 77 | 80 | 82 | 82 |
| **Product 3** | | | | | |
| Total market size (₦ million) | 40 | 50 | 60 | 70 | 80 |
| Product 3 sales | 3 | 5 | 8 | 10 | 12 |
| **Product 4** | | | | | |
| Total market size (₦ million) | 60 | 61 | 61 | 61 | 60 |
| Product 4 sales | 2 | 2 | 2 | 2 | 2 |
| **Product 5** | | | | | |
| Total market size (₦ million) | 100 | 112 | 125 | 140 | 150 |
| Product 5 sales | 4 | 5 | 5.5 | 6 | 6.5 |

In the current year, the market share of the market leader, or the nearest competitor to the company, has been estimated as follows:

Market share of market leader or the company's nearest competitor

| Market for: | % |
|---|---|
| Product 1 | 37 |
| Product 2 | 26 |
| Product 3 | 12 |
| Product 4 | 29 |
| Product 5 | 20 |

**Required**

(a) Using the Boston Consulting Group model, how should each of these products be classified?

(b) How might this analysis help the management of the company to make strategic decisions about its future products and markets ('product-market strategy')?

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Answer

A **star** is a product in a market that is growing quickly, where the company's product has a large market share or where the market share is increasing. **Product 3** appears to be a star. The total market is expected to double in size between Year – 2 and Year + 2. The expected market share in two years' time is 15%, compared with 7.5% in Year – 2. Its market share in the current year is over 13%, which makes it the current market leader.

A **cash cow** is a product in a market that has little or no growth. The market share, however, is normally quite high, and the product is therefore able to contribute substantially to operational cash flows. **Product 2** appears to be a cash cow. In the current year its market share was over 53%, and it is the market leader.

A **dog** is a product in a market with no growth, and where the product has a low share of the market. Dogs are likely to be loss-making and its cash flows are probably negative. **Product 4** appears to be a dog. The total market size is not changing, and the market share for product 4 is only about 3%. This is much less than the 29% market share of the market leader.

A **question mark** is a product with a fairly low market share in a market that is growing fairly quickly. **Product 1** appears to be a question mark. The total market is growing quite quickly, but the market share of Product 1 is about 4% and this is not expected to change. **Product 5** also appears to be a question mark, for the same reason.

The company should decide on its strategy for the products it will sell.

It should benefit from the cash flows generated by its only cash cow,

Product 2.

It should invest in its star, Product 3, with the objective that this will eventually become a cash cow.

It should give serious consideration to abandoning its dog, Product 4, and withdrawing from the market.

It has to make a decision about its two question marks, Product 1 and Product 5. The main question is whether either of these products can become a star and cash cow. Additional investment and a change of strategy for these products might be necessary, in order to increase market share.

For all the products (with the exception of Product 4, if this is abandoned) the company should also consider ways of making the products more profitable. Techniques such as **value chain analysis** might help to identify cost savings.

### 28.6.5 Weaknesses in BCG model analysis

There are several criticisms of the BCG model.

(a) The BCG model assumes that the competitive strength of a product in its market depends on its market share, and the attractiveness of a market for new investment depends only on the rate of sales growth in the market. Unless a product can achieve a large share of the market, it is not sufficiently competitive. Unless a market is growing quickly enough, it is not worthwhile to invest more money in it. It can be argued that these assumptions are incorrect.

(b) A product can have a strong competitive position in its market, even with a low market share. Competitive strength can be provided by factors such as product quality, brand name or brand reputation, or low costs.

(c) A company might benefit from investing in an industry or market where sales growth is low.

(d) It might be difficult to define the market.

(e) There might be problems with defining the geographical area of the market. A market might be defined in terms of a single country, a region of a country or as an international or global market.

(f) It might also be difficult to identify which products are competing with each other. For example, the total market for cars may be divided into different categories of car, but there may be problems in deciding which models of car belong to each category.

(g) It might be that the BCG matrix is better for analysing the performance of strategic business units (SBUs) and market segments. It is not so useful for analysing entire markets, which might consist of many different market segments.

(h) It might be difficult to define what is meant by 'high rate' and 'low rate' of growth in the market. Similarly, it might be difficult to define what is meant by 'high' market share and 'low' market share.

## 28.6 SWOT analysis

### 28.6.1 The nature of SWOT analysis

SWOT analysis is a technique used in strategic planning for identifying key factors that might affect business strategy. These factors are both internal to the company and external, in its environment. SWOT analysis can be used in the strategic planning process to analyse the company's capabilities and core competencies (or lack of them) and also to carry out an environmental analysis.

SWOT analysis is an analysis of strengths, weaknesses, opportunities and threats.

(a) **S** Strengths. Strengths are internal strengths that come from the resources of the entity.

(b) **W** Weaknesses. Weaknesses are internal weaknesses in the resources of the entity.

(c) **O** Opportunities. Opportunities are factors in the external environment that might be exploited, to the entity's strategic advantage.

(d) **T** Threats. Threats are factors in the external environment that create an adverse risk for the entity's future prospects.

Strengths and weaknesses are concerned with the internal capabilities and core competencies of an entity. Threats and opportunities are concerned with factors and developments in the environment.

In order to prepare a SWOT analysis, it is necessary to:

(a) analyse the internal resources of the entity, and try to identify strong points and weak points

(b) analyse the external environment, and try to identify opportunities and threats.

### 28.6.2 Strengths and weaknesses

Strengths and weaknesses relate to factors within the entity, such as the strength and weaknesses of its processes and systems, its resources, its management and its track record of success or failure in the past.

Senior management in a company might have their own opinion of the strengths and weaknesses of the company, but a management information system should be able to provide **measured** and reliable information about strengths or weaknesses.

The table below contains examples of activities, processes and resources where there might be strengths or weaknesses that could have strategic significance.

| | |
|---|---|
| **Products and brands** | Strength of the brand name Quality of products (or services)<br>The portfolio of products, assessed in terms of<br>(1) stages in their life cycle, or<br>(2) a Boston Consulting Group portfolio analysis<br>Profitability and return on capital<br>Contribution to cash flow |
| **Research and development** | Number of innovations<br>Success rate for new innovations<br>Speed of innovation: speed in responding to new products of competitors<br>Costs |
| **Marketing** | Abilities of the sales force<br>Success in the past in selling products<br>Efficiency of 'channels of distribution' – making the product available to customers<br>Network of intermediaries – retail stores, agents or distributors<br>Market size Market share<br>Numbers of regular customers<br>Customer service operations |
| **Distribution/delivery** | Location of distribution centres<br>Cost of distribution<br>Fleet of delivery vehicles |
| **Finance** | Availability of long-term capital Availability of short-term funding (cash) Profitability<br>Operational cash flows<br>Return on investment<br>Credit control, collection of receivables, bad debts |
| **Assets (buildings, equipment)** | Type and value of assets<br>Quality of assets Production capacity<br>Location of assets |

| | |
|---|---|
| **Employees and managers** | Skills and experience<br>Training<br>Loyalty<br>Motivation<br>Industrial relations |
| **Organisation and management** | Centralised/decentralised management<br>Management style<br>Information systems |
| **Suppliers and inventory** | Relationship with key suppliers<br>Storage capacity for inventory<br>Speed of inventory turnover |

### 28.6.3 Threats and opportunities

An information system should provide information to management about threats and opportunities in the environment. The sources of this information are outside the entity itself. There might be a wide range of information sources, such as official publications, newspaper reports, government statistics, physical observation of competitors and customers, and discussions with suppliers.

The nature of threat and opportunities in the environment can be classified into several broad groups. One method of classification is known as PESTEL:

| | |
|---|---|
| **Political threats and opportunities** | Government regulations, for example, towards giving permission for new business developments and construction projects.<br>Government policy, for example towards government spending programmes.<br>Consequences of a change of government. |
| **Economic threats and opportunities** | Economic change: rate of economic growth or recession Exchange rates Interest rates Anti-monopoly regulations Rate of inflation Taxation |
| **Social threats and opportunities** | Social change: for example changes in the age distribution of the population<br>Cultural change: for example, changes in leisure activities<br>Movements in the population |
| **Technological threats and opportunities** | Any technological or scientific development |

| | |
|---|---|
| **Environmental threats and opportunities** | Cost and availability of forms of energy<br>Pollution<br>Preservation of the environment: sustainable business |
| **Legal threats and opportunities** | New laws<br>Decisions by a court of law |

### 28.6.4 Preparing a SWOT analysis

A SWOT analysis might be presented as four lists, in a cruciform chart, as follows: (Illustrative items have been inserted, for a small company producing pharmaceuticals).

**Example: SWOT analysis**

| **Strengths** | **Weaknesses** |
|---|---|
| Extensive research knowledge<br>Highly-skilled scientists in the work force<br>High investment in advanced equipment<br>Patents on six products High profit margins | Slow progress with research projects<br>Poor record of converting research projects into new product development<br>Recent increase in labour turnover |
| **Opportunities** | **Threats** |
| Strong growth in total market demand<br>New scientific discoveries have not yet been fully exploited | Recent merger of two major competitors<br>Risk of stricter regulation of new products |

In order to prepare a SWOT analysis, it is necessary to:

(a) analyse the internal resources of the entity, and try to identify strong points and weak points

(b) analyse the external environment, and try to identify opportunities and threats.

### 28.6.5 Strategic management accounting and SWOT analysis

Management accounting systems should be able to support SWOT analysis by management, by providing relevant information. Much of this information can be quantified.

In the example above of the pharmaceuticals company, it should be possible to provide quantified data about items such as:

(a) time to complete research projects

(b) percentage of research projects that move on to a development phase

(c) amount invested in capital equipment

(d) labour turnover rates (compared to average labour turnover in the industry)

(e) profit margins

(f) growth in total market demand and annual sales.

## 28.7 Ansoff's growth vector analysis

### 28.7.1 Four product market strategies for growth

Ansoff's growth vector analysis (Ansoff's grid) is another model for strategic development and growth.

The Ansoff growth vector might be presented as follows:

**Illustration: Ansoff's grid**

| Market | | Current | New |
|---|---|---|---|
| | Current | Market penetration | Product development |
| | New | Market development | Diversification |

The model identifies four strategies for developing products and markets in order to grow the business.

The four strategies are as follows:

(a) Market penetration

(b) Product development (innovation)

(c) Market development

(d) Diversification

### 28.7.2 Market penetration strategy

This is a strategy of trying to gain higher sales in the entity's current markets with its existing products. Market penetration is achievable:

(a) when the total market is growing, or

(b) by increasing market share.

For example, a company providing mobile telephone services might pursue a market penetration strategy, by trying to sell to more customers. This is possible

if the total demand for mobile telephone services is increasing, or by taking market share from competitors.

A market penetration strategy is a low-risk strategy, and is unlikely to result in a high rate of sales growth. The product is not altered and there is no attempt to find new markets for the product.

### 28.7.3 Product development strategy (innovation strategy)

This is a strategy for growth that involves developing new products for existing markets and customers. For example, a software company might develop a new product or enhanced product that it tries to sell to its existing customers.
Similarly, a car manufacturer might develop a new model of car, which it then tries to sell to its existing customers.

### 28.7.4 Market development strategy

This is a strategy of trying to enter new markets for the entity's existing products. In other words, it is a strategy of selling current products to new customers by finding a new market, or a new market segment. For example:

(a) a supermarkets company might try to increase its sales by entering the market for Internet shopping and home delivery

(b) a company might grow by trying to enter markets in other countries.

### 28.7.5 Diversification strategy

This is a strategy of developing new products for new markets. A diversification strategy is a high-risk strategy, because the company needs to develop a new product that will meet customer needs successfully, but it does not yet have much knowledge or understanding of customers in the market and what their needs might be.

There are two types of diversification:

(a) **Related diversification**, where the business entity develops new products and markets that are in a related industry. For example, a manufacturer of ice cream might diversify into producing soft drinks.

(b) **Unrelated diversification**, where the business entity develops new products and markets that are in an industry where it has no previous experience. For example, a manufacturer of ice cream might diversify into making and selling shoes.

Unrelated diversification is usually a much higher-risk strategy than related diversification. However, even a strategy of related diversification can be a high risk.

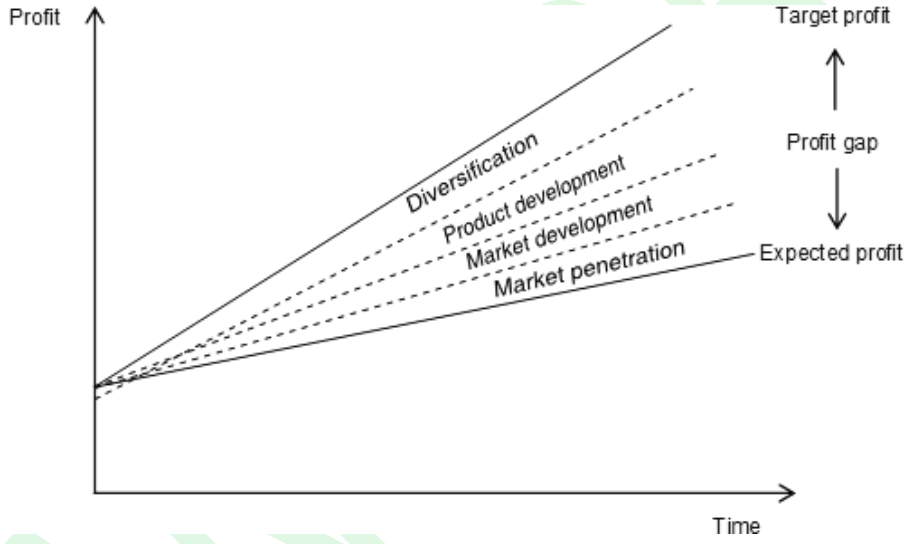
### 28.7.6 Ansoff's growth vector and gap analysis

Ansoff's growth vector can be used together with gap analysis. Gap analysis is the analysis of the difference between a strategic target and the expected performance that will be achieved without any new strategies.

For example, a company might measure the gap between the profits it would like to make in five years' time and the profits it would expect to make if it did not undertake any new growth strategy.

Having estimated the size of the profit gap, the company can then consider growth strategies to increase profitability. The contribution of each growth strategy to profits can be estimated. Together, a combination of growth strategies might enable a company to close the profit gap and pursue strategies that will enable it to meet its targets.

**Illustration: Strategies to fill the profit gap**




### 28.7.7 Management information

Management should be provided with information that helps them to monitor the success of their growth strategy. The items of information that might be provided include:

(a) Potential market demand
(b) Market size
(c) Market share
(d) Information about competitors and their products
(e) Pricing information
(f) Information about costs
(g) Information about required investment and financing
(h) Estimated returns from a chosen strategy
(i) The risks in the chosen strategy.

## 28.8 Marketing

### 28.8.1 The marketing approach

As stated earlier, markets can be defined by their customers and potential customers. Companies and other business entities compete with each other in a market to sell goods and services to the customers. The most profitable entities are likely to be those that sell their goods or services most successfully.

Business success is achieved by providing goods or services to customers in a way that meets customer needs successfully.

Customers will buy from the business entities that meet their needs most successfully.

Much business strategy is based (partly) on the marketing approach or the marketing concept, which is that the aim of a business entity is to deliver products or services to customers in a way that meets customer needs better than competitors. To do this, the business entity must have a competitive advantage over its competitors, and a strategic aim is to achieve a competitive advantage, and then keep it.

### 28.8.2 Customer needs

Customers buy products or services for a reason. When they can choose between two or more competing products, there is a reason why they choose one product instead of another.

A major factor in the decision to buy a product is usually price. Many customers choose the product that is the cheapest on offer, particularly when they cannot see any significant difference between the competing products.

If the buying decision is not based entirely on price, the customer must have other needs that the product or service provides. These could be:

(a) a better-quality product;

(b) better design features;

(c) availability: not having to wait to obtain the product;

(d) convenience of purchase;

(e) the influence of advertising or sales promotions.

There are many different types of customer, each with their own particular needs. A product that meets the needs of one customer successfully might not meet the needs of another customer nearly as well.

Customers may be grouped into three broad types:

(a) consumers: these buy products and services for their personal benefit or use;

(b) industrial and commercial customers: customers might include other business entities;

(c) government organisations and agencies.

In some markets, most customers are consumers. In industrial markets, all customers are industrial and commercial customers, and possibly some government customers. In some markets, such as the markets for military weapons, the only customers are governments.

As a general rule, the needs of different types of customer vary. Industrial and commercial customers are more likely than consumers to be influenced by price.

Consumers will often pay more for a branded product (due to the influence of advertising) or for convenience.

### 28.8.3 The 4Ps of the marketing mix

The marketing approach is to identify customer needs and try to meet customer needs more successfully than competitors. To do this, business entities need to offer or provide a 'mix' of the four Ps that will appeal to customers. The 4Ps are:

(a) Product

(b) Price

(c) Place

(d) Promotion.

**Product** refers to the design features of the product, and the product quality. In addition to the product itself, features such as short lead time for delivery and reliable delivery could be important. Product features also include after-sales service and warranties. For services, the quality of service might depend partly on the technical skills and inter-personal skills of the service provider.

**Price** is the selling price for the product: some customers might be persuaded to purchase by a low price or by the offer of an attractive discount.

**Place** refers to the way in which the customer obtains the product or service, or the 'channel of distribution'. Products might be bought in a shop or supermarket, from a specialist supplier, by means of direct delivery to the customer's premises or through the internet.

**Promotion** refers to the way in which product is advertised and promoted. It includes direct selling by a sales force (including telesales).

Marketing can be analysed at a tactical level, and decisions about the marketing mix might be included within the annual marketing budget. However, marketing issues can also be analysed at a strategic level.

It is important in strategic analysis to understand what customers will want to buy, and why some products or services will be more successful than others.

### 28.8.4 C Analysis

Once the goals and targets of the marketing effort are known the next step is to develop the marketing strategy.

The 5 Cs provides a useful framework for constructing a marketing strategy.

**Customer**: The needs of customers that are to be met must be determined. Information should be gathered on market segments, benefits the customer wants, whether value of the benefits outweigh the costs, frequency of purchases, quantity of purchases, retail channels, and needs based on trends over time.

**Company:** – Whether the company can meet those customer needs must be determined. For example, does the company have the right product line and/or technical expertise? SWOT analysis can be used to answer these questions.

**Competition**: – Determine who competes with the company in meeting the customers' needs:

(a) Is it an active competitor or a potential threat?

(b) What is their offering?

(c) What are their strengths and weaknesses?

**Collaborators**: Determine if there is any outside source that can help the company such as distributors, suppliers, etc.

**Context**: Determine if there are any limitations due to factors in the environment (for example, regulations, taxation etc.).

## 28.9 Benchmarking

### 28.9.1 The purpose of benchmarking

Benchmarking is a process of setting standards or targets for products, services or work processes with reference to organisations that are recognised as models of 'best practice'. A benchmark is an organisation that provides the 'best practice' for comparison. An entity uses benchmarking to evaluate its own products, services or work processes by comparing them with the 'best practice' of the benchmark organisation.

The purpose of benchmarking is to identify measures that need to be taken to improve or change, so that the organisation becomes as good as, or better than, the benchmark.

#### Definition of benchmarking

'Benchmarking is the continuous process of measuring products, services and practices against the toughest competitors or the companies recognised as industry leaders ("best in class")' (The Xerox Company).

#### The benchmarking process

Benchmarking should be a continuous process, and it usually consists of the following stages:

(a) Identify aspects of performance that should be compared with a 'benchmark partner'.

(b) Select a suitable benchmark (a 'benchmark partner').

(c) Compare the product, service or process with the benchmark.

(d) Identify gaps in performance between the benchmark and the entity's own product, service or process.

(e) Identify changes that can be made to improve performance.

(f) Implement the improvements.

(g) Monitor the success of the changes in improving performance, and measure the benefits.

### 28.9.2 The potential benefits of benchmarking

Benchmarking can offer several benefits.

(a) It can be used to identify aspects of performance that are weak, where improvements are necessary.

(b) It can be used to set targets for improvement that are realistic and practicable.

(c) It can be used to look at practices in companies in different industries, and to learn from them.

(d) It encourages continuous improvement: benchmarking encourages managers

and employees to make improvements, and to believe that changes are necessary.

### 28.9.3 Methods of benchmarking

There are several methods of benchmarking:

(a) internal benchmarking

(b) competitive benchmarking

(c) process benchmarking

(d) customer benchmarking.

Benchmarking can also be grouped into the following categories:

(a) strategic benchmarking

(b) functional benchmarking

(c) 'best practices' benchmarking (process benchmarking)

(d) product benchmarking.

### 28.9.4 Internal benchmarking: league tables

Internal benchmarking uses a benchmark inside the organisation itself. Other parts of the same organisation are compared with the benchmark.

For example, a company might have several regional or area offices. The best-performing regional office might be taken as a benchmark, and the other regional offices are compared with it. The benchmarking exercise should identify the reasons why each region has not performed as well as the benchmark. When the reasons for the worse performance are recognised, plans can be made to deal with the problems and achieve improvements.

League tables

One method of making internal benchmarking comparisons is to establish a league table. Points may be awarded for various aspects of performance, and for each profit centre or division a total points score is calculated, depending on how well or badly it has performed for each of the aspects.

A league table may then be published, with the 'winners' scoring the most points and the 'losers' at the bottom of the league table.

League tables may also be used within the not-for-profit sector. In the UK for example, state-owned schools are ranked within league tables, according to their relative success or failure in major national examinations.

The use of league tables is intended to encourage improvements in performance through competition – no division wants to be at the bottom of the table and many will want to be at the top.

In principle, each division is measured according to the same key or critical measures of performance, and the system should therefore be 'fair'. However, many local' factors will affect the performance of a particular division. In comparing the performance of schools, for example, much depends on the quality of the students, and it is unfair to compare the performance of a state school in a prosperous neighbourhood with the performance of a school in a 'ghetto' community.

A further problem is that divisional managers may be made responsible for aspects of performance that are outside their control, especially where the level of

performance involves the co-operation between two or more divisions. It is unfair to assess the performance of a division on factors that are outside the control of its management.

Finally, league tables (like other measures of performance) encourage 'cheating', such as trying to hide unfavourable data. Divisional managers may also take action to improve short-term performance even if this has adverse implications for longer-term results. The league tables may therefore become the main focus for management, instead of the actual performance levels that the league tables are trying to encourage.

### 28.9.5 Competitive benchmarking

Competitive benchmarking uses a successful competitor as the benchmark. A company compares its own products and systems with those of the competitor, and the purpose is to discover the reasons why the competitor is more successful.

When the reasons are identified, plans can be made to improve competitiveness, either by copying what the competitor does, or devising new products or systems that are even better than those of the competitor.

Comparing yourself with the main competitors makes good sense in a competitive business environment. A practical difficulty with competitive benchmarking, however, may be a lack of detailed information about the competitor.

(a) It should be possible to fully analyse a competitor's products – by buying them and looking at them in close detail.

(b) However, it may be more difficult to study a competitor's systems and methods of operation in detail. For example, a competitor may have a superior system for handling customers' calls, or a more efficient warehousing system, or a better order processing and despatch system. A rival company will not be allowed to examine these systems in detail.

**Example: Benchmarking**

Benchmarking began with the Xerox Corporation in the US in 1982. Xerox, a manufacturer of photocopier machines, was in financial difficulties and losing market share to Japanese competitors, who were selling high-quality photocopiers at a much lower price.

Xerox set up a management team that:

1. identified key performance indicators for operations such as order fulfilment, distribution, production costs, retail selling prices and product features, and
2. compared the performance of Xerox in each of these areas against those of its most successful competitors.

Xerox used the findings of its benchmarking exercise to identify areas for improvement. Improvements were made, and as a result customer satisfaction improved, costs were cut and Xerox improved its competitive position in the market.

Other companies followed the example of Xerox, and benchmarking became an established practice for performance measurement.

**Example: Competitive benchmarking**

In 1991, the Massachusetts Institute of Technology and J D Power and Associates published a survey of car manufacturing plants in Japan, the USA and Europe. Japanese car production was used as a benchmark, and the survey found that productivity was much higher in Japan (where the average time to produce a car was 16.2 man hours) than in Europe (where the average time to produce one car was 36.2 man hours).

The survey analysed possible reasons for the superior performance of Japanese producers, and made comparisons of performance in the areas of training time for new employees, absenteeism and the number of defects per vehicle produced.

The survey provided useful information for US and European car producers, but they had a huge gap to close before they could begin to compete effectively with their Japanese competitors.

## Problems with competitive benchmarking

There are several problems with benchmarking the performance of a business against its competitors.

To benchmark effectively it is necessary to obtain meaningful and reliable comparative information about the performance of the competitor. Much of this information, particularly non-financial information, will be unavailable unless the competitor is willing to provide it. If the competitor is a private company and is not required to publish detailed financial statements, comparative financial information may also be difficult to obtain.

There is no reason why a competitor should agree to provide information, unless they too are interested in benchmarking and so would be willing to consider information sharing. The risk of handing over confidential information to a competitor, or providing information that could give a competitor some marketing advantage, is likely to make any company unwilling to agree to such a scheme.

There are some organisations that specialise in taking financial information from firms in the same industry, and providing 'inter-firm comparisons' for the participants, without giving away sensitive information about any individual company. However in practice most inter-firm comparison is carried out between quoted companies by stock market analysts.

The cost of benchmarking might be quite high, and too large to justify the benefits to be obtained from a benchmarking system. To deal with this problem, it would be necessary to ensure that the system is kept fairly simple, and as much of the preparation of benchmarking comparisons as possible should be computerised.

There may be problems with getting managers to understand the purpose and benefits of inter-firm comparisons. When benchmarking comparisons are available, managers and other employees need to be told what they should do with it. The purpose and use of benchmarking information would therefore have to be explained clearly to staff, and systems put in place for the monitoring and use of the information obtained.

There may be a risk that a benchmarking exercise with competitors, if practicable, will be used to criticise staff for performing 'worse' than competitors. Management must ensure that the system, if put in place, does not create a 'culture of blame' that is likely to make employees defensive and resentful.

### Competitive benchmarking and competitor analysis

Competitive benchmarking is not the same as competitor analysis. Competitor analysis involves a comparison by a company of its own performance with the performance of its main rivals. A company might draw up a 'league table' consisting of itself and its competitors, with the best performer at the top of the table and the worst performer at the bottom. For example, in the UK, some of the major supermarket chains draw up a league table of prices, with the chain offering the cheapest prices at the top of the table and the chain with the highest- price food stores at the bottom.

However, this is not benchmarking. Benchmarking is used to identify differences, and then to develop new ways of doing things, in order to make improvements in performance. The aim should be to make improvements that make the company better than its competitors, rather than improvements that help the company to close the gap with its competitors.

## 28.9.6 Process benchmarking

Process benchmarking is the most common method of benchmarking. It involves a comparison of the performance of the entity in one particular activity or process with the performance of another entity in a different industry. This type of benchmarking seeks to identify best practice anywhere, by looking at organisations with a reputation for excellence.

The purpose of process benchmarking is to use a benchmarking approach to analyse operational systems, such as purchasing, call handling (by call centres), order processing, delivery systems, information systems, and so on.

An organisation compares its own practices in an aspect of its operations with those of a benchmark organisation that is in an **unrelated industry** (and so is not a competitor). For example, a company may compare its warehousing and distribution systems with a benchmark organisation, its customer call centre operations or its IT system maintenance arrangements.

A process benchmarking programme is agreed between two organisations, which then share information about their systems and compare their performance. Each organisation is able to use the benchmarking process to review its systems and procedures, and look for ways of improving their performance.

Benchmarking can be used as an approach to **improving quality** – in products, services and systems. Comparisons with the 'best' can provide ideas:

(a) for copying the benchmark organisation, or

(b) for doing something in a different way, not necessarily in exactly the same way as the benchmark organisation

> **Example: Process benchmarking**
>
> The Xerox Company wanted to improve its performance in dealing with customer orders. It identified Bean, a catalogue retailer specialising in outdoor clothing, as a benchmark for excellence in this area. The two organisations, Xerox and Bean, collaborated with each other in comparing their systems, exchanging information. Xerox management studied the order fulfilment process at Bean and used its findings to improve its own systems.
>
> Process benchmarking can be very effective in helping a company to gain a competitive advantage over its rivals. 'Benchmarking … is not a method for copying the best practices of competitors, but a way of seeking superior process performance outside the industry. Benchmarking makes it possible to gain competitive superiority rather than competitive parity.'

### 28.9.7 Customer benchmarking

Customer benchmarking is a completely different approach. This uses the customer as a benchmark, by trying to establish what the customer wants and expects. A company can compare what a customer wants with what the company actually provides.

Gaps can be identified between customer expectations and 'reality', and the company can then look for ways to close the gap.

### 28.9.8 Strategic benchmarking

Strategic benchmarking involves a comparison of the strategies of different companies. A company can compare its own strategies with those of its most successful competitor, or with the strategies of successful companies in other industries.

Strategic benchmarking usually involves a comparison with the most successful competitor. A company will use benchmarking to find out why the competitor is more successful. A starting point for the comparison is usually a survey of customers and shared suppliers, to find out what the competitor does better.

Aspects of strategy that might be considered include:

(a) strategic objectives

(b) core competencies

(c) process capability

(d) products

(e) strategic alliances

(f) the use of technology.

### 28.9.9 Functional benchmarking

Functional benchmarking is a form of competitor benchmarking. It involves a comparison of performance of a core business function in the company with the performance of the same function in a successful competitor. For example, functional benchmarking might involve a comparison of:

(a) the sales and marketing function

(b) the research and development function.

The aim should be to find out why the competitor appears to perform this function more successfully, in order to identify changes and improvements that should be made.

Process benchmarking compares processes in more detail.

### 28.9.10 Product benchmarking (reverse engineering)

Product benchmarking, also called reverse engineering, is a form of competitor benchmarking. It involves a comparison of an entity's products with the products manufactured by its main competitors.

The comparison will usually look at:

(a) the competitor's costs

(b) product concepts

(c) strengths and weaknesses in product design and quality.

This product analysis will usually involve obtaining some products of the competitor and analysing them in the workshop or laboratory.

### 28.9.10 Requirements for successful benchmarking

There are several requirements for benchmarking to be effective as a way of improving competitiveness.

(a) It is important to select key aspects of performance for benchmarking. These are the aspects of performance that have to be successful (and improved) in order to gain a competitive advantage over rivals.

(b) It must be a continuous process, not a 'once only' exercise. Competitors do not 'stand still', and successful competitors will continually innovate and improve. It is essential to keep repeating benchmarking exercises in order to avoid falling behind again as the business environment changes.

(c) Benchmarking should be a method for becoming better than competitors, not just for closing the gap on competitors and 'catching up'. The aim should be to achieve superior performance.

(d) When benchmark partners are used for process benchmarking, the collaboration should be open and honest. A company should be prepared to give more information to its benchmark partner than it is hoping to obtain from the benchmark partner.

### 28.9.11 Problems with benchmarking

There are several problems that can make it difficult to use benchmarking successfully.

**(a)** It might be difficult to identify a critical process where benchmarking could

provide valuable information to help an entity improve its performance. Benchmarking might select processes that are not critical to performance. The value of any benefits achieved will therefore be small and insignificant. Other problems with benchmarking include:

**(b)** Identifying the right benchmarks and sources

**(c)** Finding the best practice organisations to compare with.

**(d)** Articulating the value propositions for benchmarking.

**(e)** Guiding how to use benchmarks to support decision making.

**(f)** Planning and scoping benchmarking activities

**(g)** It is difficult to obtain reliable information for comparison with a benchmark.

**(h)** benchmarking exercise and then to obtain the required information

## 28.10 Chapter review

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

(a) Explain, perform and interpret C analysis

(b) Explain and apply Porter's five forces model to identify industry attractiveness

(c) Explain and apply the Boston Consulting Group model to identify categories of product (business) in a company's portfolio

(d) Explain and interpret value chain analysis

(e) Use Ansoff's grid to identify possible strategic directions

(f) Explain and apply benchmarking to compare performance against information provided (for example, about a competitor)

(g) Construct and interpret a SWOT analysis

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**Skills level**
**Performance management**

CHAPTER 29

# ALTERNATIVE VIEWS OF PERFORMANCE MEASUREMENT AND MANAGEMENT

Chapter Contents


29.0 Learning objectives

29.1 Learning outcome

29.2 Assess and evaluate the effectiveness of the performance pyramid in linking the strategy , operations and performance.

29.3 Assess and evaluate the use of balanced scorecard approach in improving the range and the linkage between performance measures.

29.4 Evaluate and advise on the value based management approaches to performance management.


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# 29. Alternative views of Performance Measurement and Management

## 29.0 Learning objective

This chapter introduces readers to process of assessing and evaluating effectiveness of performance pyramid in linking the strategy to operations and performance. It also exposes the concept of balance score card and value based management as other models for appraising performance management.

## 29.1 Learning outcomes

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

(a) master the knowledge of assessing and evaluating the effectiveness of models like performance pyramid, balance scorecard and value based management for the purpose of appraising performance management.

## 29.2 Assess and evaluate the effectiveness of the performance pyramid in linking the strategy, operations and performance.

1. Introduction
2. Alternative views to performance evaluation
3. Alternative models of performance evaluation.

### 29.2.1 Introduction:

Alternative views of performance management emphasise continuous feedback, employee development, and a focus on growth rather than only on appraisal, moving away from traditional, often annual evaluations, measurements through performance pyramid, use of balance score cards and value based management approaches.

### 29.2.2 Alternative views to performance evaluation

These approaches can be detailed:

(a) **Continuous Feedback:** Instead of infrequent, formal reviews, these approaches prioritize ongoing communication and feedback, allowing for real-time adjustments and improvements.

(b) **Employee Development:** The focus shifts from simply evaluating performance to supporting employee growth and skill development, fostering a culture of continuous learning.

(c) **360-Degree Feedback:** This approach gathers feedback from multiple sources, including peers, supervisors, and subordinates, providing a more comprehensive view of an employee's performance.

(d) **Management by Objectives (MBO):** This system focuses on setting specific, measurable, achievable, relevant, and time-bound (SMART) goals and regularly reviewing progress towards them.

(e) **Key Performance Indicators (KPIs):** These are specific, measurable metrics used to track performance and progress towards organisational goals.

(f) **Peer Support Programs:** These programs rely on colleagues to help employees feel less isolated in their roles, offering advice and support.

(g) **Adaptive Performance Management:** This approach is flexible and responsive to changing business needs, allowing for adjustments to goals and performance expectations as circumstances evolve.

(h) **Social Performance Management:** This approach leverages social media and online tools to facilitate communication, collaboration, and feedback among employees

With many organisations moving away from rating based performance management systems, why are they making this move and what is the alternative to performance management systems?

From our research at BeTalent we believe there are at least 5 reasons why the Performance Management style of measuring and monitoring talent isn't working.

**Misassumption 1: "You reach high performance by developing weaknesses"**

The whole premise of traditional performance management methods is based on the belief that you can develop future performance and potential by focusing on the past and by identifying and concentrating on bridging gaps or overcoming weaknesses.

**Misassumption 2: "You need to tell people when they are or are not talented"**

Many organisations have been focusing on the wrong type of conversation, talking about whether someone is or is not talented. We believe that everyone is talented, so a more meaningful and productive conversation would be to explore the nature of that talent and how it can be harnessed within the business context for the future.

**Misassumption 3: "The organisation is responsible for developing their people"**

Many organisations have been hand holding their employees through the talent journey; not enabling or encouraging employees to take real ownership and accountability for their own learning and development. The very qualities that organisations require such as self-management, drive and leadership are being minimised in the performance management conversation.

**Misassumption 4: "9 box ratings give insight into future potential"**

Asking managers to put their employees into one of nine boxes is based on the assumption that managers understand how to observe, assess and differentiate between performance and potential. Many managers are not educated to understand this difference and are often too close to the individual and too removed from the corporate or talent strategy to make this assessment with any degree of accuracy or certainty.

**Misassumption 5: "Performance conversations held twice a year are sufficient"**

We all know that having a "moment in time" conversation with an employee just a couple of times each year isn't the best way to really get to know them, to build sufficient trust and engagement in the relationship, or to be able to talk about deeply

personal topics such as performance and potential, aspirations and ambitions, anxieties and capability. Yet this method of performance management still prevails.

### 29.2.3 What are the alternatives?

We share a few suggestions we believe may give the performance management conversations of the past a new focus into the future:

(a) Move from focusing on the past to a focus on the future; to explore aspirations and engagement as much as performance.
(b) Don't get stuck on gaps; instead truly explore, understand and leverage strengths
(c) Explore more honestly the extent to which someone's strengths, values and aspirations "fit" with the future business needs.
(d) Move the accountability for learning and growth to the individual; so they make choices about the pace, the scale and the topic. Then enable and align with corporate requirements.
(e) Stop putting people into boxes; unless you train managers to really understand the elements of potential, readiness and performance and how to assess each of them.
(f) Focus on the conversation, building trust and engaging with employees, so that honest conversations can be had around capability and potential.

### 29.2.4 Alternative models of performance evaluations:

The Models of performance management that provide alternative views to performance evaluation includes:

(a) Performance Pyramid model
(b) Balance scorecard model
(c) Value based management approaches

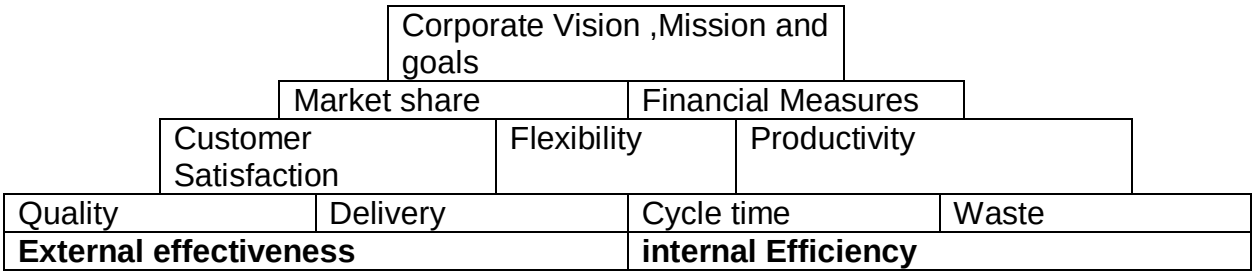
**Performance Pyramid Model**

Generally, a performance management system should include both financial and non financial indicators in appraising corporate performance. The new models used in alternatively appraising the performance of corporate entities include

Using the Performance Pyramid model to analyse performance management.

The performance pyramid model, developed by Richard Lynch and Kelvin Cross, is a hierarchical framework that links an organisation's overall vision and strategy to day-to-day operations, focusing on performance measurement and improvement across different levels. The performance pyramid model incorporates both financial and non-financial performance indicators to link strategic goals (Top level of the pyramid - Corporate visions and missions) with day-to-day operations across multiple levels of an organisation. It measures external effectiveness through customer satisfaction, flexibility, and productivity, as well as internal efficiency through quality, delivery, cycle time, and waste. The performance pyramid aims to integrate objectives from the corporate vision level down through business and departmental levels which are cascaded to the four levels of management strategic level (Level 1) which overseas the realisation of strategic goals of the organisation as encapsulated in the vision and mission statements.

Below is sketch showing the four levels of the performance pyramid as postulated by Lynch and Cross.




Performance Pyramid by Lunch and Cross

The levels of the pyramid can be further be explained thus:
The **level 1 otherwise referred to as visionary capacity level** outlines the organisation's long-term goals and how these goals and objectives can be achieved corporate success and competitive advantage through its missions, visions and strategies.

The **level 2 referred to as mental capacity level** focuses on achieving critical success factors in terms of market-related and financial measures. This is linked to the Divisional Management (Level 2) role which focuses on market related indices such as market share , customer satisfaction index, market size etc. and financial measures like short-term targets for cash flow and profitability, and long-term financial goals which facilitates share growth

The **level three aspect of the pyramid otherwise referred to as the emotional capacity level** dwells on the Strategic Business units roles which are focused on business units that emphasizes on customer satisfaction , flexibility in operation processes as well as determination to ensures productivity. These are the enablers of the strategies that that help the corporate entity in the achievement of level 2 and 1 objectives.

Finally, the **operational units and departmental roles (Level 4) otherwise referred to as the physical capacity level** handles day to day operation which covers all tasks aimed at achieving the set goal of the corporate entity. These end objective are regarded as the driving forces for the achievement of level 1 objectives.

From the diagram above, the left side of the pyramid showcases the the external focus of performance management which is purely and predominantly non-financial in nature.

The right side focuses on the internal efficiency and predominantly, financially related.

Thus , the performance pyramid model is designed as a hierarchical structure linking strategic goals with operational objective. The four levels of the performance pyramid are:

| S/N | Levels | Other names for the level | Explanation |
|---|---|---|---|
| 1 | Top level | Spiritual capacity Level | Corporate vision and strategy |
| 2 | Second level | Mental capacity Level | Business unit objectives, focusing on market and financial performance. |

| | | | |
|---|---|---|---|
| 3 | Third Level | Emotional capacity Level | Business unit objectives, focusing on market and financial performance. That is business operating system, bridging the gap between top-level and operational measures (e.g., customer satisfaction, flexibility, productivity). |
| 4 | Bottom level | Physical level Level | Specific operating issues and individual performance measures at departments and work centers (e.g., quality, delivery, and cycle time, waste). Thus this level lays emphasis on product and service quality, seamless delivery , achievement of appropriate cycle time for operation, production, material supply, supply to end users and management of waste. |

The benefits of adopting Performance pyramid in corporate performance evaluation are:

(a) **improved alignment:** it helps the alignment of various goals at the various levels.
(b) **enhanced communication:** it facilitates clear communication of corporate objectives.
(c) **focus on continuous improvement:** it helps in appraising corporate performance at al levels.
(d) **facilitates needs assessment:** It helps in facilitating needs assessment.

Performance measurement plays significant role in sustaining performance improvement. It helps in linking strategy with operation. It provides basis for staff motivation. It helps staff in creating their personal goals It facilitates the setting of clear organisational goal, It helps in aligning corporate goals with sub-unit objectives and As a framework, it helps in facilitating needs assessment.

The drawback of the Performance management pyramid is only shown to satisfying two stakeholders out of the numerous interest holders in the an organisation. The two interest holders are the shareholders and the customers not providing indices for the use of other stakeholders like workers, suppliers, investors, and government.

## 29.3 Assess and evaluate the use of balance scorecard approach in improving the range and linkage between performance measures:

### 29.3.1 The concept of the balanced scorecard

The balanced scorecard approach was developed by Kaplan and Norton in the 1990s as an approach to measuring performance in relation to long-term objectives. They argued that for a business entity, the most important objective is a financial objective. However, in order to achieve financial objectives over the long term, it is also necessary to achieve goals or targets that are non-financial in nature, as well as financial.

The concept of the balanced scorecard is that there are several aspects of performance ('perspectives on performance') and targets should be set for each of them. The different 'perspectives' may sometimes appear to be in conflict with each other, because achieving an objective for one aspect of performance could

mean having to make a compromise with other aspects of performance. The aim should be to achieve a satisfactory balance between the targets for each of the different perspectives on performance. These targets, taken together, provide a balanced scorecard, and actual performance should be measured against all the targets in the scorecard.

The reason for having a balanced scorecard is that by setting targets for several key factors, and making compromises between the conflicting demands of each factor, managers will take a more balanced and long-term view about what they should be trying to achieve. A balanced scorecard approach should remove the emphasis on financial targets and short-term results.

However, although a balanced scorecard approach takes a longer-term view of performance, it is possible to set shorter-term targets for each item on the scorecard. In this way it is possible to combine a balanced scorecard approach to measuring performance with the annual budget cycle, and any annual incentive scheme that the entity may operate.

### 29.3.2 The balanced scorecard: four perspectives of performance

In a balanced scorecard, critical success factors are identified for four aspects of performance, or four 'perspectives':

(a) customer perspective

(b) internal perspective

(c) innovation and learning perspective

(d) financial perspective.

Of these four perspectives, three are non-financial in nature.

For each perspective, Kaplan and Norton argued that an entity should identify key performance measures and key performance targets. The four perspectives provide a framework for identifying what those measures should be, although the specific measures used by each entity will vary according to the nature of the entity's business.

For each perspective, the key performance measures should be identified by answering a key question. The answer to the question indicates what the most important issues are. Having identified the key issues, performance measures can then be selected, and targets set for each of them.

| Perspective | The key question |
|---|---|
| **Customer perspective** | **What do customers value?**<br><br>By recognising what customers value most, the entity can focus its performance targets on satisfying the customer more effectively. Targets might be developed for several aspects of performance such as cost (value for money), quality or place of delivery. |
| **Internal perspective** | To achieve its financial and customer objectives, what processes must the organisation perform with excellence?<br><br>Management should identify the key aspects of operational performance and seek to achieve or maintain excellence in this area. For example, an entity may consider that customers value the quality of its service, and that a key aspect of providing a quality service is the effectiveness of its operational controls in preventing errors from happening. |
| **Innovation and learning perspective** | **How can the organisation continue to improve and create value?**<br><br>The focus here is on the ability of the organisation to maintain its competitive position, through the skills and knowledge of its work force and through developing new products and services, or making use of new technology as it develops.<br>**How does the organisation create value for its owners?** |
| **Financial perspective** | Financial measures of performance in a balanced scorecard system might include share price growth, profitability and return on investment. |

Kaplan and Norton argued that although the main objectives of a business are financial, it is essential for long-term success that the organisation should be able to meet the needs of its customers (the customer perspective). In order to satisfy customers, it must have internal processes that are efficient and effective in delivering the goods or services that customers need (the internal perspective). In order to have effective and efficient internal processes, an organisation needs people with knowledge and skills, as well as a capacity to continue innovating (the innovation and learning perspective).

Several measures of performance may be selected for each perspective, or just one. Using a large number of different measures for each perspective adds to the complexity of the performance measurement system.

## 29.4 Using the balanced scorecard

With the balanced scorecard approach the focus should be on strategic

objectives and the critical success factors necessary for achieving them. The main focus is on what needs to be done now to ensure continued success in the future.

The main performance report for management each month is a balanced scorecard report, not budgetary control reports and variance reports.

Examples of measures of performance for each of the four perspectives are as follows. The list is illustrative only, and organisations will use balanced scorecard measures that are appropriate for their business.

| Perspective | Outcome measures |
|---|---|
| Critical financial measures | Return on investment<br>Profitability and profitability growth<br>Revenue growth<br>Productivity and cost control Cash flow and adequate liquidity<br>Avoiding financial risk: limits to borrowing |
| Critical customer measures | Market share and market share growth<br>Customer profitability: profit targets for each category of customer<br>Attracting new customers: number of new customers or percentage of total annual revenue obtained from new customers during the year<br>Retaining existing customers<br>Customer satisfaction, although measurements of customer satisfaction may be difficult to obtain<br>On-time delivery for customer orders |
| Critical internal measures | Effectiveness of operational controls, measured by the number of control failures identified during the period |
| Critical innovation and learning measures | Success rate in winning contract orders<br>Effectiveness of operational controls, measured by the number of control failures identified during the period<br>Production cycle time/throughput time<br>Amount of re-working of defective units |
| Employee | Revenue per employee Employee productivity<br>Employee satisfaction<br>Employee retention or turnover rates<br>Percentage of total revenue earned from sales of new products<br>Time to develop new products from design to completion of development and |

| | |
|---|---|
| | introduction to the market |

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**Example: Balanced scorecard**

Kaplan and Norton described the example of Mobil in the early 1990s, in their book *The Strategy-focussed Organisation*. Mobil, a major supplier of petrol, was competing with other suppliers on the basis of price and the location of petrol stations. Its strategic focus was on cost reduction and productivity, but its return on capital was low.

The company's management re-assessed their strategy, with the aim of increasing market share and obtaining stronger brand recognition of the Mobil brand name. They decided that the company needed to attract high-spending customers who would buy other goods from the petrol station stores, in addition to petrol.

As its high-level financial objective, the company set a target of increasing return on capital employed from its current level of about 6% to 12% within three years.

From a **financial perspective**, it identified such key success factors as productivity and sales growth. Targets were set for productivity (reducing operating costs per gallon of petrol sold) and 'asset intensity' (ratio of operational cash flow to assets employed).

From a **customer perspective**, Mobil carried out market research into who its customers were and what factors influenced their buying decisions. Targets were set for providing petrol to customers in a way that would satisfy the customer and differentiate Mobil's products from rival petrol suppliers. Key issues were found to be having petrol stations that were clean and safe, and offering a good quality branded product and a trusted brand. Targets were set for cleanliness and safety, speedy service at petrol stations, helpful customer service and rewarding customer loyalty.

From an **internal perspective**, Mobil set targets for improving the delivery of its products and services to customers, and making sure that customers could always buy the petrol and other products that they wanted, whenever they visited a Mobil station.

## 29.5 Conflicting targets for the four perspectives

A criticism that has been made against the balanced scorecard approach is that the targets for each of the four perspectives might often conflict with each other. When this happens, there might be disagreement about what the priorities should be.

This problem should not be serious, however, if it is remembered that the financial is the most important of the four perspectives for a commercial business entity. The term 'balanced' scorecard indicates that some compromises have to be made between the different perspectives.

A useful sporting analogy was provided in an article in *Financial Management* magazine (Gering and Mntambo, November 2001). They compared the balanced scorecard to the judgements of a football team manager during a football match. The objective is to win the match and the key performance measure is the score.

However, as the match progresses, the manager will look at other important

aspects of performance, such as the number of shots at the goal by each side,

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the number of corner kicks, the number of tackles and the percentage of possession of the ball enjoyed by the team.

Shots on goal corner kicks, tackles and possession of the ball are all necessary factors in scoring goals, not conceding goals, and winning the match. The manager will therefore use them as indicators of how well or badly the match is progressing. However, the score is ultimately the only thing that matters.

In the same way, targets for four perspectives are useful in helping management to judge progress towards the company's objectives, but ultimately, success in achieving those objectives is measured in financial terms. The financial objective is the most important.

## 29.5 Using Value based management approaches to analyse performance management

### 29.5.1 Value based Management

Value based management (VBM) is a strategic approach that focuses on maximising the long-term value of a business or organisation by managing the customer base by value. The goal is to better optimise profitability and as a result, create value for shareholders.

Most business work hard to ensure they achieve returns that are commensurate with their investment. This goal are shown in the quantity and quality of product or service produced and levels of customers satisfied vis-a-viz the return generated. That while VBM considers both the long and short term objectives , it encourages employees (Management and their subordinates ) to think and act like the owners while emphasizing on the long term goal of the organisation.

Value Based Management has the following benefits:

(a) focus on value creation through the alignment of strategies, operations and decision;
(b) improves the process of decision making and adapting such decisions on the need to create value and operating in conditions of competitive advantage;
(c) creating value through proper resources allocation strategy;
(d) vbm aligns the corporate objectives of all stakeholders to achieve common goal that will create value for the company;
(e) vbm ensures effective adaptability and innovations that will generate value that guarantee a competitive advantage for the company; and
(f) the approach will help the entity make decisions that reduce corporate risks.

Value based Management is value driven, highly profit oriented, empowers team work, ensure good production, pricing efficiently, and innovation., management of good customer base, effective marketing, and good financial planning.

### 29.5.2 Challenges of value based management

The problems of VBM are:

(a) Setting it up is complex because of its multi-facet nature.
(b) It can lead to shelving of other business potential which could hitherto be profitable.
(c) In setting up the framework for VBM, considerations must be made for social and environmental factors which are complex.
(d) It is not easy to identify the value drivers which are the key factors that **motivate the organisation into setting up the VBM such as customer satisfaction, operational efficiency, innovation or expansion of market share or market size.**
(e) **Finally, the need to establish clear and measurable long term goals and objectives which must align with the process of value creation is not easy to attain.**
(f) **Value based Management and Measurement is cumbersome since it works with non-financial measures**

## 29.6 Value For Money (VFM)

### 29.6.1 The nature of value for money

The value for money approach to measuring performance in non-for-profit organisations is based on the idea that these organisations must work within financial constraints. Government departments must operate within budget limits. Charities must operate within spending limits set by the amount of donations they receive.

Not-for-profit organisations should therefore aim to make the best use of the money available to them, and create 'value' in what they do. Making the best use of money is described as achieving value for money or VFM.

There are three aspects to achieving value for money, often referred to as the '3Es':

(a) Economy
(b) Efficiency
(c) effectiveness.

The concept of VFM can also be applied in commercial for-profit businesses, but it is more commonly used in performance measurement systems of not-for-profit organisations.

**Economy**

Economy means keeping spending within limits, and avoiding wasteful spending. It can also mean achieving the results but for less cost. A simple example of economy is found in the purchase of supplies. Suppose that an administrative department buys items of stationery from a supplier, and pays ₦2 each for pens. It might be possible to buy pens of the same quality to fulfil exactly the same purpose for ₦1.50 each. Economy would be achieved by switching to buying the ₦1.50 pens, saving ₦0.50 per pen with no loss of operating efficiency or effectiveness.

### Efficiency

Efficiency means getting more output from available resources. Applied to employees, efficiency is often called 'productivity'. Suppose that an employee in the government's tax department processes 20 tax returns each day. Efficiency would be improved if the same individual increases the rate of output, and processes 25 tax returns each day, without any loss of effectiveness.

### Effectiveness

Effectiveness refers to success in achieving end results or success in achieving objectives. Whereas efficiency is concerned with getting more outputs from available resources, effectiveness is concerned with achieving outputs that meet the required aims and objectives. For example, the effectiveness of treatment of a particular medical condition will be improved if the proportion of patients who are treated successfully rises from 80% to 90%.

## 29.6.2 VFM as a public sector objective

Management accounting systems and reporting systems may provide information to management about value for money. Has VFM been achieved, and if so, how much and in what ways?

Value for money audits may be carried out to establish how much value is being achieved within a particular department and whether there have been improvements to value for money. Internal audit departments may carry out occasional VFM audits, and report to senior management and the manager of the department they have audited.

Value for money is an objective that can be applied to any organisation whose main objective is non-financial but which has restrictions on the amount of finance available for spending. It could therefore be appropriate for all organisations within the public sector.

The objective of **economy** focuses on the need to avoid wasteful expenditure on items, and to keep spending within limits. It also helps to ensure that the limited finance available is spent sensibly. Targets could be set for the prices paid for various items from external suppliers. Audits by the government's auditors into departmental spending may be used to identify:

(a) any significant failures to control prices, and

(b) unnecessary expense.

The objective of **efficiency** focuses on the need to make full use of available resources. The objective of **effectiveness** focuses on the need to use resources for their intended purpose and achieve the objectives of the organisation.

Unfortunately, in practice government is often accused of wasteful spending, inefficient operations and failure to get anything done – these are all the 'traditional' faults of an over-sized bureaucracy!

**Example: Value for money (3 Es)**

State-owned schools may be given a target that their pupils (of a specified age) must achieve a certain level of examination grades or 'passes' in a particular examination.

A VFM audit could be used to establish spending efficiency within a school.

**Economy**. Was there any unnecessary spending? Could the same value have been obtained for lower spending?

**Efficiency**. Have the school's resources been used efficiently? Could more output have been obtained from the available resources? Could the same results have been achieved with fewer resources? A study of efficiency might focus on matters such as teaching time per teacher per week, and the utilisation of resources such as science equipment and computer-based training materials.

**Effectiveness**. The most obvious measurements of effectiveness are the number or percentage of pupils achieving the required examination 'passes', or the grades of pass mark that they have achieved. Effectiveness is improved by increasing the pass rate.

A problem with VFM as a performance measurement system is that it is not easy to apply VFM to **planning and** setting performance targets. An organisation can assess retrospectively whether or not a particular aspect of operations has achieved value for money**, but it is not so easy to plan in advance just how value for money will be achieved.**

**Example: Value for money audit**

A local authority sets up a project aimed at encouraging more young people in the area into employment, with the objective of increasing the number of 16-24 year olds in the local area who are in employment by 10% over three years.

The project managers were very driven to achieve this target and the project ultimately increased employment rates of this demographic by 12% over the period. However, the enthusiasm with which meeting the set target was embraced did result in higher than expected costs and there was an overspend of 8% on the budget for the project.

The overspend prompted a value for money audit to be carried out. A key finding from this was that the project was marginally less expensive, on an outcome by outcome basis, than similar campaigns run by other local authorities in the country.

**Required**

Determine whether or not you consider the local authority employment project to have delivered value for money by making reference to the economy, efficiency and effectiveness of the project.

**Answer**

**Economy:** For the project to deliver economy it should control its expenditure and make the best use of its resources. The overspend on the budget shows that the cost control could have been better and indicates that economy may not have been achieved for this project.

**Efficiency:** The project will be efficient if it has made full use of its resources in the best possible way to meet the objectives. The comparative data indicates that, on an outcome by outcome basis, the project cost slightly less than similar projects carried out by other local authorities. This suggests that the project was efficient.

**Effectiveness:** The project will be considered effective if it met its objective of increasing employment in the target demographic by 10% over the period. This target was exceeded and an increase in 12% was observed. This indicates that the project was effective.

**Overall:** the project was both efficient and effective. It does not appear that it was economic which implies that overall value for money may not have been achieved. However, it is possible that the cost projections were too ambitious. If this was the case the project may have delivered value for money overall. Further investigation will be needed.

### 29.6.3 Quantitative measures of efficiency

Efficiency relates the quantity of resources to the quantity of output. This can be measured in a variety of ways

(a) Actual output/Maximum output for a given resource × 100%

(b) Minimum input to achieve required level of output/actual input × 100%

(c) Actual output/actual input □ 100% compared to a standard or target

**Example: Quantitative measures of efficiency**

A hospital has an operating theatre which can be utilised for 20 hours per day. The maximum number of operations that can be performed in any day is 40. If on a particular day 35 operations were performed, this represents

35/40 × 100% = 87.5% efficiency

A local authority must ensure that the refuse of all residents is collected each week for re-cycling. This normally requires 1,000 man hours. If in a particular week 900 man hours were used this represents

1,000/900 × 100% = 111.1% efficiency

Schools may have a standard pupil to teacher ratio of 27. If a particular school has 550 pupils and 21 teachers then the actual ratio is 26.2 which represents

27/26.2 × 100% = 103.05% efficiency.

### 29.6.4 Quantitative measures of effectiveness

Effectiveness relates what has been achieved to the intended objectives for achievement.

> **Example: Quantitative measure of effectiveness**
>
> The operating theatre in a hospital may have a maximum capacity of 40 operations per day and the average utilisation of this capacity may be 87.5%. This is a measure of efficiency in the use of the hospital operating theatre. But the aim of operations in hospitals is to treat patients successfully. The target may be for 95% of operations to be successful, but the actual success rate (measured perhaps by whether patients need further treatment after their operation) may be just 90%. This would be a measure of effectiveness in obtaining value for money.

### 29.6.5 Value Based Management (VBM) and Value for Money (VFM) :

Value-based management (VBM) focuses on creating and maximizing shareholder value, while "value for money" is a broader concept encompassing the perceived worth of a product or service relative to its cost. VBM uses metrics like Economic Value Added (EVA) to measure performance, while "value for money" is a customer-centric perspective.

Equally, Value-added is different from value based management as the value added showcases the difference between the price of product or service and the cost of producing it. The price is determined by what customers are willing to pay based on their perceived value.

Value-based pricing is a strategy of setting prices primarily based on a consumer's perceived value of a product or service. Value pricing is customer-focused pricing, meaning companies base their pricing on how much the customer believes a product is worth

### 29.6.6 Other methods of analysing Performance of Organisation

### 29.6.7 Fitzgerald and moon building block model

**The characteristics of services and service industries**

Many organisations provide services rather than products. There are many examples of service industries: hotels, entertainment, the holiday and travel industries, professional services, banking, recruitment services, cleaning services, and so on.

Performance measurement for services may differ from performance measurement in manufacturing in several ways:

(a) **Simultaneity**. With a service, providing the service (‘production’) and receiving the service (‘consumption’ by the customer) happen at the same time. With production, the product is sold to the customer after it has been manufactured.

(b) **Perishability**. It is impossible to store a service for future consumption: unlike manufacturing and retailing, there is no stock or inventory of unused services. The service must be provided when the customer wants it.

(c) **Heterogeneity**. A product can be made to a standard specification. With a service provided by humans, there is variability in the standard of performance. Each provision of the service is different. For example, even if they perform the same songs at several concerts, the performance of a rock band at a series of concerts will be different each time. Similarly, a call centre operator answering telephone calls from customers will be unable to deal with each call in exactly the same way.

(d) **Intangibility**. With a service, there are many intangible elements of service that the customer is given, and that individual customers might value. For example, a high quality of service in a restaurant is often intangible, but it is noticed and valued by the customer.

Since services differ to some extent from products, should performance setting and performance measurement be different in service companies, compared with manufacturing companies?

### 29.6.8 Controllable performance in service industries

A starting point for analysing performance measurement in service industries is that companies in a service industry should be able to link their competitive strategy to their operations, to make sure that the services that they are providing will enable the company to achieve its strategic objectives. Performance management systems have an important role, because they can:

(a) show how well or how badly the organisation has performed in achieving its strategic objectives, and

(b) identify where improvements are needed.

Performance management systems have been developed in many organisations that:

(a) link performance measures to objectives

(b) include external as well as internal measures of performance

(c) include non-financial as well as financial performance indicators

(d) recognise that a compromise is often necessary between different performance targets, such as targets for service quality and targets for the cost or the speed of providing the service.

The performance indicators that are used can vary widely between different service industries, and there is no standard set of performance measurements that apply to all services.

However, a framework for analysing performance management systems in service industries was provided by Fitzgerald and Moon.

### 29.6.9 Fitzgerald and Moon: performance measurement in service industries

Fitzgerald and Moon (1996) suggested that a performance management system in a service organisation can be analysed as a combination of three building blocks:

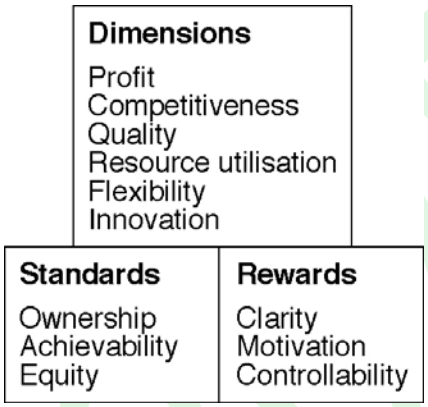
(a) Dimensions

(b) Standards

(c) Rewards.

These are shown in the following diagram.

**Illustration: Building blocks for performance measurement systems**




### 29.5.10 Dimensions of performance

Dimensions of performance are the aspects of performance that are measured. A critical question is: What are the dimensions of performance that should be measured in order to assess performance?

Research by Fitzgerald and others (1993) and by Fitzgerald and Moon (1996) concluded that there are six dimensions of performance measurement that link performance to corporate strategy. These are:

(a) profit (financial performance);

(b) competitiveness;

(c) quality;

(d) resource utilisation;

(e) flexibility; and

(f) innovation.

Some performance measures that might be used for each dimension are set out in the following table:

| Dimension of performance | Possible measure of performance |
|---|---|
| **Financial performance** | Profitability<br>Growth in profits<br>Profit/sales margins<br>Note: Return on capital employed is possibly not so relevant in a service industry, where the company employs fairly small amounts of capital. |
| **Competitiveness** | Growth in sales<br>Retention rate for customers (or percentage of customers who buy regularly: 'repeat sales')<br>Success rate in converting enquiries into sales<br>Possibly market share, although this may be difficult to measure |
| **Service quality** | Number of complaints<br>Whether the rate of complaints is increasing or decreasing<br>Customer satisfaction, as revealed by customer opinion surveys<br>Number of errors discovered |
| **Flexibility** | Possibly the mix of different types of work done by employees<br>Possibly the speed in responding to customers' requests |
| **Resource utilisation** | **Efficiency/productivity measures**<br>Utilisation rates: percentage of available time utilised in 'productive' activities |
| **Innovation** | Number of new services offered<br>Percentage of sales income that comes from services introduced in the last one or two years |

Other measures of performance might be appropriate for each dimension, depending on the nature of the service industry. However, this framework of six dimensions provides a structure for considering what measures of performance might be suitable.

The dimensions of performance should also distinguish between:

(a) 'results' of actions taken in the past, and

(b) 'determinants' of future performance.

### 29.5.11 Performance: results of past actions

Some dimensions of performance measure the results of decisions that were taken in the past, that have now had an effect. Fitzgerald and Moon suggested that results of past actions are measured by:

(a) financial performance; and

(b) competitiveness.

### 29.5.12 Determinants of future performance

Other dimensions of performance will not have an immediate effect, and do not measure the effects of decisions taken in the past. Instead they measure progress towards achieving strategic objectives in the future. The 'drivers' or 'determinants' of future performance are:

(a) quality;

(b) resource utilisation;

(c) flexibility; and

(d) innovation.

These are dimensions of competitive success now and in the future, and so are appropriate for measuring the performance of current management. Measuring performance in these dimensions 'is an attempt to address the short-termism criticism frequently levelled at financially-focused reports' (Fitzgerald). This is because they recognise that by achieving targets now, future performance will benefit. Improvements in quality, say, might not affect profitability in the current financial period, but if these quality improvements are valued by customers, this will affect profits in the future.

### 29.5.13 Standards

The second part of the framework for performance measurement suggested by Fitzgerald and Moon relates to setting expected standards of performance, once the dimensions of performance have been selected.

There are three aspects to setting standards of performance:

(a) To what extent do individuals feel that they **own** the standards that will be used to assess their performance? Do they accept the standards as their own, or do they feel that the standards have been imposed on them by senior management?

(b) Do the individuals held responsible for achieving the standards of performance consider that these standards are **achievable**, or not?

(c) Are the standards **fair ('equitable')** for all managers in all business units of the entity?

It is recognised that individuals should 'own' the standards that will be used to assess their performance, and managers are more likely to own the standards when they have been involved in the process of setting the standards.

It has also been argued that if an individual accepts or 'owns' the standards of

performance, better performance will be achieved when the standard is more demanding and difficult to achieve than when the standard is easy to achieve.

This means that the standards of performance that are likely to motivate individuals the most are standards that will not be achieved successfully all the time. Budget targets should therefore be challenging, but not impossible to achieve.

Finding a balance between standards that the company thinks are achievable and standards that the individual thinks are achievable can be a source of conflict between senior management and their subordinates.

Standards should also be fair for everyone in all business units, and should not be easier to achieve for some managers than others. To achieve fairness or equity, when local conditions for the individual business units can vary, it is often necessary to assess performance by relying on subjective judgement rather than objective financial measurements.

### Rewards

The third aspect of the performance measurement framework of Fitzgerald and Moon is rewards. This refers to the structure of the rewards system, and how individuals will be rewarded for the successful achievement of performance targets.

One of the main roles of a performance measurement system should be to ensure that strategic objectives are achieved successfully, by linking operational performance with strategic objectives.

According to Fitzgerald and Moon, there are three aspects to consider in the reward system.

(a) The system of setting performance targets and rewarding individuals for achieving those targets must be clear to everyone involved. Provided that managers accept their performance targets, **motivation** to achieve the targets will be greater when the targets are **clear** (and when the managers have participated in the target-setting process).

(b) Employees may be motivated to work harder to achieve performance targets when they are **rewarded for successful achievements**, for example with the payment of a bonus.

(c) Individuals should only be held **responsible for aspects of financial performance that they can control**. This is a basic principle of responsibility accounting. A common problem, however, is that some costs are incurred for the benefit of several divisions or departments of the organisation. The costs of these shared services have to be allocated between the divisions or departments that use them. The principle that costs should be controllable therefore means that the allocation of shared costs between divisions must be fair. In practice, arguments between divisional managers often arise because of disagreements as to how the shared costs should be shared.

## 29.7 Applying the Fitzgerald and Moon framework

The actual measures of performance used by companies in service industries will

vary according to the nature of the service. Fitzgerald and Moon used case studies, however, to show how their framework can be used to assess performance management systems.

One successful (and large) organisation reported as a case study was a food retailing business with a large number of stores. Applying the Fitzgerald and Moon framework, the performance management system was analysed as follows:

### 29.7.1 Dimensions of performance

| Dimension of performance | Measures used | performance |
|---|---|---|
| Financial performance | Profit by store and by region. | Profit is seen as a very important measure of performance.<br><br>The performance of each store and region is publicised within the company, by means of 'league tables', so that each store manager knows how his store has performed in comparison with others |
| Competitiveness | Market share (at company level).<br>Prices of competitors for each local store.<br><br>Observation | The company places great importance on monitoring the prices charged by competitors. Prices are monitored for each store, at the 'local' level.<br><br>Market share is assessed from published market share statistics.<br>Managers of local stores may visit the stores of competitors to see how full their car park is, and compare this with the number of cars in the car park of their own store |
| Quality of service on specific transactions | Letters and other messages from customers.<br>Observation | The quality of service is monitored by 'mystery shoppers' – individuals hired by the company to visit stores disguised as customers, to observe the quality of service provided. |

| | | |
|---|---|---|
| Quality of service overall | A range of measures for each store and warehouse/depot | A number of different aspects of service quality are monitored and measured, and a performance league table for stores and warehouses is published internally |
| Flexibility | No formal performance measurement | However, managers are aware of the need for flexibility. For example, when there are staff shortages due to absenteeism, store managers will telephone part-time staff and ask them to fill the vacancies at short notice. |
| Resource utilisation | Sales per square metre.<br><br>Wastage rates | |
| Innovation | No formal performance measurements | The need to innovate continually is recognised, however, and innovation is discussed regularly at business planning meetings. |

The company used four of the six dimensions of performance to assess the performance of individual stores and the performance of each region.

### 29.7.2 Standards of performance

The research found a significant difference between the level of ownership for:

(a) profit; and

(b) quality of service.

Managers participated in the process of setting profit targets for their store or region, through the formal business planning process. However, standards for quality of service were imposed by central management (head office). The view of senior management was that quality standards must be the same at every store in the country; therefore, standards must be decided at head office for the company as a whole.

‘Standards’ of performance were assessed for both profitability and quality of service.

| Standard | Comment |
|---|---|
| **Profit** | |
| Ownership | Managers were involved in setting profit targets, as part of the discussions with head office about annual targets and business planning. |
| Achievability | The standards/targets were considered achievable by the managers responsible for achieving them. |
| Equity | In setting profit targets for each store, allowance was made for the effect of competition from local competitors to each individual store. |
| **Quality of service** | |
| Ownership Achievability | Standards were imposed by head office. However, they were seen as achievable.<br>An aspect of standard-setting was the use of internal benchmarks, and comparisons of quality standards at different stores within the company. |
| Equity | No allowances were made for different local conditions. All stores throughout the country were expected to achieve the same standards. |

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### 29.7.3 Reward mechanisms for achieving standards

The three elements of reward systems within the Fitzgerald and Moon framework are:

(a) clarity of goals and targets;

(b) how managers are motivated to achieve targets; and

(c) whether there are any problems about shared costs and controllability of costs

The research findings were as follows:

| Element | Comments |
|---|---|
| Clarity of goals | Managers were aware of company strategy, and clearly understood how their performance would contribute to the achievement of strategic objectives. |
| Motivation:<br>short-term financial motivation<br>non-financial aspects | Store managers received a bonus for achieving targets. In addition, there were 'team' bonus payments.<br>Managers had pride in their position in the league tables of stores, and were motivated to improve or maintain their position in the league. |
| Controllability | There were no problems with controllability of costs or allocation of shared costs. |

### 29.7.4 Conclusions

Conclusions drawn from this case study, based on the Fitzgerald and Moon framework, were as follows:

(a) The company was highly successful.

(b) It had a clear statement of strategy that was well understood by management in regions and local stores.

(c) Performance measures were consistent with that strategy.

(d) Performance measures were reported regularly, covering a range of financial and non-financial aspects of performance.

(e) The performance measurements were clearly defined and communicated to employees at all levels in the company, and there were regular reports on actual achievements.

(f) The driving force for performance targets was the satisfaction of customers' needs.

(g) The performance measurement system was reinforced by a rewards system to motivate managers and by a pride in performance.

### 29.7.5 Benchmarking in performance management

It may be useful to be aware of benchmarking as a method of assessing performance. Benchmarking involves comparing performance with the performance of another, similar organisation or operation. In other words, another organisation or department is used as a 'benchmark for comparison'.

Performance can be assessed in terms of whether it has been better or worse than the selected benchmark. By making such comparisons, it should be possible to identify strengths and weaknesses in performance.

There are three main types of benchmarking.

(a) **Internal benchmarking**. An entity may have many similar operations, such as regional or area branches. For example, a retail company may have a network of retail stores. The best-performing stores or departments within stores can be used as a benchmark, and the performance of other branches compared against it.

(b) **Competitive benchmarking**. This involves comparing the performance of the organisation against the performance of its most successful competitors. In this way, the areas of performance where the competitor is better can be identified, and measures can then be planned for reducing the gap in performance.

(c) **Operational benchmarking**. A company might use benchmarking to assess the performance of a particular aspect of its operations, such as customer order handling, handling e-commerce orders from the internet, or warehousing and despatch operations. It may be able to identify a company in a completely different industry that carries out similar operations successfully. The other company might be prepared to act as a benchmark,

and allow its operations to be studied and its staff interviewed. The benefit of this type of benchmarking is that a business is able to learn from world-class companies how to improve its operations and raise its performance levels.

### 29.7.6 Benchmarking as a tool in performance management

Benchmarking is a strategic tool commonly used in Total Quality Management (TQM) to improve processes, products, and services by comparing performance metrics with those of industry leaders, competitors, or best practices. Here's how benchmarking is applied within the framework of TQM:

**(a)** Identifying benchmarking targets: In TQM, organisations first identify key performance indicators (KPIs) relevant to quality, such as defect rates, cycle times, customer satisfaction scores, or process efficiency metrics. These KPIs serve as benchmarks against which the organisation's performance will be measured

**(b)** Selecting benchmarking partners: Organisations choose benchmarking partners or targets—other companies or organisations that are known for their excellence in the areas being assessed. These partners could be industry leaders, competitors, or organisations with best practices that align with the organisation's goals.

**(c)** Gathering data: Once benchmarking partners are identified, data related to the selected performance metrics is collected from both the organisation and the benchmarking partners. This data may include process documentation, performance reports, customer feedback, and other relevant information.

**(d)** Analysing performance gaps: The collected data is then analysed to identify performance gaps between the organisation and the benchmarking partners. This analysis helps pinpoint areas where the organisation falls short of best-in-class performance and where improvement efforts should be focused.

**(e)** Understanding best practices: Through benchmarking, organisations gain insights into the best practices, techniques, and strategies employed by benchmarking partners to achieve superior performance. This understanding allows organisations to learn from others' successes and identify opportunities for improvement.

**(f)** Developing improvement plans: Based on the analysis of performance gaps and best practices, organisations develop improvement plans or action strategies aimed at closing the identified gaps and achieving performance levels comparable to or betterthan the benchmarking partners.

**(g)** Implementing changes: Improvement plans are implemented through systematic changes to processes, systems, or organisational practices. This may involve redesigning workflows, implementing new technologies, providing training to employees, or making other organisational changes to enhance quality and performance.

**(h)** Monitoring progress: Throughout the implementation phase, organisations continuously monitor progress against the established benchmarks and performance targets. Regular performance reviews allow organisations to track the effectiveness of improvement initiatives and make adjustments as needed.

**(i)** Sustaining improvement: Benchmarking is not a one-time activity but an ongoing process. To sustain improvement in quality and performance,

organisations must continually reassess their performance against benchmarks, identify new opportunities for improvement, and adapt to changing market conditions and customer needs.

### 29.7.7 Importance of "Benchmarking" in TQM

Benchmarking plays a crucial role in Total Quality Management (TQM) for several reasons:

(a) Identifying best practices: Benchmarking allows organisations to compare their processes, practices, and performance metrics against those of industry leaders or competitors. By studying organisations known for their excellence in quality management, TQM practitioners can identify best practices and adopt them to improve their own processes.

(b) Setting performance standards: Benchmarking helps organisations establish performance standards and benchmarks for quality-related metrics such as defect rates, cycle times, customer satisfaction scores, and product/service features. By benchmarking against industry leaders or recognised standards, organisations can set ambitious yet achievable targets for quality improvement.

(c) Gap analysis: Benchmarking facilitates a thorough gap analysis, enabling organisations to identify areas where they fall short of best-in-class performance. By comparing their current performance against benchmark data, organisations can pinpoint specific weaknesses or inefficiencies in their processes and prioritise improvement efforts accordingly.

(d) Learning from others: Benchmarking provides valuable learning opportunities for organisations seeking to enhance their quality management practices. By studying the strategies, techniques, and innovations implemented by top performers in their industry or related sectors, organisations can gain insights into new approaches and methodologies for achieving excellence in quality.

(e) Driving continuous improvement: TQM is inherently focused on continuous improvement, and benchmarking serves as a catalyst for ongoing enhancement efforts. By regularly benchmarking their performance against industry standards or competitors, organisations can identify opportunities for further optimisation and innovation, ensuring that they remain competitive in the long term.

(f) Enhancing Customer Satisfaction: Benchmarking helps organisations understand customer expectations and industry norms, allowing them to align their quality management efforts more closely with customer needs and preferences. By benchmarking customer satisfaction scores and feedback against industry benchmarks,organisations can identify areas for improvement and implement changes to enhance the overall customer experience.

(g) Stimulating innovation: Benchmarking encourages organisations to explore new ideas and approaches to quality management. By studying innovative practices implemented by industry leaders or emerging competitors, organisations can identify opportunities for innovation and differentiation, driving continuous improvement and fostering a culture of innovation within the organisation.

## 29.8 CHAPTER REVIEW

**Chapter review**

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

(a) Explain the nature of performance and non-performance indicators in a performance management system

(b) Measure and use a range of financial performance indicators

(c) Measure and use a range of non-financial performance indicators

(d) Explain the nature of short-termism in performance measurement

(e) Explain the relevance of sustainability measurements (social and environmental measurements) for an assessment of longer-term performance

(f) Explain the balanced scorecard approach to performance management and apply it in a given scenario

(g) Explain and analyse models like Performance pyramid, balance scorecard models and value based management Model.

(h) Analysis of total quality management (TQM) and its effect or organisations

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## SOLUTIONS TO PRACTICE QUESTIONS

### Solution 1

Possible performance indicators for a health and safety function include (but are not limited to) the following:

**(a)** Number of accidents in period – no injury

**(b)** Number of accidents in period – causing injury

**(c)** Number of fatalities in a period;

**(d)** Number of days since a fatality;

**(e)** Days lost through work related illness

**(f)** Number of days spent on health and safety training for health and safety officers.

**(g)** Number of days spent on health and safety training for employees

The number of appliances old has increased by 7.1% (28,000 to 30,000).

At first sight this is very pleasing. However, there is no information about the margins in respect of these sales. If the sales have increased as a result of price reductions there might be a negative impact on the profitability of the company.

### Solution 2

**Unit sales**

Also there is no information about the size of the market. If the market has increased by 10% (say) then the company has lost market share and the performance which looks favourable may not actually be so.

**On-time delivery**

There is a worrying deterioration of the percentage of deliveries made on time.

This could lead to increase costs if the customer contracts include service level agreements calling for compensation for late delivery.

There is also a possibility of loss of custom in the future.

**Sales return**

There is a very worrying increase in the number of units returned. This might be due to the company sending incorrect order or selling defective unit. Either of these could be explained by staff being unable to cope with the increased activity levels. Correction of mistakes has an associated cost including the possible loss of future sales to customers who are dissatisfied. The increase could also be due to the company allowing its customers to buy goods on a sale or return basis. This makes it more difficult to interpret the increase in sales as still more goods might be returned in the future.

The increased sales seem to have caused other areas of performance to suffer.

**Skills level**
**Performance management**




# PREDICTING AND PREVENTING CORPORATE FAILURES

Chapter content

30.0 Learning objective

30.1 Learning outcomes

30.2 Assess how long term survival brings about the necessity of considering life cycle issues

30.3 Calculate and advise on the potential likelihood of corporate failure utilising qualitative and quantitative performance measures and models, including z-score and Argenti

30.4 Identify the advantages and disadvantages of each of quantitative and qualitative corporate failure prediction models.

30.5 Identify and advise on performance management strategies that may be adopted to prevent corporate failures

30.6 Evaluate the operational charges in organizational performance management system required to implement performance improvement strategies.

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# 30 Predicting and preventing corporate failures

## 30.0 Learning objective

This chapter introduces candidate to the knowledge of assessing how long term survival brings about necessity to consider life cycle issues, determine the possible factors that can lead to business failures, advantages and disadvantages of using quantitative measures and qualitative measures and models in appraising organisations.

## 30.1 Learning outcomes

On completion of this chapter, candidates should be in a better position to assess the importance of long term survival will arise from considering the necessity of life cycle issues. Candidates should have an informed knowledge of the possible factors that can lead to business failures as well as advantages and disadvantages of using quantitative measures and qualitative measures and models in appraising organisations**.**

## 30.2 Assess how long term survival brings about the necessity of considering life cycle issues

### 30.2 .1 Introduction to life cycle costing

Life cycle costing (LCC) is sometimes called 'whole life costing' or 'whole life cycle costing'. It is a technique that attempts to identify the total cost associated with the ownership of an asset so that decisions can be made about asset acquisitions. It recognises that decisions made at the initial acquisition have the effect of locking in certain costs in the future.

The principles of LCC can be applied to both complex and to simple acquisitions.

(a) As a simple example if a person buys a new printer that person is committed to buying toner cartridges that are compatible to the printer. Thus in choosing between two printers the initial cost of one might be less than the other but its toner cartridges might be more expensive. Life cycle cost analysis would allow a choice to be made based on the total life time costs.

(b) A company will of course be concerned with cost when it buys a complex asset of some kind but it will also be concerned with reliability, servicing time, maintenance costs etc.

(c) Life cycle costing can be applied to:

(d) Major asset acquisitions.

(e) Introduction of new products to the market.

### 30.2.2 Asset acquisitions

The cost of ownership of an asset is incurred throughout its life and not just at acquisition. A decision made at the purchase stage will determine future costs associated with an asset.

### 30.2.3 Life cycle costs

The costs of a product or asset over its life cycle could be divided into three categories:

(a) **Acquisition costs, set-up costs or market entry costs**. These are costs incurred initially to bring the product into production and to start selling it, or the costs incurred to complete the construction of a building or other major construction asset

(b) **Operational costs or running costs** throughout the life of the product or asset

(c) **End-of-life costs**. These are the costs incurred to withdraw a product from the market or to demolish the asset at the end of its life.

Acquisition costs or set-up costs are usually 'one-off' capital expenditures and other once-only costs, such as the costs of training staff and establishing systems of documentation and performance reporting. Similarly, end-of-life costs are 'one- off' items that occur just once.

Running costs or operational costs are regular and recurring annual costs throughout the life of the product or asset. However, these may vary over time: for example maintenance costs for an item of equipment, such as the maintenance costs of elevators in a building, are likely to increase over time as the asset gets older.
Although costs are incurred throughout the life of an asset, a large proportion of these costs are committed at a very early stage in the product's life cycle, when the decision to develop the new product or construct the new building is made

The need to achieve long term survival as a necessity for considering life cycle issues is very important. The life cycle issue could be Thus Management are expected to review and assess product or service or equipment whose useful life are subjected to life cycle phenomenon.

"Life cycle issues" generally refer to problems or challenges that arise during the various stages of a product, process, or system's existence, from its inception (development and introduction) to its end (Decline and exit). Some of the life cycle issues include:

### 30.2.3 Those related to Product Life cycle:

The issues concerned different stages of the product development , introduction growth, maturity, decline and exit.

(a) Challenges in achieving target audience, adapting to customer preferences, achieving market share.

(b) Difficulties during product development: in the areas of innovation, improving product design

(c) Issues involved in manufacturing and supply chains such as production challenges, costs, quality control issues and timely delivery of materials.

(d) Environmental issues regarding the impact of the environment on product manufacturing, use and disposal.

Those issues related to Business/Organisational Life Cycle from start up , growth, maturity , and decline and exit**:**

(a) Funding and investment with the associated problems of securing initial funding, managing debt and attracting investors.

(b) Leadership and Management difficulties and organisational structure issues.

(c) Market related issues like Competitive tendencies, adapting to market trends and customer problems.

### 30.2.4 The Importance of assessment of Long term survival for life cycle Products and Things :

The need to achieve long term survival as a necessity for considering life cycle issues has warranted the need for life cycle assessment. The objective of assessing life cycle issues for the purposes of enhancing the long term survival of products and things that are subjected to life cycle phenomenon are:

(a) Desire for Product relevance

(b) Desire for Product or organisational continuity

(c) Desire for Product sustainability

(d) Increase product demand

(e) Sustain product profitability

(f) Address the issues of environmental drawbacks

(g) Support the life cycle programme of the product or organisation.

(h) Maintain operational efficiency and relevance

(i) Enhance product or organisational service quality to continue to meet customers or owners desire.

(j) Improve the evaluation of options

(k) Identify the stage of product development or organisational life that require additional investment or innovation.

(l) To note the best strategy to adopt in order to advance longer life cycle.

(m) To know when to curtail the life of a product or organisation especial when there are symptons of corporate failure.

(n) To know when to correct design or product error.

## 30.3 Calculate and advise on the potential likelihood of corporate failure utilising qualitative and quantitative performance measures and models, including z-score and Argenti

Corporate failure represents the discontinuation of company's operations due to weak corporate governance, management incompetence, and bad investment strategies which will lead to inability of the company to earn sufficient returns on investments.

## 30.4 Identify the advantages and disadvantages of each of quantitative and qualitative corporate failure prediction models.

### 30.4.1 Predicting Corporate failures

Corporate failure can be assessed using both quantitative (financial ratios, models) and qualitative (management, internal factors) measures, offering a more comprehensive view of potential distress.

### 30.4.2 Quantitative measures

Quantitative measures can be financial and non-financial

(a) **Financial measures include:**
   i. Profitability ratio (return on capital employed, return on investment, gross margin, net profit margin and earning per share. etc.
   ii. Liquidity ratios like low current ratio , low quick ratio and low cash ratio.
   iii. Solvency ratios such as high debt ratio, low equity-debt capital ratio etc**.**

(b) **Bankruptcy prediction models:**
   Altman Z-Score: A well-known model that uses financial ratios to assess a company's risk of bankruptcy.

### 30.4.3 Qualitative measures:

(a) management quality can be assessed by poor management, including ineffective decision-making or lack of strategic vision, can lead to failure.

(b) internal factors such as lack of information flow such as poor communication and

(c) information systems can hinder effective decision-making.

(d) creative accounting practices which include manipulating financial statements to

(e) hide problems is a red flag.

(f) poor debt management leading to frequent debt rollovers or requests for additional

(g) funding can indicate financial difficulties.

(h) shareholder issues such as lack of active shareholders or a high percentage of

(i) outside shareholders can signal problems.

(j) the non-financial signs like frozen management salaries, delayed capital expenditure,

(k) falling market share, rising staff turnover

**30.4.4 External qualitative factors:**

(a) economic downturn such as adverse economic conditions;

(b) deteriorating industry trends and changes in consumer behaviour; and

(c) Argenti's A-score model which is a qualitative model that uses a scoring system to asses the likelihood of a company's failure based on management defects. The A score is based on a set of financial ratios similar to the Z-score but includes a stronger emphasis on qualitative factors such as management competency and insudtry reputation. Terminal signs can be used in determining declining sales and loss of market share as well as increasing in expenditure profile.

## 30.5 Identify and advise on performance management strategies that may be **adopted to prevent corporate failures**

Causes of corporate failures are:

(a) **Economic distress:** Economic problems and down turn is a major cause of corporate failure. Economic downturns can result in reduction of business activities which will invariably lower sales and company profit potentials. These will make it impossible for companies to settle their financial obligations.

(b) **Management incompetence:** Managerial and executive incompetence can result from ineffective management control and poor coordination. The result of such problem can bring about low performance in the organisation resulting in enhancing corporate indices of failures.

(c) **Weak corporate governance:** Ineffective board control can result in corporate failure, especially where the rules, practices and processes that will help the organisation to maintain accountability, transparency and fairness for the stakeholders are jeopardised.

(d) **Poor technological innovation:** The inability of the company to cope with advancements in technology through requisite innovations makes it impossible to align with such new ways of operating through research

processes. This failure will make the company less competitive and innovative.

(e) **Bad investment decision:** When companies embark on investments that contribute less return towards its growth, it is a recipe for failure. If the company borrowed funds to invest in a project, and it is unable to meet with the associated obligation because the project was not properly managed, it could lead to corporate failure.

(f) **Poor infrastructural facilities**: Poor infrastructural set up and facilities especially power supply, good transportation system, communication system and security can cause company failure.

(g) **Un-conducive political environment and environmental challenges**: Restive political setting and environmental negativities can accelerate the failure of company.

Symptoms of corporate failure

(a) low profitability

(b) high gearing

(c) low liquidity

(d) declining sales and loss of market share

(e) increasing expenditure profile

In order to avoid corporate failures, the business must adopt the following strategies

(a) creation of good business strategies

(b) operational controls must be in place

(c) good corporate governance

(d) participative management

(e) managerial competence is required

(f) the customer must be respected as king to advance customer patronage

(g) management of information using appropriate system and equipment

(h) good human resource management is required

## 30.6 Operational changes in organisational performance management system required to implement performance improvement strategies.

Performance improvement requires setting clear and measurable goals, providing regular feedback and training, recognising achievements and fostering a culture of continuous improvement. This is further explained below:

(a) Clear and measurable goals: There is a need to set a clear and measurable goals, which is normally referred to as SMART goals. Which

means that goals should be simple, measurable, achievable, relevant and time bound.

(b) Feedback and communication must be consistent and be regular to ensure timely feedback that guarantees open and unhindered communication.

(c) Training and human capital development: Human capital training and development should be encouraging and continuous, with management providing needed and adequate resources that ensures human capital are identified and all openings filled without leaving any gap.

(d) Recognition and rewards are appropriately recognised, provided for hardworking personnel. Performance improvement plans (PIPs) must be put in place through structured approach, improvement techniques with regular monitoring to ensure that accurate feedback are made.

(e) Models that encourage management accountants to continue the use of continuous improvement packages should be encouraged. Techniques like total quality management (TQM) , just in time techniques(JIT) and activity based budget programme are needed. Equally, effective management information system (MIS) must be adopted.

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### 30.6.1 Total quality management

Total quality management (TQM) is a management philosophy that emphasises continuous improvement in all aspects of an organisation's operations, with the ultimate goal of achieving customer satisfaction. It involves the participation of all employees, from top management to frontline workers, in the pursuit of quality excellence. TQM focuses on customer needs and expectations, process improvement, teamwork, and the use of data and analysis to make informed decisions.

Principles of total quality management

(a) customer focused

(b) continuous improvement

(c) employee participation

(d) process management as organisational activities are interrelated and interconnected

(e) fact based decision making

(f) suppliers relationship management

(g) strategic management of the objectives with strategic goals.

(h) continuous training and education of work force.

30.6.2 TQM techniques/tools

(a) quality planning

(b) process management tools like flowsharting, mapping, work flow charts

(c) continuous improvement

(d) statistical process control parameters like control charts, statistical sampling techniques, pareto analysis and statistical sampling techniques

(e) quality tools like flowcharts, pareto analysis (80:20 rule), scatter diagrams, and cause effect diagram.

(f) customer check lists.

### 30.6.3 The importance of TQM

(a) process and product quality

(b) process mapping

(c) standardization

(d) continuous improvement

(e) employee participation

(f) error prevention

(g) customer focused

(h) quality control

## PART G

## EMERGING ISSUES IN PERFORMANCE MANAGEMENT

1. **Current development in management accounting**
2. **Current issues and trends in Performance Management**

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**Skills level**
**Performance management**




# CURRENT DEVELOPMENT IN MANAGEMENT ACCOUNTING

Chapter Contents

31.0 Learning objective
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31.2 Introduction
31.3 The challenges in management accounting
31.4 Emerging trends in management accounting
31.5 Current development in management accounting

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# 31 Current development in management accounting

## 31.0 Learning objective

This chapter discusses current developments in management accounting and the challenges posed to management accountant by this developments.

## 31.1 Learning outcomes

On completion of this chapter, readers should be able to:

(a) understand current developments in management accounting; and

(b) discuss challenges that these developments posed to management accountants.

## 31.2 Introduction:

Management accounting, generally referred to as managerial accounting, provides financial and non-financial information to internal stakeholders (managers) to aid in decision-making and planning, focusing on internal reporting and analysis rather than external reporting like financial accounting. The major features of management accounting are:

(a) internal reporting tool for decision making;

(b) focus on cost analysis critical for planning and budgeting;

(c) provides tool and techniques for performance measurement; and

(d) determination of costs of products and services.

Thus Management accounting as a method of accounting that focuses on gathering of cost data which are processed to information that help management in making informed decision.

This aspect of managerial accounting function has been affected by challenges that undermines reports generated for managers.

## 31.3 The challenges of management accounting

Management accounting encounters various challenges arising from the evolving environmental conditions confronting modern business organisations. These challenges include:

(a) **Rapid environmental shifts**: Management accounting is increasingly impacted by globalisation, evolving competitive landscapes, and

continuous technological innovation. Advancements in digital tools, cloud-based systems, and internet-based data storage have transformed how financial information is accessed, processed, and utilised.

(b) **Economic volatility and global uncertainty**: Fluctuating economic conditions—such as global crises, recessions, and unpredictable market dynamics—pose significant hurdles. Added complications from foreign exchange instability and political influences further disrupt business planning and decision-making.

(c) **Complex regulatory frameworks**: Navigating ever-changing accounting standards, tax regulations, and compliance requirements challenges accountants to stay constantly informed and adaptable. The intricate nature of these laws demands increased expertise and precision.

(d) **Data security and privacy concerns**: Sensitive managerial accounting data is highly vulnerable to cyber threats. As businesses shift towards cloud-based storage, ensuring robust cybersecurity measures, maintaining confidentiality, and preserving the integrity of financial data has become paramount.

(e) **Evolving roles and skill demands**: Today's management accountants must go beyond traditional responsibilities such as recordkeeping and basic reporting. The changing landscape calls for professionals with versatile talents, advanced technological literacy, and a commitment to ongoing learning and upskilling to stay relevant.

(f) **Big data and information overload**: The sheer volume of data available to organisations can overwhelm systems and individuals. Poor data management may lead to flawed cost allocation, budgeting errors, and inaccurate forecasting, which could impede strategic decision-making.

(g) **Lack of organisational alignment**: In many cases, management accountants struggle to harmonise their practices with internal and external organisational factors. These include company size, structure, workplace culture, available human resources, and prevailing managerial approaches all of which influence the effectiveness of accounting strategies

## 31.3 Emerging trend in management accounting:

Integration of advanced technologies

The digital revolution has introduced a suite of powerful tools that are transforming management accounting:

(a) Big data and analytics: Management accountants are leveraging massive datasets, both structured and unstructured, to gain deeper insights into customer behavior, market trends, and operational efficiencies. Predictive analytics, powered by machine learning, is enabling proactive decision-making and scenario planning.

(b) Artificial intelligence (AI) and automation: AI-driven automation is streamlining repetitive processes such as transaction processing, variance analysis, and reporting. More critically, AI is being used to detect anomalies, identify risks, and forecast future outcomes with unprecedented accuracy.

(c) Cloud computing: The migration to cloud-based platforms has democratized access to powerful management accounting tools, facilitated real-time collaboration, and allowed for seamless integration of financial and non-financial data from multiple sources.
(d) Blockchain technology: With blockchain's immutable record-keeping, management accounting can now ensure greater transparency, reduce the risk of fraud, and enhance trust in financial reporting and supply chain management.

### 31.3.1 Enhanced focus on non-financial metrics

Traditional accounting centered on financial performance, but management accounting is increasingly incorporating non-financial indicators:

(a) Environmental, social, and governance (ESG) reporting: Stakeholders demand transparency regarding sustainability, ethical practices, and social responsibility. Management accounting professionals are tasked with integrating ESG metrics into performance measurement and strategy formulation.
(b) Customer and employee metrics: Customer satisfaction, brand loyalty, employee engagement, and innovation rates are now considered essential drivers of long-term value, and management accounting captures these in performance dashboards.
(c) Balanced scorecard evolution: The balanced scorecard framework has evolved, placing greater emphasis on intangible assets and strategic objectives, not just financial returns.

### 31.3.2 Strategic business partnering

The role of the management accountant is shifting from scorekeeper to strategic business partner:

(a) Cross-functional collaboration: management accounting practitioners are increasingly embedded within cross-departmental teams—marketing, operations, R&D—to provide real-time insights that shape strategic decisions.
(b) Value creation advisory: Accountants act as trusted advisors, identifying new revenue streams, optimizing resource allocation, and challenging conventional wisdom to foster innovation.
(c) Change management: As organisations undergo digital transformation, management accounting professionals lead change initiatives, helping teams adapt to new technologies and processes.

### 31.3.3 Data Visualization and Storytelling

Making data accessible and actionable is a key management accounting trend:

(a) Interactive dashboards: Tools such as power BI and tableau enable management accountants to create dynamic dashboards that provide instant insights into key performance indicators.
(b) Data storytelling: The ability to weave compelling narratives around data is essential. Management accountants are learning to present complex

analyses in ways that resonate with executives and non-financial stakeholders alike.

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### 31.3.4 Agility and real-time decision support

The pace of business is accelerating, demanding a more agile approach to management accounting:

(a) Rolling forecasts: Static annual budgets are being replaced by rolling forecasts, which allow organisations to respond quickly to environmental changes.
(b) Scenario modeling: management accounting professionals use scenario planning to simulate various strategic options, assess risks, and stress-test assumptions in real time.
(c) Continuous performance management: Frequent performance reviews and feedback loops enable rapid course corrections and ensure strategies remain aligned with market realities.

### 31.3.5 Globalisation and multinational challenges

Multinational organisations face unique challenges in management accounting due to complex regulatory environments, currency fluctuations, and cultural differences:

(a) Transfer pricing and tax optimization: management accounting experts are essential in structuring transactions to optimize global tax positions while ensuring compliance with international regulations.
(b) Global benchmarking: Comparative performance measurement across regions and business units helps identify best practices and areas for improvement.
(c) Cultural intelligence: Understanding local business customs and integrating diverse perspectives is increasingly important for effective management accounting in global organisations.

### 31.3.6 Sustainability and long-term value creation

Management accounting is increasingly oriented toward strategies that promote organisational resilience and sustainable growth:

(a) Integrated reporting: Combining financial, environmental, and social data in a single report allows stakeholders to assess a company's holistic performance and long-term prospects.
(b) Resource stewardship: management accounting professionals are guiding organisations to optimize resource use, reduce waste, and develop circular business models.
(c) Stakeholder engagement: Engaging with a broad range of stakeholders—including customers, suppliers, communities, and investors—is vital for formulating strategies that support long-term value creation.

### 31.3.7 Talent Development and New Skill Sets

The competencies required of management accountants are evolving rapidly:

(a) Data science and analytics: Proficiency in data analytics and statistical modeling is now essential for management accounting professionals.
(b) Business acumen: Strategic thinking, negotiation, and communication skills are increasingly prioritized alongside technical expertise.

(c) Continuous learning: Ongoing professional development, certification, and adaptability are necessary to keep pace with technological and market changes.

**Questions**

1. Management Accounting has been associated with a number of trends and directions in the course of its development from inception to date. Discuss this trends with special emphasis on the Management accounting techniques that were heralded during such trends.
2. There has been scholarly belief that strategic management accounting is the most recent trend in management accounting. Support this assertion with credible points defining the various management accounting techniques and methods that heralded this trend.
3. Management Accounting is said to have developed from the inadequacies of financial accounting. Is this assertion correct? If so justify it.
4. Explain the stages in the development of Management accounting and the various trends associated with these developments

## 31.4 Chapter review

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

(a) Challenges of management accounting;

(b) Current and contemporary issues in management accounting;

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# CHAPTER 32
# CURRENT ISSUES AND TRENDS IN PERFORMANCE MANAGEMENT

**Skills level**
**Performance management**




**CURRENT ISSUES AND TRENDS IN PERFORMANCE MANAGEMENT**

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32.4 The challenges in performance management
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32.7 Application of information technology in performance management


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## 32.0 Learning objective

This chapter is aimed at bringing to the knowledge of candidates current developments in Performance Management, the challenges faced by performance management during its developmental stages as well as current developmental issues in Performance management.

## 32.1 Learning outcome

On completion of this chapter, candidates should be in a better position to understand he current developments in Performance Management especially challenges that impacted on the development as well as emerging issues. Candidates are to show versatility in information management and cloud accounting.

## 32.2 Introduction

Performance management is viewed broadly in accounting profession as a broad spectrum of subject that is not limited to employee performance measurement and management but encompasses management and accounting appraisals of business entities, their processes and objectives. Contemporary performance management faces challenges including skills gaps, employee engagement, and the need for adaptable, technology-driven processes to align with the ever-changing business landscape. Challenges in performance management accounting include aligning performance measures with organisational goals, ensuring employee buy-in and engagement, effectively communicating the benefits of the system, and managing the administrative burden. Additionally, lack of training, resistance to change, and limitations in available resources can also present hurdles.

Management accounting is a broader field that provides financial information and analysis to support internal decision-making, planning, and control within an organisation. Performance management accounting, a key aspect of management accounting, specifically focuses on measuring, evaluating, and improving organisational and individual performance. It leverages management accounting techniques to assess how effectively an organisation achieves its objectives.

## 32.3 Performance Management and Management Accounting

Performance management is a specialised aspect of management accounting which dwells in the main with advanced aspect of performance measurement as well as performance management information system.

Management accounting is aimed at providing information that will help management in planning, controlling and taking informed decision. Management accounting supports strategic planning, budgeting and cost management using techniques as cost accounting , budgeting variance analysis , profitability analysis. It area of coverage organisation's financial and operation activities.

Performance Management in most cases referred to as Performance management accounting are specifically designed to focus on measuring , evaluating and improving organisational performance. It achieves these roles using some advanced management accounting techniques and hi-tech performance management methods to track performance measurements that are financial and non-financial in nature and linked with corporate goals and objectives in order to identify deviations and consequently drive improvements. The tools and techniques that are used by performance managers include key performance indicators (KPIs), variance analysis, benchmarking and cost benefit analysis (CBA)

In most cases Performance management is viewed as an important subset of management accounting using data and analysis extracted from management accounting to drive performance improvements utilizing hi-tech information to assess performance that will help the corporate entity to assess performance, guide decision making for continuous improvement. .

Also, Performance Management in furthering its decision making role, uses performance measurement systems to set targets that are financial in nature such as targets that are financial in nature such as ROCE, profit margins, sales indices, liquidity metrics, and solvency measures and non-financial information to look at other important metrics like

non-financial performance measures in business such as output capacity, labour productivity, labour turnover, customer satisfaction and innovation.

.

In some cases , the difference between management accounting and performance management appear very tiny as some limit performance management to performance of employees of an organisation especially in the area of . Clearly, a comprehensive management accounting system should therefore provide information for setting targets and measuring actual performance at all levels. It should also provide non-financial information as well as financial information in the areas of Staff skills gap and process of upskilling and reskilling, employee engagement and staff motivation, staff improvement and appraisal, technology and data management
and feedback.

Again , performance management looks at organisational leverage on technology and data improvement and implementation especially real time information management and implementation. Adaptation to environmental changes and the effective desire to remain resolutely sustainable with the context of environmental changes, social issues and market related matters.

Performance measurement systems, covers planning and monitoring actual

performance in details , relying on the provision of relevant, reliable and timely information from internal and external sources. Performance management is therefore concerned with planning and controlling, at all levels within an organisation. Thus, Performance management systems have a key role to play in many aspects of strategic planning and are concerned with:

(a) setting targets for the achievement of the organisation's main strategic objective;

(b) setting targets for each strategy that is implemented for achieving the main strategic objective;

(c) setting targets at all levels of management within the organisation: all planning targets (at all levels within the entity) should be consistent with the strategic targets and objectives;

(d) measuring actual performance;

(e) comparing actual performance with the targets;

(f) where appropriate, taking control measures; and

(g) where appropriate, changing the targets.

Finally, even though it is glaringly not easy to assert the critical difference between management accounting, the fact remains that Management accounting is a class of accounting that is aimed at helping management in planning, controlling and taking informed decision while performance management is the critical role expected of performance managers that is focused on the use of performance management systems to look at organisational leverage on technology and data improvement and implementation especially real time information management and implementation.

## 32.4 The challenges in performance management

Performance management accounting faces several key challenges, including a lack of clear goals, inadequate feedback, and difficulties in engaging employees. Other significant hurdles include limited resources and time, resistance to change, and ensuring alignment between individual and organisational objectives. These challenges were instrumental to the need to exploit other basic options to develop performance management to cope with the envisaged problems. The challenges are spelt out thus:

(a) Poor alignment of goals as well as lack of goal clarity.
(b) Theis generally led to poor motivation and poor performance.
(c) Ineffective communication leading to Poor feedback mechanism.
(d) Poor use of irrelevant metric system to achieve effective performance measurement.
(e) Staff resistance to self imposed performance metrics even when such metrics does not provide needed test of required measurement.

(f) Increase in volume and complexity of data which require certain analytic tools for their processing.

(g) Again data overload require information system that is equipped with advanced technology and system to achieve accurate and real-time processing and report.

(h) Flawed performance evaluation method especially when non-financial data and information are involved.

In summary, the above highlighted challenges if not addressed can jeopardize the effectiveness of the critical roles of performance management which is to specifically facilitate the measuring , evaluating and improving organisational performance using advanced management accounting techniques and hi-tech performance management methods to track performance measurements that are financial and non-financial in nature and linking corporate goals and objectives in order to identify deviations and consequently drive improvements.

## 32.5 Contemporary and current issues in performance management:

Contemporary and current issues are often used interchangeably. Contemporary issues refers to those issues that are happening presently and currently while current issues are things that are happening now. The current issues in performance management accounting that is currently happening now bothers on how Performance management is navigating through various challenges that revolve around leveraging technology, addressing sustainability and ESG reporting, and navigating ethical challenges in a rapidly evolving globalized environment especially as it affect core objective of performance measurement. The current issues are set out below:

### 32.5.1 Advancement in digitalization and technology:

The current issues in performance management are affected by Issues bothering on technological advancement and digital transformation in the areas of automation in computer equipment and tools, financial programming, improved data analytics in the processing of large data, real time processing of information ,management of cyber security systems and cloud computing services.

### 32.5.2 Alignment of goals and objective in a corporate entity:

The current and contemporary issues in performance management accounting bothers on the fact that with the advancement in performance management, there became the need to align operational objectives with strategic goals of the organisation. In order to reduce incidence of dysfunctional processes as well as suboptimization, there is need to encourage strategic alignment of goals between the strategic business units as well as the overall goal of the corporate entity. This also include intra-personal goals and objectives.

### 32.5.3 Digital transformation and technology leverage:

One of the important thing that happening in the present environmental setting of organisations the explosion of data base which must be robustly processed

and analysed using appropriate instrument to not only generate appropriate information , but ensured that produced information are stored for future use.

### 32.5.4 Performance Managers must be prepared to address the sustainability issues in the environment

The present focus of Business organisation is to ensure its survival in the present environment which bothers on physical environment, social environment and economic environment. Must business through its performance management processes lay emphasis on ESG reporting, governance issues that concerns transparent reporting and accountability as this goes a long way in enhance corporate sustainability and correct performance reporting.

### 32.5.5 Use of hi-tech facilities to ensure data accuracy and security:

With the high rate of globilisation, intensive competitive tendencies and increase in multi-dimensional trading activities, the volume of data generated had become massive and prone to mistakes and errors. Performance management sensing the weakness associated with these especially in the area of achieving data accuracy and security of information had made for use of hi-tech facilities to ensure large data are subjected to accurate processing with the intention of meeting the correct need of top management and other stakeholders. Hi-tech storage facilities are needed to ensure cyber security of such information are protected in order to ensure and retain data integrity.

### 32.5.6 Surmounting ethical issues in the work and external environment

Performance Management apart from ensuring the determination of acceptable measuring indices for corporate performance , it ensures that such roles are devoid of fraudulent issues that will jeopardize correct and honest financial reporting, reduce conflict of interest and above all , sustain good ethical behaviour. All these are the current bedrock ion which the current performance management resides.

### 32.5.7 Other contemporary and current issues of interest in Performance management:

Other contemporary issues that are critical in the furtherance of performance management includes issues like working to ensure company develop taleted management team that has the ability of retaining skilled staff that will ensure corporate success.

Other important issue include globalization, matters of corporate governance, ability for organisation to be robust enough to look at issues of varying tax regulations, transfer pricing matters in a globalized economy, performance measurement development and implementation systems, budgetary tools , bench marking and total quality management implementation to achieve continuous improvement. All the above issues are currently considered in the development of performance management

## 32.6 Emerging issues in Performance Management

Emerging issues in performance management include issues that will need to be looked upon as critical for future development of performance management. Performance Management is a shift from management accounting which is basically traditional and merely covers the cost ascertainment , planning and control aspect off the subject using budgeting and budgetary control. The area of concentration now is the modern performance evaluation on both financial and non-financial performance with continuous feedback and feed forward budgeting. It also addresses the challenges of achieving modern performance management through prioritizing employee well-being and engagement, leveraging technology to streamline the process and provide real-time insights, addressing bias in evaluation, providing clear impetus to use required tools and computer progammes to handle large data and associated problems. Adopting modern techniques that use modern technology, techniques that will close skill gaps . Such modern techniques like Total Quality Management, Customer Accounting, Throughput Accounting, and Back-flush Accounting to enhance performance. It also uses integrated system through data driven programmes and computer facility to provide robust performance management system.

## 32. 7 Application of information technology in performance management


| | |
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### 32.7.0 Introduction

The rapid changes occasioned by technology disruptions have made it necessary to incorporate new elements of technology into various subjects of the professional examinations syllabus, including performance management. This need is supported by the World Economic Forum (WEF) report on the future of jobs 2020, which indicates that Information Technology (IT) skills will be essential requirements for accountants from the year 2021.

The Institute of Chartered Accountants of Nigeria (ICAN), being a member of the International Federation of Accountants (IFAC), has subscribed to the Federation's policy of producing future ready accountants. To this end, skills that will ensure that newly qualified professional accountants are equipped with skills that will make them able to take responsibility in the new global economy.

The IT element in this subject is to provide students with the necessary tools that will be applied in decision making process required in performance management. Therefore, it includes application of technology to decision making and principles of project planning and management.

### 32.7.2 Implementing performance management systems ` accessibility

A key factor in the design of a performance management system is the way in which information is to be made available and accessible to the intended users.

Individuals with performance management responsibilities must have information to do their work. IT systems make it possible, in principle, to provide individuals with enormous amounts of data and information. There could be a risk that an information system makes so much information available to users that there is 'information overload'. Individuals may receive so much information that they do not necessarily know what are the most important and relevant items, and so they do not make the best use of the information they are given.

Performance management systems should be designed in a way that makes information accessible in a convenient and helpful way. Users should have ready access to the information they use the most often. They may in addition need access to other information occasionally.

Important factors to consider in the design of a performance management

system are:

(a) What information is needed by individuals using the system?

(b) Why is the information needed or useful? What will the user do with it?

(c) How often is it needed?

(d) Where will the information be obtained from? In other words, how should the source

(e) data be captured?

(f) How should the information user be able to access the information?

(g) For essential and important items of information, it should be the responsibility of the system designers to make sure that individuals are provided with the information.

(h) Information or data that is essential to carrying out a task must be provided to the user in a convenient way. For example, individuals who use an IT system for operational variance control must be able to access the data they need to drill down into individual variances. Gaining access to this

information should be made as easy and convenient as possible for the user.

(i) Similarly, information that individuals will use often should also be made easily accessible.

When the information requirements of individuals are less predictable, or less frequent, a system might make the information accessible to users, but the leave the responsibility with the user for finding it when it is needed.

For example, intranets have made it possible to provide enormous amounts of data to employees within an organisation. However, there is so much information available that it might become the responsibility of the recipient to make sure that he gets the information that he wants, rather than the responsibility of the provider of information to make sure that it reaches individuals who might need it.

### 32.7.3 Supporting the tasks of the manager

According to 'traditional' theory of organisation and management, the tasks of management are to:

(a) Set targets and make plans for achieving those targets;

(b) Communicate;

(c) Organise activities;

(d) Co-ordinate activities;

(e) Provide leadership or direction;

(f) Motivate others;

(g) Monitor performance; and

(h) Take control measures to improve performance.

**Performance management**

The new IS/IT performance management systems will be used by managers to manage the performance of the organisation, and individuals and work units within it.

The requirements for the new performance management system include:

(a) Clear objectives, expressed perhaps as critical success factors;

(b) Targets for each objective, expressed perhaps as key performance indicators;

(c) Using these key performance measures to measure actual performance; and

(d) Providing managers with a comparison of actual performance with the target, or a comparison of target performance with current forecasts.

IS/IT systems can be designed to provide managers with the key performance measures that they should monitor. For example, executive information systems can be designed so as to provide senior managers with:

(a) Readily-available information about current performance or historical performance in selected key areas; and

(b) A facility to 'drill down' to analyse aspects of performance in more detail, if required.

**Quality of planning and control**

The information provided by the performance management system can improve the quality of planning and control. For example, decision support systems can be used for forecasting and preparing plans. Sensitivity analysis and scenario testing are made much easier with computer models, and these improve planning by testing the assumptions that have been used in preparing the plans and testing the robustness of the plans.

However, there is some risk that performance management systems can be used to plan in excessive detail, or to apply excessive control. Management may use performance management systems to demand regular and detailed reports from employees, to the point where employees spend too much time on reporting and too little time on value-adding activities.

### 32.7.4 Impact of IT on employer/employee relations

**IT systems and organisation structure**

IT-based performance management systems can affect the relationship between employees and management, and between employees and the organisation they work for.

IT-based performance management systems make information more easily accessible. As a result of improved communications and more convenient methods of communication, it is often possible for managers to organise and control the activities of a larger number of subordinates. In other words' the 'span of control' within an organisation may become much wider.

Communication systems, particularly e-mail, allow any individual to contact anyone else. It is possible for a junior employee to send an e-mail direct to the CEO, without the message having to pass through a number of intermediate managers.

In some organisations, there has been some reduction in management hierarchies. Organisations can operate efficiently with a 'flatter' structure (fewer levels of management).

(a) Although a function of management is to provide information and communication, a large part of this activity can be 'automated'.

(b) Since employees are able to access information themselves, for example from an intranet database, it is often possible to delegate more responsibility to operating staff, thereby reducing the need for junior management or supervisory staff.

### The effect of home working on an organisation

IT has made it much easier for individuals to work from home. For an organisation, the benefits of home-working include:

(a) A reduction in the need for office accommodation, and so a saving in costs;

(b) Providing more attractive working conditions for individuals who would prefer to work from home instead of commuting into work: for example, home-working may attract individuals wishing to work from home because of family commitments; and

(c) Limited disruption to work in the event of a major transport strike.

There are also disadvantages with home working:

(a) Management - It may be more difficult to exercise management control over individuals who work in a distant location (from home) rather than in direct contact in an office. For example, it can be difficult to co-ordinate the activities of several different home-workers;

(b) Employees are likely to feel more distant and isolated, and might need strong self-motivation to work effectively; and

(c) When employees work from home, it is very difficult to make them feel a member of a work team.

### Implications of groupware for team-building

The same 'social problem' may arise when groupware is used to help individuals to work together as an electronic team. Groupware allows individuals to function as a 'team' without having to be in close physical proximity to each other. For example, groupware may allow team members to 'meet' and 'discuss' problems electronically, when they are geographically far apart. **This affects working relationships**, because teams linked electronically are unlikely to 'bond' as effectively as a team whose members all work in the same office.

### E-mail and work practices

E-mail has had a profound effect on the way that individuals work with each other.

E-mail, the Internet and mobile telephone technology have all created a culture in which individuals expect immediate access to information and immediate responses to queries. Communication has become much faster, and in many cases, this means that tasks are accomplished more quickly, and organisations operate more efficiently.

### Disadvantages of e-mail

Although e-mail improves communications, and so can improve the efficiency and effectiveness of a business, there are some potential disadvantages that need to be controlled.

(a) E-mail users may receive large amounts of junk mail ('spam' mail), although this can be reduced by anti-spam software.

(b) E-mails may expose a user's computer system to viruses.

(c) There can be a security problem, when information is sent to someone by e-mail without checking whether the person is authorised to receive it.

(d) Employees may get involved in 'chatting' to other individuals by e-mail, for example by exchanging gossip or jokes. Friendly exchanges of this sort can become time-consuming.

(e) Many users tend to respond immediately to e-mail messages, when their time would be better spent concentrating on more urgent issues in hand. Individuals sending e-mails often expect an immediate response, and are (unjustifiably) annoyed if they do not get a quick reply.

(f) There is a tendency for users to send e-mail messages without properly checking what they are sending. Messages may contain many typing errors and other mistakes, and the sender may forget to attach documents or may attach the wrong documents.

Some of the disadvantages of e-mail are 'technical' problems, but many are linked to employee behaviour – for example, importing viruses, excessive use of e-mail for chatting, inefficient use of time and prioritising of work.

Using e-mail within an organisation therefore has implications for control over e-mail use, and the ways in which this control should be applied. This affects management/employee relationships.

**De-skilling of operatives**

As a result of IT, some labour skills have been lost, or replaced by other skills. The automation of many operations removes or reduces the need for individuals to acquire specialist skills.

De-skilling has occurred in many aspects of work. For example, many engineering skills have been automated. Computers can be used to check for faults in an item of equipment (for example, a car) instead of relying on the skills of individual engineers.

Computer systems are also used to automate procedures, such as handling telephone calls from customers. Telephone operatives may be required to follow the procedures set out on a computer screen when dealing with a customer query or complaint, instead of using their initiative.

Consequences of de-skilling may be:

(a) For the employer, a saving in employment costs (because employees do not have to be as highly-skilled) and lower training costs; and

(b) For the employee, a loss of interest in the work and pride in performance.

### 32.7.5 Problem areas: organisational impact analysis

**Problem areas when implementing an IS**

When an information system is designed, developed and implemented, several problem areas must be managed carefully.

(a) The new system should contribute to the economic, financial or operational performance of the organisation. However, when a new system is developed, a 'balance' or compromise must often be made between:

i. A system that meets the user's requirements exactly, and the 'quality' of the system design;

ii. Keeping costs within acceptable limits; and

iii. Implementing the system within an acceptable time scale.

It is generally impossible to develop and implement a system of the highest quality within a short time scale and for a low cost.

(b) The new system is likely to have an impact on organisational and social matters, and in doing so, may arouse strong resistance and hostility form the intended users of the system.

Research has shown that organisational and social issues are significant factors causing new information systems to fail. Even when management have shown an awareness of these problems, their actions are often 'too little, too late'.

A new IS system is 'likely to have a significant impact upon an organisation's culture, structure and working practices'.

Since organisational issues can be a major problem area, it would make sense to consider them carefully at an early stage in an IS project, and try to deal with the problems that are identified.

### 32.7.6 Organisational impact analysis

'Organisational impact analysis' is, as its name suggests, the analysis of the likely impact of a new system on an organisation, including cultural, structural and political issues and the effect on working practices. It should be carried out at an early stage of a system development, and should not be left until it is too late to take suitable measures to deal with problems.

Organisational impact analysis should be carried out together with an analysis of the contribution that the new system will make to the organisation, in terms of economic benefit or the achievement of strategic goals.

The following issues should all be considered at an early stage in the project development, up to the implementation of the new system, as well as in a post-implementation review.

### 32.7.6 Contribution of the system to the economic and strategic goals of the organisation

a. There should be a regular analysis of the projected benefits from a new system, to assess whether the system is still expected to meet the organisation's needs within an acceptable time scale and for an acceptable cost.

(b) The proposed system should conform to the current IS/IT strategy of the organisation. (If it does not, the project should be abandoned, or IS/It strategy should be reviewed and changed.)

(c) Resources should be allocated to an IS project, so that priority is given to the most important parts of the project. This can be achieved using the **spiral model** approach to system development, which is explained later.

**(d)** Management should be aware of the need to think about **business process re-engineering (BPR)** in conjunction with developing a major new system.

**(e)** A new system should be designed to support planned future changes in the organisation, and so may need to be flexible in order to allow for these future changes when they occur. Management should not focus on current requirements and ignore planned changes in the future.

### 32.7.7 Human-related issues

Human-related issues should be considered.

(a) Training. Management should assess whether a suitable and sufficient training programme has been planned for all users of the system.

(b) It may be necessary to consider health and safety aspects of using the new system, or ergonomic factors. For example, there may be risks from a new system to the eye sight of users (from working at computer screens), or other aspects of their health. There may be a need for specially-designed chairs for computer users, or a need for regular health check-ups.

(c) The motivation and needs of system users should be considered. There should be an assessment of how the motivation and needs of the system users will be satisfied (if at all) by the implementation of the new system.

(d) There should be an assessment of the working styles and the IT skills of the individuals who will be the system users, to decide the implications these may have for system design or training needs.

(e) Job re-design. There should also be an assessment at an early stage in the system design of whether the new system will change the job specifications of individuals and the relative importance of their work.

All these human-related issues could lead to strong resistance to the new system.

### 32.7.8 System implementation

Another aspect of organisational impact analysis should be the period of transition from the old system to the new system, when the new system is eventually implemented. Again, this analysis should begin at an early stage in the project development.

(a) Management should carry out an assessment of how the planned timing of the new system implementation will interact with any other planned changes in the organisation that will be expected at about the same time.

(b) There should also be an assessment of the likely disruption to the organisation that implementing the new system will cause, and how long this disruption might last.

### 32.7.9 Organisation structure, culture and power

There should be an assessment of how the new system will have an impact on:

(a) The structure of the organisation (for example, will the management hierarchy become 'flatter', will there be more centralisation or decentralisation of authority, or will there be job losses or transfers of staff to other work?)

(b) The culture of the organisation (defined as 'the set of important assumptions, often un-stated, which members of an organisation share in common')

(c) The balance of power within the organisation. Information (and knowledge) gives power to the individuals who control it. An information system may alter the balance of power. If this can be foreseen, management can anticipate the political implications of introducing the new system.

Organisational impact analysis is needed because it helps management to identify the potential problems that anew system might create, and do something to resolve the problems before it is too late for effective measures.

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## 32.8 Feasibility study

### 32.8.1 Purpose of a feasibility study

**Definition: Feasibility study**

A feasibility study is the first stage in a project to develop a new IS/IT system. The purpose of a feasibility study is to assess:

(a) Whether a new information system is required; and

(b) What are the different options that exist for a new system.

The study should also consider the different options and recommend one of these.

A feasibility study is carried out by a feasibility study group, which prepares a feasibility report and submits this, either to the senior IT manager or to a project steering committee.

In the basis of the feasibility study, a decision is then taken whether to initiate the project and develop and implement the IS/IT system.

### 32.8.1 The steering committee and the feasibility study group

**Definition: Steering committee**

The project steering committee should be responsible for supervising and controlling the development of a new IS/IT system. The committee should consist of senior managers with IT expertise, financial project management expertise and business knowledge.

**Definition: Project sponsor**

The project sponsor is the person with overall responsibility for the new system and may be the head of the steering committee. The sponsor should be the 'project champion'. For example, where the new system will be used entirely or mainly by one department, the project sponsor may be the department, represented on the committee by the head of the department.

The steering committee establishes the terms of reference for the feasibility study. These should include:

(a) A statement of the purpose and objectives of the new system;

(b) The scope of the feasibility study;

(c) The budget limits for the project, if these can be decided before the study; and

(d) The time scale for the study and the report.

### 32.8.2 Role of business analysts

Before a feasibility study is started, some work may be carried out by business analysts. The role of a business analyst is to identify new business opportunities to exploit, or business problems that need to be resolved. They might suggest a business solution to the opportunity or problem, which may or may not involve the development of a new IS/IT system.

On the basis of the recommendations of a business analyst, an entity may decide to establish a project steering committee and carry out a feasibility study. The business analyst who recommended the new system will probably become a member of the feasibility study group.

### 32.8.3 The feasibility study group

**Definition: Feasibility study group**

The feasibility study group is the team that carries out the feasibility study. Its members should be appointed by the project steering committee. The group should be fairly small, so that it can work efficiently as a team. It should include:

(a) IT experts;

(b) representatives of the department or departments that will use the computer system;

(c) one or more individuals with financial expertise (for example, an accountant); and

(d) A business analyst (possibly).

### 32.8.4 Stages in a feasibility study

After the formation of the steering committee, the stages in a feasibility study are as follows:

**(a)** Formation of the study group and setting the terms of reference for the study;

**(b)** Planning the study. The time scales for reporting must be agreed, with a target date for the submission of the feasibility report to the project steering committee;

**(c)** A feasibility study budget should be agreed by the steering committee;

(d) **Information gathering** - The first activity in the feasibility study should be to gather information about the current system that is used by the organisation that the new system will replace. Problems with the existing system should be identified and analysed. This task involves collecting, recording and analysing information about the existing system;

(e) **Identify alternative systems -** Having identified the weaknesses (and strengths) in the current system, the study group should consider alternatives for a new system that will meet the requirements of the system user better than the current system, at an acceptable cost. Each alternative should be considered in some detail, and an outline system design may be prepared for each. (Since preparing an outline design and testing it for feasibility may take some time, the feasibility study group may consider only a limited number of alternative systems – perhaps just two or three;

Each alternative for a new system should be evaluated, using tests of:

i. Technical feasibility;

ii. Operational feasibility;

iii. Social feasibility; and

iv. Economic feasibility;

The economic feasibility test for a new system involves a **cost-benefit analysis**;

The project group decides which alternative system it will recommend to the steering committee; and

The **feasibility report** is prepared and submitted, with a recommendation about which new IS/IT system, if any, to develop.

### 32.8.5 Technical, operational, social and economic feasibility

Each alternative new system considered by the feasibility study group should be tested for technical, operational, social and economic feasibility.

#### (a) Technical feasibility

The purpose of a technical feasibility test is to decide whether the proposed new system is technically feasible – in other words, whether it could work technically and achieve its intended purpose within the intended cost budget.

Technical issues to consider may include whether the new system

i. Will provide response times that are fast enough for operating requirements

ii. Can be connected technically to other existing systems ('integrated' with other systems)

iii. Will be able to handle the expected volumes of transactions and processing.

In other words: *Can the system perform technically* in the way the user will want and expect?

**(b) Operational feasibility**

The purpose of an operational feasibility test is to decide whether the new system can be operated by the user's staff and in accordance with the user's practical needs. The main concern with this test is to ensure that the system will be able to handle *all the operational requirements* that the user will expect?

Matters to consider include:

i. Whether the user's existing staff have the necessary skills to operate the system, or whether they could acquire the necessary skills through training;

ii. Whether changes might be needed in the user's organisation structure, for example with the creation of new jobs or the elimination of some type of existing job; and

iii. Whether it would be necessary to make other operational changes, such as a change in shift working or working hours, so that the system can operate for more hours each day.

*Will these operational changes be feasible?*

Other operational issues could affect the feasibility of a project. These include:

i. Data conversion. This is the conversion or transfer of data from the files of the 'old' system to the files of the new system. There may be practical difficulties or risks to the data that could make the new system difficult to install successfully.**Data protection legislation**. The system may need to include personal data about individuals on its files, in which case it may come within the scope of data protection legislation. A check should be made that the proposed new system will comply with **the requirements of the le**gislation.

**(c) Social feasibility**

A social feasibility test is a test of the likely response of the system's users and customers to the system. For example, if a bank is considering introducing a new system for its account holders (customers) the study group would need to consider what the strength of the resistance might be from customers who may have to use the system.

If a new system would affect the way that employees do their work, or if it would threaten their job security, there could be hostility and resistance to the system that may be difficult to overcome.

If resistance to the new system from users or customers might be strong, the study group may decide that the system is not socially feasible.

### (d) Economic feasibility

The purpose of an economic feasibility test is to establish whether the system is economically justified, and whether it can deliver the expected benefits and whether it can be operated within acceptable cost limits.

An economic feasibility test therefore involves a **cost-benefit analysis** exercise, to establish whether the expected benefits from the system would justify the costs of developing and operating it. It is important to identify both the tangible and intangible benefits and costs. The qualitative (intangible) benefits from a new system could be more significant than its quantitative (tangible) benefits.

The feasibility study group is *unlikely to recommend a project unless it passes certain economic or financial tests* of acceptability.

## 32.9 Cost-benefit analysis: costs and benefits

**Definition: Cost-benefit analysis**

A cost-benefit analysis involves a comparison of the expected costs of a new system with the benefits the system is expected to provide. The economic feasibility test involves a comparison of tangible costs and tangible benefits. There may also be significant intangible costs or benefits.

Some of the main tangible costs and benefits of a new system are set out in the following table.

| Category of cost | Main items of cost |
|---|---|
| *Costs of system development* | • **Cost of in-house staff** used for system development work. A large number of staff, mainly IT staff and user department staff, will be involved during the development phase for the new project.<br>• **Costs of external IT support**. These costs may include the costs of out-sourced IT development work<br>• **Costs of software purchased** from external software suppliers.<br>• **Costs of new computer hardware** for the new system |

| | |
|---|---|
| *Costs of system installation* | • **Staff training costs**. User department staff will need to be trained in the use of the new system.<br>• Cost of developing and printing user **instruction guides or manuals**<br>• **System changeover costs**. Costs will be incurred in converting the data files for the current system and transferring the data to files for the new system.<br>• There may also be additional running costs if the new system is operated in parallel with the old system for a period of time, until the new system is considered 'safe'.<br>• **Redundancy costs**. There may be some redundancy costs, if jobs are lost because of the new system. |
| *System operating costs* | • Costs of **leasing or renting** new equipment or communication links<br>• Costs of system **maintenance** and updating<br>• **Outsourcing** costs, for any parts of the new system operations that are outsourced<br>• Costs of operating a **help desk** for the system.<br>• Costs of **materials consumed** (e.g. paper for printing) and replacement parts for equipment<br>• Any **other** additional costs of operating staff |

### 32.9.1 Tangible and intangible benefits

The tangible benefits from a new system should be estimated, if possible, in money terms. In some cases, however, it may be difficult to convert a tangible operational benefit (such as faster response times, or more reliable data) into a money value.

Tangible benefits of a new system may include:

(a) Higher profits, where the system enables the entity to increase its sales revenue (for example, through the provision of a new e-commerce system);

(b) Lower operating costs, for example from improvements in efficiency and staff time saved;

(c) Improved service to customers. For example, an on-line ordering system might result in the faster delivery of purchased items to customers;

(d) Improvements in accuracy and reliability of data. For example, a new system might provide more up-to-date information for users. Similarly, a

new decision support system for managers may improve the quality of information to managers, and help them to make better decisions; and

(e) Improvements in communications between users of the system.

### 32.9.2 Cost-benefit analysis: techniques of financial evaluation

The financial evaluation of a proposed new IS/IT system involves a comparison of expected costs and expected benefits. The following list is a reminder of the key relevant techniques you learnt about in other ICAN modules:

(a) Payback period;

(b) Return on investment (ROI);

(c) Discounted cash flow;

(d) Net present value (NPV); and

(e) Internal rate of return (IRR).

### 32.9.3 The feasibility study report

The final stage of a feasibility study is for the study group to produce a feasibility report for submission to the project steering committee. The report should be a recommendation, which may be:

(a) To develop the system, using one of the system designs studied by the group; and

(b) To retain the existing system, and not to develop a new system.

The contents of a typical feasibility report are as follows:

(a) An executive summary, giving a brief summary of the report and its main recommendation(s);

(b) The terms of reference for the feasibility study;

(c) The objectives of the new system;

(d) Information about the feasibility study and how it is carried out;

(e) An analysis of the current system, its weaknesses and why a new system is required. Also the costs of running the current system;

(f) The alternative solutions for a new system that the study group considered;

(g) A recommendation of the preferred alternative solution for the system, supported by tests of feasibility; and

(h) A plan for the development and implementation of the new system.

If the steering committee accepts the recommendation of the feasibility report, the necessary authorisation for capital expenditure should be obtained. The project to develop the new system should then be initiated.

### 32.9.4 Project initiation

#### Characteristics of a project

Work to develop and install a new IS/IT project is usually organised as a project. A project has number of characteristics:

(a) The project should have a specific objective. This should be defined in terms of scope (what the system is expected to do), time schedule and cost. In the case of IT development work, a project is to design, develop and install a specific IS/IT system;

(b) A project team is assembled to carry out the work. Membership of this team may change during the course of the project, as some individuals complete their work and other individuals are brought in to do their part of the work. The management and composition of a project team are considered in more detail later; and

(c) A project should have a schedule and a time scale for completion. It has a starting time, which is when the project is formally initiated. It also comes to an end, when the IS/IT system has been designed, developed and installed. When the project ends, the project team is disbanded.

An IS/IT project should also have the following characteristics:

(a) An IS/IT project should have a **sponsor**. The sponsor is the organisation or department financing the project;

(b) An IS/IT project has a **customer**, who will be the user of the system. The customer may also be the sponsor, but is not necessarily the sponsor; and

(c) A project requires a **budget** for the design and development work. This should be used to plan future expenditure and also to apply control over actual spending (using a budgetary control reporting system). The cost budget might be divided into a budget for each stage of the development project.

### 32.9.5 The project management process

The key elements of project management after project initiation are planning and control. However, there are five stages of project management.

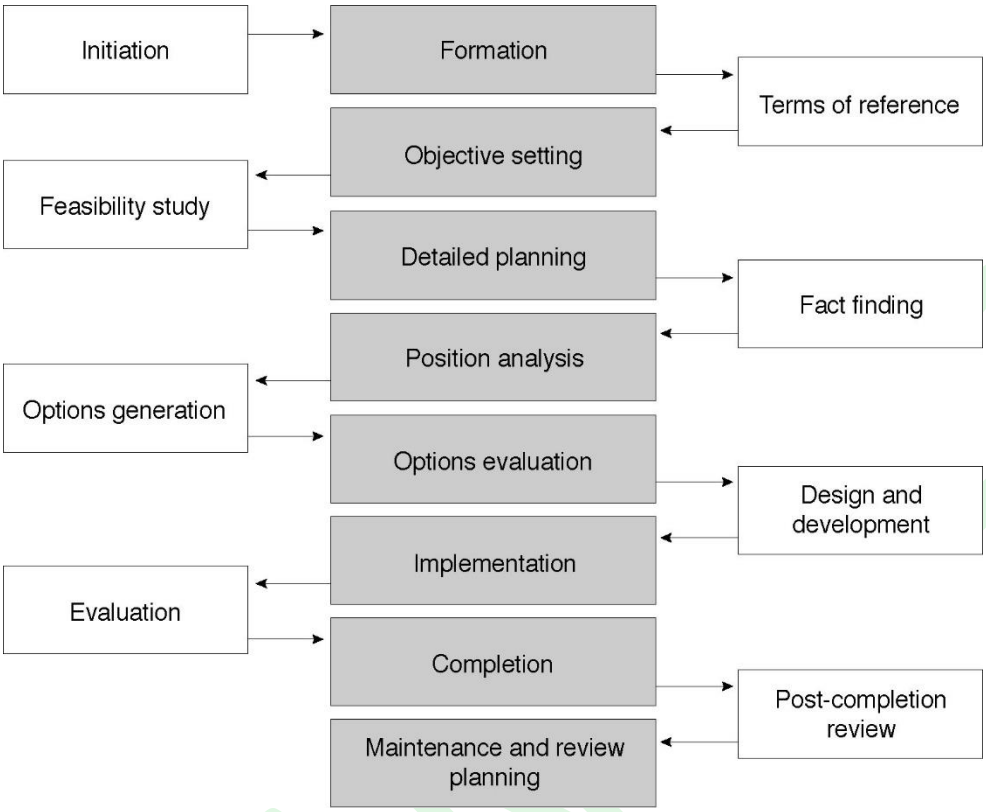
#### The 5 stages of project management

| Stage | Description |
|---|---|
| 1. Initiation | The goals and objectives of the project should be established when the project begins. These can be set out in a **project initiation document (PID)**. The PID is used to develop and clarify the **terms of reference** for the project. |

| | |
|---|---|
| | The project might be initiated by the Board of Directors, the project sponsor or the steering committee. |
| 2. Planning | The project must be planned. There must be plans for each stage of the project. The plans should specifying the resources required to complete each stage of the project, a schedule (sequence of events and time scale for completion), a detailed budget and performance specifications for the system. |
| 3. Executing | The plans must be put into action. Project management are responsible for directing the project activities. |
| 4. Controlling | The project managers should monitor the progress of the project, to check whether it is on time for completion, within its cost budget and meeting the user's specifications. Where necessary, management should take corrective action when actual performance falls below or behind the plan. Some re-planning and re-scheduling might be required. |
| 5. Completing | The project management must ensure at the end of the project that it has been completed fully and meets requirements. On completion, the responsibility of the project managers ends, and responsibility for running the system is handed over fully to the management for the computer user. |

### 32.9.6 Phases of project development

The stages or phases of project development for a bespoke system are as follows.




### 32.9.7 Project initiation document and terms of reference

**Definition: Project initiation document (PID)**

A project initiation document (PID) is a document that formally establishes the IT project, and provides the authority for the project work to begin.

There are no widely-accepted 'rules' about what the PID should contain, although it ought to include the terms of reference for the project.

**Terms of reference**

**Definition: Terms of reference**

The terms of reference are a formal statement of what the project is expected to achieve.

Terms of reference will usually contain the following items:

(a) A **statement of the business objectives** of the entity, and how the new IS/IT system is intended to contribute to those objectives. In other words, how does the new project fit into the overall plans and objectives of the entity?

(b) A **statement of the specific objectives of the project** - The terms of reference should state what the new IS/IT system should achieve, and what it is expected to do;

(c) A statement of the **scope of the project** - The project should have a stated scope. Who is expected to use the project when it is implemented, and who will not use it? For example, will it be specific to a particular department or region, or will it be used by the entire entity? Which operations will be affected by the new project?

(d) A statement of any **constraints or restrictions** for the project. For example, it might be decided that the project should use in-house IT staff only, and that none of the work should be outsourced; and

(e) A target **date for completion**.

### 32.9.8 Other parts of a project initiation document

The PID may also make the following specifications:

(a) The sponsor and the user (customer) for the project should be identified. The PID should state who has the ultimate authority to approve the project on completion, and who has the authority to resolve any arguments or disagreements that may arise during the course of the project;

(b) The PID should also specify the resources that will be made available to the project, in terms of staff, technical resources and budgeted expenditure limit;

(c) The project manager should be identified, and the size and composition of the project team may also be specified;

(d) There may also be a policy statement on purchasing and procurement, specifying the type of equipment that must be used for the project. (This may be necessary, for example, if the entity has a policy of using compatible IT equipment for all its IT systems.); and

(e) The PID may also include an outline project plan, although this may not be produced until later (by the project manager, after his or her appointment).

### 32.9.9 The project manager

**Definition: Project manager**

A project manager is appointed to lead the project team. He or she is responsible for achieving the objectives for the project, as specified in the terms of reference.

**Tasks of the project manager**

The tasks of the project manager are to:

(a) Agree the scope of the project (as specified in the terms of reference for the project);

(b) Produce a project plan, setting out the different stages of the project and times for completion of each stage, and also the resources required during each stage;

(c) Initiate the work on the project, agreeing individual responsibilities with each member of the project team;

(d) Liaise with the sponsor and the customer for the project, and discuss the progress of the work and any problems that have arisen;

(e) Motivate the project team;

(f) Monitor the progress of the work;

(g) Ensure that the project meets certain quality standards;

(h) Report on progress to the project steering committee, project sponsor and customer for the project;

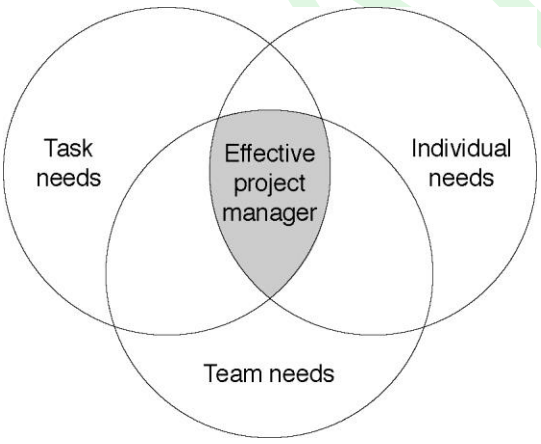
(i) Deal with any slippage in the work that threatens a delay to completion;

(j) Ensure that the new system is properly tested and meets its specifications; and

(k) Deliver the completed IS/IT system at the completion of the project.

**The skills of the project manager**

According to Adair an effective project manager must satisfy three overlapping needs:




These are (1) the needs to get the task done, (2) the need to create an effective project team and (3) the need to encourage every individual in the team to give

commitment to the project. A successful manager gives sufficient attention to all three needs to ensure that the project is completed successfully.

Yeates and Cadle have suggested that a project manager requires the following **core skills**:

(a) Leadership skills;

(b) Understanding of technology (IT knowledge);

(c) Skills in evaluating and decision making;

(d) People management;

(e) Communication skills;

(f) A knowledge of systems design and maintenance requirements;

(g) Planning skills;

(h) Control skills;

(i) Financial awareness;

(j) Procurement skills;

(k) Negotiation skills;

(l) Skills in negotiating contracts; and

(m) An awareness of legal issues.

## 32.10 The project team

**Definition: Project team**

The project team must include individuals with the necessary skills and expertise, collectively, to achieve the project objectives and deliver the completed IS/IT system.

A team is assembled for each project, although the composition of the team may change during the course of the project, as the work progresses and new skills are required for the next stages of the work.

For a project to design and develop a new IS/IT system in-house, the project team will include, for at least some of the time:

(a) Systems analysts;

(b) Programmers;

(c) Data analysts; and

(d) User department representative(s).

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### 32.10.1 Systems analysts

Some systems analysts may become involved in a project from the feasibility study stage, as part of the feasibility study group. They have IT expertise, but their specific skills are:

(a) Analysing existing systems, to establish the user's requirements: they interview staff of the project customer and analyse and document the current system; and

(b) Developing and designing new systems.

They must provide design specifications for the system that can be approved by the project sponsor, customer or project steering committee. They must also produce a specification for every part of the new system, sufficient to enable programmers to write the software on the basis of the specification provided.

After programming has been completed and the software has been tested, one or more systems analysts should be responsible for systems testing. This involves testing that all the different parts of the software fit together, and that the IS/IT system functions properly as a whole.

**Programmers**

Programmers write the software for the new system, following the detailed specifications provided by the systems analysts.

**Data analysts**

Data analysts are specialists in the construction of data files, particularly databases. Their task is to specify, design and build the database (or databases) for the IS/IT system. Most of their work is carried out after the systems analysts have designed the system, although they may assist the systems analysts during the design stage by producing entity-relationship models (described in a later chapter).

### 32.10.2 User department representative

The user or customer for the new system may appoint a representative to the project team. The role of this representative should be to:

(a) Ensure that the systems analysts have understood the user's requirements properly, by checking the details of the system design;

(b) Learn the new system in detail so that the user department has someone with an in-depth knowledge of the system when it eventually 'goes live';

(c) Organise training in the new system for user department staff, and write the user instruction guide; and

(d) Organise the testing of the system by the user before the finished IS/IT system is accepted as complete and ready for implementation.

### 32.10.3 Project team management structure

Project teams usually have a flat management structure. Typically, a project team may have a manager and no other person with seniority over anyone else. Everyone in the team, apart from the manager, is brought into the team to perform a task or function, regardless of his or her experience. There is a distinct absence of 'bosses' and 'juniors'.

This flat management structure is very different from the traditional structure of a large department, such as an IT department, which may have two, three or four grades of management for each IT specialism – for example, chief programmers, senior programmers, programmers and junior programmers.

A flat management structure is ideal for project work, for several reasons.

(a) A project team is assembled to undertake a specific project and it is disbanded when the project is complete.

(b) Individuals are brought into a project team to perform a specific task or function, and when they have finished the work for which they were needed, they can leave the project and move to another project.

(c) The size and composition of a project team therefore varies throughout the project, and this makes it difficult to establish a management hierarchy.

(d) Individuals are brought into a project team for their skills and the work they can do, not for their management seniority.

(e) A flat management structure is well-suited to a flexible team structure, and allows an entity to move its staff from one project to another, without having to worry about who is more senior and who should be 'in charge' – other than the project manager.

This flexible structuring of project teams also makes it possible for individuals to move more easily between different projects, and carry out different tasks for different projects. For example, an individual who is the project manager on one project may be moved when the project is completed to another project, as programmer, systems analyst or data analyst.

This flexibility and ability to move individuals from one project to another to do specific tasks, regardless of their 'seniority' or expertise, can only work effectively if salaries are also flexible. Where a flat management structure is used for project work, it is usual to have wide salary bands for each type of employee – for example, a wide salary band for systems analysts. Individuals with a high level of skill and experience can therefore be paid much more than an inexperienced person for similar work.

### 32.10.4 Project quality plan

It is essential that quality is maintained throughout an IS/IT development project, so that a high-quality system will be achieved at the end of the project.

A project quality plan might be prepared, providing specifications for various aspects of the project, in order to ensure that the required project quality standards are achieved.

The project quality plan may contain the following items:

(a) **Project overview -** This gives a broad description of the project and its objectives, and identifies the project user/customer. This section of the project quality plan should be consistent with the project initiation document (terms of reference);

(b) **Project organisation** - This section of the quality plan specifies the management and organisation structure for the project, and the management responsibilities. It includes, for example, the names of:

i. The members of the project steering committee;

ii. The project sponsor;

iii. The person to contact in each user or customer department;

iv. The project manager; and

v. The project team members.

It should also specify the formal reporting procedures, the methods to be used for monitoring and controlling the project, and the decision-making responsibilities.

For example, the quality plan may specify that the progress on the project should be monitored by a project assurance team (with named members) which should meet regularly to consider progress reports from the project manager;

(a) **Project requirements** - This section of the project quality plan specifies the requirements for the project, in terms of what must be delivered. The project work may be divided into phases, with each phase ending when a recognisable 'milestone' is achieved. Target dates will be set for reaching each milestone. (The new project may be introduced in stages.)

The project specifications should include performance specifications for the new system, security specifications, the required standards and any legal specifications.

The completed project will be tested against these specifications, to make sure that they have been met successfully;

(b) **Project development** - This section of the quality plan specifies the methods to be used to develop the new system, and the testing requirements. The different phases of the development work should be identified, with target completion dates for each phase (e.g. detailed system analysis, detailed system design, programming, program testing, system testing, user testing and implementation;

(c) **Quality assurance** - This section of the plan specifies how the work on the project should be reviewed as it progresses, to ensure that it is being performed to the required standards and specifications. The methods that will

be used to carry out quality assurance checks should be specified. Quality assurance can be carried out by means of self-checking, by peer review by colleagues on the project team or by means of external reviews by a review team;

(d) **Configuration management**. This section of the plan deals with systems and procedures for the control of software throughout the project. There are two main elements to configuration control over software:

i. **Change control** - This is concerned with requests for changes to the detailed specifications for the IS/IT system as the project progresses. When changes are requested, there should be a formal system for documenting the requests – including the reason why the change is needed and why it is desirable. There should be a system for approving requests for changes, and for ensuring that they are made correctly (with suitable changes to all system specifications and programming documentation, and suitable testing to make sure that the change has been made correctly);

ii. **Version control**. During system development, programs may be altered many times, to correct errors and to implement approved changes. As a consequence, there may be many different versions of the same program, and only one of them is the 'current' version at any time. A system for labelling each version of every program must therefore be applied, so that there is no confusion about the different versions and the correct version is always used;

(e) **Testing methods** - The testing methods to be used must be specified. These should include program testing, systems testing and user acceptance testing, to be carried out before the system development is complete;

(f) **Documentation standards** - A section of the quality plan should specify the documentation that should be produced for the new system. For example, the requirements specification for a project might be drawn up using a standard format in order to ensure that nothing is omitted from the statement of requirements and that the requirements should be comprehensible;

(g) **Procurement -** A section in the quality plan should specify quality standards for the procurement of hardware and any off-the-shelf software. For example, the quality plan should state that a specified **Invitation to Tender procedure** must be followed for the procurement of major hardware items such as computer equipment and communications link rentals;

(h) The **work performance of sub-contractors** must also be subject to specified performance quality standards;

(i) **Risk management** - The project quality plan should also specify requirements for risk management for the project. For example, the plan might specify that there should be a review of risks at each stage of the project (by the project team or project assurance team), and that significant risks should be recorded, together with details of the measures taken to eliminate or mitigate the risks.

### 32.10.2 Project planning: phases and tasks

#### Splitting a project into phases

A task of the project manager is to plan the work for the project, obtain the resources (staff, equipment and so on) to carry out the work and schedule the work so that the project is completed on schedule, or at the earliest possible time.

In order to plan and schedule the work for the project, it is necessary to identify all the tasks that have to be completed.

A first step in the identification of tasks is to identify the main stages of the project. Each stage should have an identifiable beginning and an identifiable end (a 'milestone'). In a typical IS/IT development project the main stages of the project may include the following:

| Stage | Starting point | Completion point (milestone) |
|---|---|---|
| **Project planning** | Project initiation document/ terms of reference | Project quality plan |
| **System analysis and design** | Project quality plan | Detailed system specification |
| **Programming** | Detailed system specification | Completion of system testing |
| **Database design** | Detailed system specification | Database design specifications and construction of database |
| **Implementation** | Completed system tests and database construction | Handover of system to the user/customer |

#### Breakdown of work into lower-level tasks

When the project has been divided into stages, each with its own identifiable beginning and end (milestone for achievement), the next step is to break down each stage into more detailed tasks, or 'lower level tasks.

For example, the systems analysis and design phase might include, as lower-level tasks:

(a) Systems analysis and the production of an outline system specification;

(b) Design of system input;

(c) Design of system output;

(d) Design requirements for individual programs (processing requirements); and

(e) File design.

A large number of lower-level tasks may be identified, although the number of tasks should be restricted. This is because the project manager will need to plan each task, and monitor its progress. Identifying too many tasks could make the job of the project manager too complex.

For each task, the project manager needs to:

(a) Estimate how much time will be needed to complete the task (measured, perhaps, in man-days or man-months); and

(b) Allocate each task to specific individuals or small groups.

### Work breakdown structure: Prince 2

**Definition: Work breakdown structure (WBS)**

A work breakdown structure (WBS) is a tool or technique for breaking the total work on a project into smaller and smaller parts, such as:

(a) the main stages of a project stages

(b) the lower-level tasks within each stage, and

(c) work packages, which are items of work within each lower-level task.

Work for each small part of the project can then be allocated to an individual or team. This helps managers to plan the work for the project and allocate each item of work to individual members of the project team.

**Example: Prince 2**

In the UK, a WBS system in common use for project planning is Prince 2. Prince stands for 'Projects in Controlled Environments'. It was first developed in 1989 by the UK government.

Prince 2 provides 'product breakdown structure' (PBS) for a project development. The project, which is seen as consisting of a number of 'products', is broken down from the top-down into smaller and smaller work packages. This enables the project activities to be identified within the context of work packages. Work packages are allocated to individuals

and teams. The project manager can then monitor the completion of each work package to control the project deliverables (including cost, time and quality).

### Dependencies between lower-level tasks

A problem with the scheduling of tasks and allocation of tasks to individual project team members is to prepare realistic estimates of how long each task might take to complete. There will be some uncertainty in the estimates.

Another problem is that many tasks in a project are inter-dependent. This means that some tasks cannot be started until other tasks have been completed. For example, program software cannot be written until the system has been specified. Programs cannot be tested until they have been written. A system cannot be implemented by the user until the files in the old system have been converted into files for the new system.

Some tasks can be carried out at the same time, in parallel with each other. For example, programming and database design may happen side-by-side. New equipment for the IT system can be procured whilst the system is being programmed and tested.

In order to schedule a project efficiently, so that it is completed in the shortest time possible (or by a target completion date), the project manager needs to identify the inter-dependencies between certain tasks.

Having specified the tasks to be completed, the resources required for each task, the estimated time to complete each task and the inter-dependencies between them, the project manager can prepare a schedule for the project. It is common to use planning tools or techniques to prepare this schedule. The most common planning tools are:

(a) **Network analysis** (also called critical path analysis); and

(b) **Gantt charts**.

### Project monitoring and control

The project manager has the primary responsibility for monitoring and control of projects during their development stage. However, the project manager is accountable to the project steering committee, or the project sponsor or the system user (the customer).

The project steering committee might appoint a **Project Assurance team**, to carry out an independent monitoring role. This team would discuss progress at regular intervals with the project manager. It should also satisfy itself that each milestone for the project has been successfully reached.

### Quality, time and cost

The main aspects of a project that should be monitored and controlled are quality, completion times and cost.

(a) The quality of the work carried out for the project development can be monitored by comparing actual achievements against the requirements that are set out in the project quality plan.

(b) The completion time for the project can be monitored by comparing the planned completion times for the critical path activities with the actual completion times.

(c) Costs can be monitored by comparing actual expenditure with budgeted expenditure, on a regular basis (for example, in monthly budgetary control reports).

### Monitoring completion times: slippage

A CPA chart can be used by the project manager to:

(a) Check whether the time-critical activities are being completed on schedule;

(b) Recognise by how much non-critical activities can be delayed without risking the completion time for the project as a whole;

(c) Recognise when the completion time for an activity has over-run the schedule (and there is 'slippage' in the timetable for completion) and analyse what the consequences of the slippage will be for the completion time for the entire project; and

(d) Allocate extra resources to time-critical activities if there is a risk of delay, or if the expected slippage is unacceptable.

### Amending a CPA chart

A CPA chart is a management tool to assist project managers with the control over the project completion time. If the chart gets out of date, because critical dates are missed, or because new estimates are prepared for the expected time to complete individual activities, the CPA chart can be updated and re-drawn.

It is important to remember that the CPA chart should have practical value. If it ceases to provide realistic information, it is no longer of any value to a project manager.

### Project management software

Project managers may use off-the-shelf project management software to help them to plan, monitor and control a project. The software enables project managers to use project management techniques with the assistance of a PC or laptop computer.

**Example: Project management software**

An example of project management software is Microsoft Project.

**Features of project management software**

Typically, project management software helps project managers to:

(a) Create a list of tasks for the project and their expected duration;

(b) Construct a CPA chart or a Gantt chart;

(c) Assign resources to each task;

(d) Prepare a budget for the project;

(e) Track the progress of tasks (and update the CPA chart from time to time);

(f) Record and monitor actual costs;

(g) Manage the documents for the project; and

(h) Prepare progress reports.

Software helps the project managers to amend plans more quickly, and prepare revised CPA charts and Gantt charts, and revised budgets.

It also helps managers to prepare better and more comprehensive project documentation.

**The main functions/benefits of project management software**

The main functions of project management software can be summarised as follows:

(a) To produce and edit CPA charts or Gantt charts easily. The project manager simply has to enter the activities, their interdependencies and their expected duration. The software will then construct the CPA chart or Gantt chart automatically. Charts can also be amended when project activities are changed. They can also be updated to the current position at any time during the project, for example when there has been slippage, so that the project manager can establish the current expected completion time for the project;

(b) To provide an accounting function for the project, by helping the project manager to prepare a budget, record actual expenditure and monitor actual costs against the budget; and

(c) To plan and monitor the use of resources on the project, particularly the number of staff working on the project. The project manager can enter the staff requirements for each activity, and the software will produce a detailed estimate of staff numbers required each day or week of the project. Where the resources required exceeds the resources available, the project manager can then use the software to look for ways of reducing staff requirements at peak times without affecting the overall project completion time, by:

   i. delaying the start of non-critical activities; or

ii. reducing the number of staff assigned to non-critical activities, and allowing these activities to take a longer time to complete.

**Managing the team**

As well as the technical team management responsibilities described above the team manager is also responsible for managing the team members. Responsibilities may include some or all of the below:

(a) Selecting personnel and building the team;

(b) Delegating roles and responsibilities;

(c) Motivating team members;

(d) Communicating information amongst the team;

(e) Rewarding the team; and

(f) Disciplining team members.

**Role of the accountant**

The numeracy and business skills of accountants are highly valued in project management. Project managers need to:

(a) Understand the economics of different options and decisions:

(b) Be able to forecast costs and profit;

(c) Generate accurate network analyses and Gantt charts;

(d) Use spreadsheets effectively; and

(e) Consider the impact of external factors as well as internal factors relevant to the project.

Accountants bring a wealth of business experience to projects and can be highly effective as either project managers or as advisors to project managers.

## 32.11 Chapter review

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

(a) explain the difference between Management Accounting and Performance management;

(b) Challenges of Performance Management;

(c) Current and contemporary issues in Performance Management;

(d) Implement performance management systems;

(e) Explain impact of IT on employer/employee relations;

(f) Identify problem areas: organisational impact analysis;

(g) Discuss system implementation;

(d) Explain feasibility study;

(e) Discuss cost-benefit analysis: costs and benefits;

(f) Explain project initiation;

(g) Discuss project planning: phases and tasks; and

(h) Explain project monitoring and control.

**Questions**

(a) There has been scholarly belief that performance management is the most recent trend in the advanced management accounting. Support this assertion with credible points defining the various performance management techniques and methods that heralded this trend.

(b) Performance Management is said to have developed from the inadequacies of management accounting. Is this assertion correct? If so justify it.

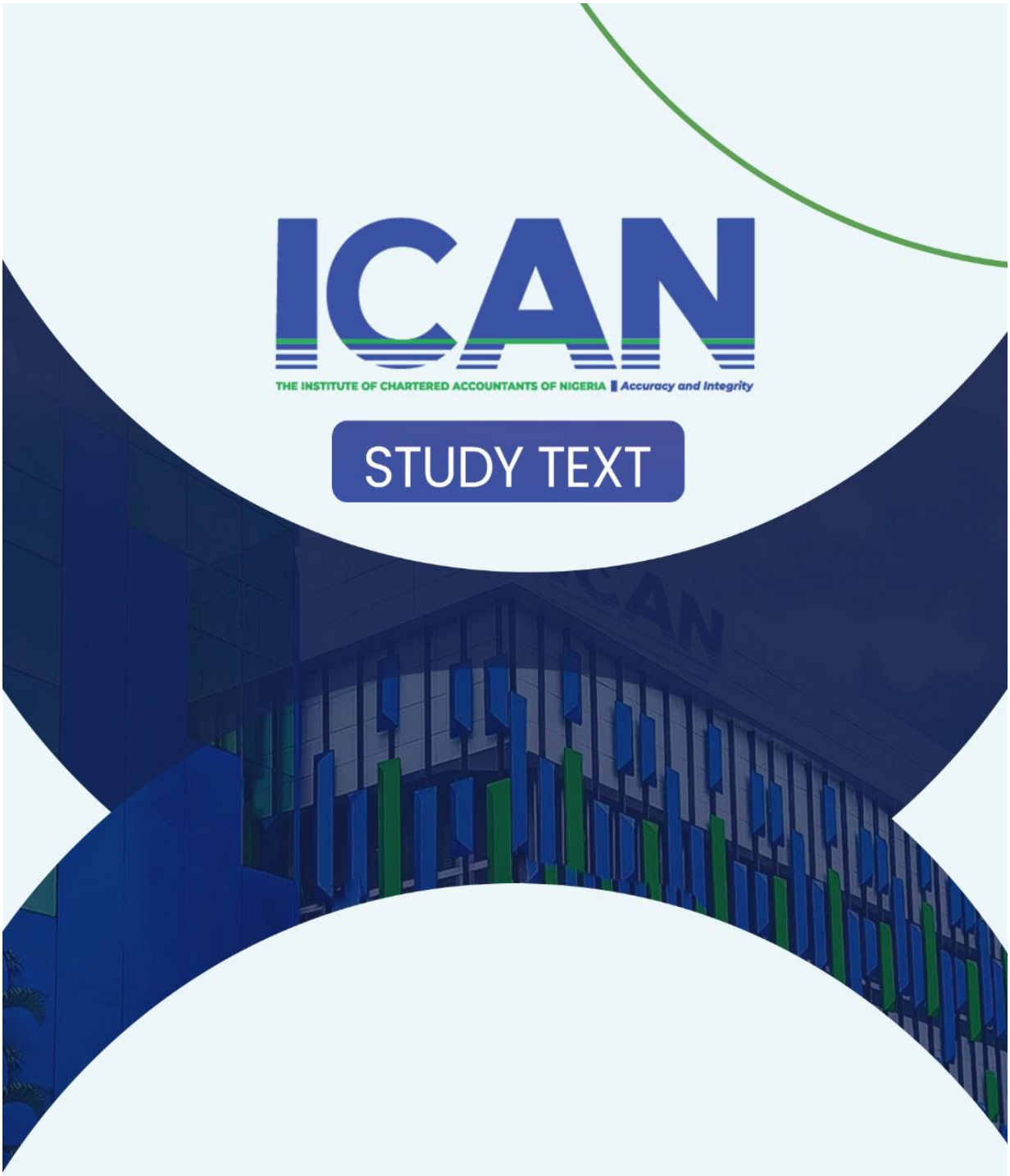
(c) What are the challenges that lend to the emergence of Performance Management.

(d) A key factor in the design of a performance management system is the way in which information is to be made available and accessible to the intended users. It is therefore advisable that Performance management systems should be designed in a way that makes information accessible in a convenient and helpful way. What are the important factors that must be considered in the design of a performance management system.

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# STUDY TEXT



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