1.0 LEARNING OBJECTIVES

After studying this chapter, readers will be able to understand:

- The scope and principles of management accounting;
- Management accounting as it relates to cost accounting and financial accounting;
- The techniques used in management accounting for planning, controlling, and decision-making;
- The roles of management accounting in an organisation; and
- The basic management accounting issues, namely: business objectives, goal congruence, etc.

1.1 DEFINITION OF MANAGEMENT ACCOUNTING

There are many definitions of Management Accounting by various organisations. However, that of the Chartered Institute of Management Accountants (CIMA) UK had gained general acceptance:

"Management Accounting - an integral part of management is concerned with identifying, presenting and interpreting information used for:

(a) Formulating strategy;
(b) Planning and controlling activities;
(c) Decision-making;
(d) Optimising the use of resources;
(e) Disclosure to shareholders and other external parties to the entity;
(f) Disclosure to employees; and
(g) Safeguarding assets".

The above ensures, according to CIMA, that there is effective:

(a) Formulation of plans to meet objectives (strategic planning);
(b) Formulation of short-term operational plans (budgeting / profit planning);
(c) Acquisition and use of finance (financial management);
(d) Recording of transactions (financial accounting and cost accounting);
(e) Communication of financial and operating information;
(f) Correction to align plans and results (financial control); and
(g) Reviewing and reporting on systems and operations (internal audit, management audit) (CIMA Terminology).

The Management Accounting Practices Committee (MAPC) of the National Accounting Association (NAA) in the United States defines Management Accounting as "the process of identification, measurement, accumulation, analysis, preparation, interpretation and communication of financial information used by management to plan, evaluate and control within an organization and to ensure appropriate use of and accountability for its resources".

Management accounting can also be defined as "the application of professional skills in the preparation and presentation of accounting information in such a way as to assist management in the formulation of policies and in the planning, and control of the operations of the undertaking" (Sizer 1996).

Management accounting also comprises the preparation of financial reports for non-management groups such as shareholders, creditors, regulatory agencies and tax authorities.

In the above definitions, we note that policy-making, planning and control are general descriptions of all the functions of management. It means that any information useful to managers which can be evaluated in monetary terms is regarded as management accounting responsibility.

In order to carry out this task efficiently, the management accountant will:
(a) Use data from the financial and cost accounting systems;
(b) Conduct special investigations to gather required data;
(c) Use accounting techniques and other appropriate techniques from statistics and operational research;
(d) Take into account human element in all activities; and
(e) Be aware of the underlying economic logic.

All of these will be done in order to produce information which is relevant for the intended purpose.

Management accounting assists management to plan, control and make decisions. The elements involved in the decision making, planning and control processes are as follow:
(a) Identify the objectives that will guide the business;
(b) Search for a range of possible courses of action that might enable the objectives to be achieved;
(c) Gather data about the objectives;
(d) Select appropriate alternative courses of action that will enable the objectives to be achieved;
(e) Implement the decisions as part of the planning and budgeting process,
(f) Compare actual and planned outcomes; and
(g) Respond to divergences from plan by taking corrective action. This will enable actual outcomes conform to planned outcomes or modify the plans, if the comparison indicates that the plans are no longer attainable.

1.2 COMPARISON OF MANAGEMENT ACCOUNTING, COST ACCOUNTING AND FINANCIAL ACCOUNTING

Cost Accounting can be defined as:

"The establishment of budgets, standard costs and actual costs of operations, processes, activities, or products and the analysis of variances, profitability or the social use of funds".

Financial accounting is defined as:

"The classification and recording of the monetary transactions of an entity in accordance with established concepts, principles, accounting standards and legal requirements and their presentation by means of profit and loss account, balance sheet and cash flow statements during and at the end of an accounting period" (CIMA).

The main differences between management accounting and financial accounting are as follow:

(a) Rules and regulations: Financial accounting reports adhere strictly to statutory (legal) requirements; For example, Companies and Allied Matters Act, 1990 (CAMA), professional pronouncements (ICAN) and accounting standards (SAS, IAS, IFRS). On the other hand, management accounting reports need not adhere strictly to these rules and regulations.

(b) Degree of details: Management accounting reports are much more detailed than Financial accounting reports. Whereas financial accounting report may show the total profit made by an organisation, management accounting report lays more emphasis on the department, branch, division or segment that contributes to the profit.
(c) **Time focus:** Management accounting reports are futuristic and predictive in nature, while financial accounting reports are historical.

(d) **Period of preparation of reports:** Financial accounting reports are usually rigidly prepared for periods such as monthly, quarterly, semi-annually or annually. On the other hand, management accounting report can be prepared anytime the management of the organisation needs it. Hence, its reporting periods are flexible.

(e) **Estimates and approximations:** Since management accounting reports are futuristic, they entail usage of estimates and approximations while in the case of financial accounting reports which are usually historical, the use of estimates and approximations are reduced to the barest minimum.

(f) **Objectives:** The objective of financial accounting report is stewardship while management accounting reports are used for planning, controlling and decision-making.

(g) **Inter-disciplinary relationship:** Management accounting relates to other courses. For example, Economics, Statistics, Psychology, Quantitative Techniques, Production Management, etc. On the other hand, financial accounting reports are prepared strictly in line with accounting standards and regulations.

(h) **Dual Concept:** Financial accounting is based on the dual concept of debit and credit while in management accounting, this is not necessary.

(i) **Taxation:** Management accounting is not prepared for taxation purposes while financial accounting is prepared for taxation purposes.

(j) **Monetary and non-monetary concept:** Financial accounting reports are expressed in monetary terms while management accounting reports are expressed in monetary and non-monetary terms.

1.3 **MANAGEMENT ACCOUNTING TECHNIQUES**

**Planning**

The management accountant's main contribution to planning lies in the preparation of budgets.

**Control**

Control, in the management sense, has been defined as "the process by which managers assure that resources are obtained and used effectively and
efficiently in the accomplishment of the organisation's goals”. As planning involves the setting of goals and objectives, control may be viewed as its counterpart in the management process.

Cost Control

The book keeping aspect of management accounting is a useful tool for cost control in small businesses. It facilitates a permanent record of costs incurred in conducting the business. It should be noted that the adequacy and reliability of accounting information contained in the records of the business concern are essential for successful planning and control. For instance, the record-keeping function may be viewed as a necessity for effective pricing decisions. If prices are set on the basis of full-cost plus mark-up, it is imperative that one has accurate information on the actual cost of the product to be sold. Similarly, even if market prices or market-adjusted prices are adopted, it is still essential to have a record of actual costs in order to determine the firm's profit margin. Clearly, the importance of accurate data for marginal pricing decisions is evident.

Standard Costing

The use of standard costs has the added advantage of encouraging a greater degree of cost-consciousness within the organization. Standards are set against which actual costs are compared, in order to determine variances from the standard. Unfavourable variances can be investigated in order to determine possible explanation for the deviation. In this manner, problem areas may be detected and dealt with expeditiously.

However, the benefit to be derived from a standard costing system must always be weighed against the cost of establishing it. Hence, one may discover that while standard costs may be effectively and efficiently employed within a small manufacturing firm, the relative costs of setting-up and implementing such a system for a local bakery may be prohibitive.

Credit Control

This is another area of great importance in management accounting. In the case of small businesses which operate strictly on cash basis, this area would appear to be unimportant. However, it is probably not uncommon to find that small retailer or manufacturer who supplies several regular customers will provide credit facilities as a normal part of trading activities.

In such instances, proper credit control is essential for ensuring that cash proceeds are realized on a timely basis. Appropriate credit terms, supplemented with accurate record keeping and skilful ratio analysis can enable the owner-manager to identify "bad-risk" customers and appropriate action.
Decision Making

Management accounting techniques are useful for effective decision making. An understanding of the concepts of relevant costs, cost-volume-profit relationships and the contribution approach to decision making may facilitate more efficient and effective decisions by enabling the immediate determination of relevant factors that have to be considered. Guidelines, such as the need to cover fixed costs or the concept of a positive contribution margin, are very helpful in making certain decisions as to whether to discontinue or continue a product line, make-or-buy, accept or reject, etc.

Financial Management

When the management accountant becomes a financial manager, he is a line manager, and use only management techniques. His cash and credit control are similar to production control, his internal audit, a form of inspection; while his cashier, wage and invoice clerks make up his work force.

Book-Keeping and Management Accounting

Book-keeping has become so much associated with accounting thinking. In the popular usage, many people use it to measure the worth of "accounting" in a book such as this. The fact is that management accounting is concerned with the economics of business rather than with the recording of past monetary accounting.

Uncertainty and Management Accounting

Management is concerned with the future and the only thing certain about the future is that it is uncertain. Management accountants should incorporate this uncertainty into their work, preferably in the form of probability assessment.

New Techniques in Management Accounting

It should be observed that a group of techniques has emerged in the world of management accounting. Some of these are as a result of using a mathematical approach to the measurement of economic performance and efficiency, and were developed in the field of operations research. These techniques include linear programming, and a range of probability-based techniques that embrace topics such as decision theory and queuing. Statistics also plays an important part in the work of the management accountants.
1.4 THE ROLES OF THE MANAGEMENT ACCOUNTANT

It is the duty of the management accountant to:

(a) Plan a profitable future for the business;
(b) Install and maintain an accounting system to monitor the performance of the business;
(c) Identify potential problems;
(d) Record transactions by producing accounting statements; and
(e) Generate information to meet the following requirements:
   (i) allocating costs between cost of goods sold and inventories for internal and external reporting;
   (ii) helping managers make better decisions; and
   (iii) planning, control and performance measurement.

1.5 BUSINESS OBJECTIVES

In order to assist management by providing information that aid decision-making and control, the management accountant must be aware of the firm’s objectives.

Profit Maximisation

Profit maximisation means maximising shareholders’ wealth. The reasons for identifying the maximisation of the present value of future cash flows as a major objective are because:

(a) It is equivalent to maximising shareholder’s value;
(b) It is unlikely that any other objective is as widely applicable in measuring the ability of the organisation to survive in the future;
(c) It is unlikely that maximising the present value of future cash flow can be realised in practice, it is still important to establish the principles necessary to achieve this objective; and
(d) It enables shareholders, as a group in the bargaining coalition, to know how much the pursuit of other goals is costing them by indicating the amount of cash required to achieve their objectives.
1.6 ALTERNATIVE GOALS

Although, profit maximisation may be a primary goal, shareholders may have secondary objectives, which may include:

(a) Maximisation of sales revenue or achieving a target level of sales, subject to a minimum profit constraint;

(b) Long term growth;

(c) Long term survival;

(d) Maintaining or increasing market value;

(e) Increasing the status of the firm; and

(f) Earning satisfactory (as opposed to maximum) profit. This is known as profit “satisficing.”

1.7 GOAL CONGRUENCE

One of the most important functions of management is to harmonise as far as is practicable the goals of the participants and sub-units with those of the organisation as a whole. This function is known as ‘goal congruence’.

The management accounting system should encourage all employees, including management to act in a manner which contributes to the overall objectives of the organisation, that is, the employee’s objective and the company’s objectives would in, ideal circumstances, coincide. The system and the approach adopted by the management accountant should motivate staff by means of genuine participation, good communication, and rapid feedback.

Goals of Groups other than Owners

An assumed objective of maximising the wealth of owners, to the exclusion of other groups in a firm has been widely criticised in recent years. It is argued that the firm is a coalition of groups, each pursuing its own objectives, and each of which is in a position to exert influence on those responsible for taking decision within the firm. Groups in the "coalition" might include the proprietors (shareholders in the case of limited liability companies), managers, trade unions, creditors, various employees and government. Groups other than the shareholders are able to exert pressure on the decision makers in the firm.
The Goals of Individuals
Individuals have their own personal goals. Similarly, groups of individuals that form the functional divisions of the business, identify their own goals. The sales manager will want to have large stocks of all products so that no customer is refused or has to wait long for delivery. The production manager will want to have long production runs to reduce set-up costs and training. The purchasing manager prefers to buy large quantities of materials, to take advantage of bulk discount and lower transport costs. The financial manager will want to maintain records of the working capital tied up in raw materials or finished goods stocks.

1.8 SUMMARY AND CONCLUSIONS
Management accounting has to do with the provision and interpretation of information, which help management in planning, controlling, decision-making and assessing performance.

The management accountant must be aware of the behavioural implications of his activities and information without losing sight of goal congruency.

Management accounting system is multi-disciplinary in nature in that statistics and operational research techniques may be utilised in the design process.

The Management accountant must reflect all uncertainties and variability of the situation because of the unpredictable nature of activities in the business environment.

The Management accountant should take into consideration the changing value of money due to the effects of inflation.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

1.9 REVISION QUESTIONS

1.9.1 MULTIPLE CHOICE QUESTIONS

(1) The primary objective of management accounting is __________

A to provide stockholders and potential investors with useful information to decision making.

B to provide banks and other creditors with information useful in making credit decisions.

C To provide management with information useful for planning and control of operations.
D To provide the Inland Revenue Service with information about taxable income.
E To assist the shareholders in security valuation.

(2) Management accounting and financial accounting differ in that management accounting information:
A is prepared, following prescribed rules
B is prepared, using a current data to influence the future.
C is prepared for stockbrokers.
D is prepared for the Internal Revenue Service.
E is historical in nature.

(3) Financial accounting is primarily concerned with providing information to all of the following, except:
A creditors such as banks and other financial institutions
B management of the firm
C the Securities and Exchange Commission
D stockholders of the company
E Inland Revenue Service

(4) The primary objective of an organisation should be to:
A maximise the firm's net worth
B maximise profits, using whatever conventional instruments necessary.
C maximise the firm's profit as long as the means used are legal.
D maximise the firm's profit using legal and ethical means.
E create employment to all stakeholders.

(5) Which of the following is NOT correct?
A Cost Accounting can be used for stock valuation to meet the requirement of internal reporting only.
B Management Accounting provides appropriate information for decision-making, planning, control and performance evaluation.
C Routine information can be used for both short-term and long-term decisions.
D Financial Accounting information can be used for internal reporting purposes.
E Cost Accounting is an integral part of management accounting.
1.9.2 SHORT ANSWER QUESTIONS

1. The application of professional skills in the preparation and presentation of accounting information in such a way as to assist the management to plan, control and make decisions is known as ____________

2. The classification and recording of the monetary transactions of an entity in accordance with established concepts, principles, accounting standards and legal requirements and their presentation by means of profit and loss accounts, balance sheets and cash flow statements, during and at the end of an accounting period is called ____________

3. "The establishment of budgets, standards costs and actual costs of operations, processes, activities or products and the analysis of variances, profitability or the social use of funds" is called ____________

4. State one area in which management accounting differs from financial accounting.

5. Identify ONE user of accounting information.

6. What is Goal Congruence?

7. State ONE technique used by management accountants.

8. State ONE objective of a profit-making organisation.

(Refer to Suggested Solution in Appendix I, page 443)
2

MANAGEMENT ACCOUNTING AND
MANAGEMENT INFORMATION
SYSTEMS

2.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

♦ Management information systems’ role in relation to management accounting;
♦ Management reports and feedback; and
♦ Information attributes.

2.1 MANAGEMENT INFORMATION SYSTEMS (MIS) AND CONTROL

Management information system as the term implies, is “a system of providing and communicating information, which will enable managers do their job.” The management accountant plays a vital role in assisting management to carry out the responsibilities of planning, controlling, communicating, decision-making, directing and organizing through the provision of management information. Thus, management information is vital to the role of management. The concern, is to consider whether there are any theoretical ‘rules’, ‘laws’, or ‘principles’ which can be applied to improve the quality of information provided at an acceptable cost.

This is relevant to the work of management accountants as a provider of information. It is important to state as follows:

(a) Managers must have information in order to do their work. Every organisation with managers must have an MIS which should:

(i) Be a good one or it might provide poor-quality information. In the long run, a poor MIS will result in poor management decisions; and
(ii) Be a formally designed and planned system or it might have grown up in any fashion. Whenever computers are used to provide information, there will probably have been some attempt at a formal design of, at least, part of the organisation’s MIS.

(b) The aim of management accounting should be to provide a carefully
designed, effective and efficient MIS. There are many ways, however, in which management accounting can be misleading. The awareness of the possible pitfalls is important.

2.2 MANAGEMENT ACCOUNTING REPORTS AND FEEDBACK

Management accounting provides information that is relevant to planning and control decisions, for example, budgetary control information, budgeting information, relevant costs for one-off decisions, and profitability reports for profit monitoring. Like any other MIS, this will help managers to plan and control the resources of their organization. Much of management accounting is concerned with the recording of actual costs for comparison with expectation or budget. This control information is known as ‘feedback’.

2.2.1 The Qualities of a good MIS

A good MIS needs to tell managers about the consumption of the organization’s resources and the revenues or other benefits from the use of those resources. It should provide quality information to managers at all levels in the management hierarchy.

2.2.2 Managers use information

(a) By relating them to other knowledge they already have; and
(b) By asking for other information before making a decision. Using information with reference to experience and knowledge is a quality of a good management.

2.2.3 Types of Information Necessary

A manager needs to know the types of information necessary for its intended purpose:

(a) What are his resources? Stock of raw materials, spare machine capacity, labour availability, the balance of expenditure remaining for a certain budget, target date for completion of a job.

(b) At what rate are his resources being consumed? For example, how fast is his labour force working? How quickly are his raw materials being consumed? How quickly are other expenses being included?

(c) How well are the resources being used? How well are his objectives being met? A manager uses resources based on the information given to him. The board of a company decides how
much of available funds should be allocated to any particular activity and the same problem faces the manager of a factory or department, or even a foreman, that is, which machines should be used, which men should be put on certain jobs, etc. Having used information to decide what should be done, a manager then needs feedback (or control information from environment) to decide how well it is being done.

2.3 COMPARISON BETWEEN DATA AND INFORMATION

The terms 'data' and 'information' are often used interchangeably. It is relevant to point out that data differs from information.

Data is defined as groups of non-random symbols which represent quantities, events, actions and things. Data is made up of characters which may be special symbols, alphabetic and numeric.

Information are data that have been processed and which are meaningful to the user. It must be of real or perceived value for its intended purpose. It also follows that what is information for one purpose or level in the organisation may be used as data for further processing into information for a different purpose and level.

Data can be gathered from both internal and external sources which are frequently derived from the day to day operations of the organisation.

It is pertinent to note that data which have been processed using specific identified techniques (planning, decision, controlling, etc.) are compared with alternatives generated in order to produce the required information which will be communicated to the user.

2.4 QUALITIES OF MANAGEMENT INFORMATION

Management information usually possesses the following attributes:

(a) **Accuracy**: The information must be communicated with sufficient confidence in its accuracy to enable the manager to make valid decisions.

(b) **Completeness**: The information to be given to the manager should be complete so that a decision is not made in ignorance of some of the key facts.

(c) **Timeliness**: Information should be produced at the right time so as to enable useful decisions to be taken.
(d) **Concise:** The manager should be provided with only the information which is useful for the purpose of his need and of a quantity for which he is capable of absorbing.

(e) **Clarity:** The information to be provided to managers should be readily intelligible. It must be devoid of ambiguity.

(f) **Cost/benefit analysis:** The cost of the information to be obtained should be less than the benefit to be derived from the information.

### 2.5 RISK AND INFORMATION PRESENTATION

Risk is present in all planning and decision making situations and may manifest itself as follows:

(a) The possibility of machine failure;

(b) The difficulties of forecasting inflation or exchange rates; and

(c) The effects of competition, changing tastes, government actions, etc.

It is important that the provider of information for planning and decision making purposes presents the information in a manner which helps the manager to understand the effects of risk on the problem being considered, and on the range of its possible outcomes.

The effects of uncertainties can be presented in reports, statements and analyses in the following ways:

(a) Results and outcomes are presented as ranges of values rather than single point estimates;

(b) Three points estimates (high, low and most likely) for analysis and presentation purposes are used;

(c) Probabilities are associated with the values and outcomes. This is because of its subjective nature. However, probability has been tested to provide possible valuable insights to the underlying risks;

(d) Sensitivity analysis may be used. This is a process by which the factors involved in the situation, for example, sales volume, cost per unit, selling price per unit and so on are varied one at a time and the effect on the outcome noted; and

(e) Confidence limits may be applied when forecasts are involved.
2.6 LEVELS OF INFORMATION

Levels of information within an organisation (as distinct from information provided by an organisation to external users, such as shareholders, the general public, pressure groups, competitors, suppliers, customers, etc.) can be analysed into three, namely:

(a) **Strategic Information**: This is used by top management to plan the organisation’s objective. Such information includes future market prospects, the availability and cost of raising new funds, total cash needs, etc. Note that strategic information is used by management for decision-making, that is, strategic planning.

(b) **Management Control Information**, also known as tactical information, is used by middle management to ensure that the resources of the business are efficiently and effectively used to achieve organisation’s objectives. Examples are productivity measurements (output per man hour or per machine hour); budgetary control or variance analysis; profit result within a particular department of the organisation; labour turnover statistics within a department; short-term purchasing requirements, etc. Please note that a large proportion of this information will be generated within the organisation as feedback and is likely to have an accounting emphasis. Tactical information is usually prepared regularly - perhaps weekly, or monthly (whereas strategic information is communicated irregularly).

(c) **Operational Information** is used by ‘front-line’ managers such as foremen or head clerks to ensure that specific tasks are planned and carried out properly within a factory or office. In the payroll office, for example, operational information relating to day-rate labour will include the hours worked each week by each employee, his rate of pay per hour, details of his deductions and, for the purpose of wages analysis, details of the time each man spent on individual jobs during the week. Operational information relates to a level of decision-making called operational control.

**Time scale for using Information**

"Historic" information might be used immediately for operational control but less frequently for management control and only rarely for strategic planning. Information can be collected and stored for future use, although, there will be a limit to its useful life.
Strategic planning may use information gathered over several years and associate it with current information from within the organisation and from the environment, so as to analyse past trends in order to predict the future.

Management control may also use information several years old to compare past and current performance.

Operational control information has a short life-span in the design of a management information system. Some thought must be given to how long information (or data) should be stored, and to what uses they will eventually be put. One advantage of computers has been its ability to store large volumes of data for a long period in a manageable space.

2.7 REPORTING BY EXCEPTION

There are physical and mental limitations to what a manager can read, absorb and understand properly before taking action. An enormous mountain of information, even if it is relevant, cannot be easily handled by a manager. Reports to management must be clear and concise and in many systems, control action, works basically on the “exception” principle. This is true of tactical information for management control.

Slight variations between actual result and the plan may be considered acceptable, and corrective action is only applied when results exceed established tolerable levels.

Information Flow

Information should be communicated to the managers who need to use it for control action. The structure of information flow, that is, how information is transmitted from where and to whom - is an important consideration in management information systems.

Information flow may be:

(a) Vertical (down or up), or

(b) Horizontal.

Vertical Communication

Communicating downwards, from superior to subordinate may be:

(a) Delegation of work, which involves giving information about objectives (job instructions);
(b) Information about procedures and practices in the organisation;

(c) Telling the subordinate what the role of his job is in relation to the objectives of the company as a whole, that is, job rationale;

(d) Informing the subordinate how well or how badly he is doing his job; and

(e) Indoctrination of the company's goals.

In practice, items (c), (d) and (e) are often neglected. The size of the downwards communication loop is normally very small between a superior and his immediate subordinate. Information may come from higher management, for example, statements about the goals of the organisation.

Although, communication from the top are often too general in character and too remote from what the employee thinks of as practical reality, to have any value.

Communicating upwards, from subordinates to superiors may be analysed into five types:

(a) Information by a subordinate about himself, his performance and his problems;

(b) Information about other employees and their problems;

(c) Comments about organisational practices and policies;

(d) Suggestions about what should be done and how it could be done; and

(e) Reports on what has been done.

It is normal for communication upwards to be restricted so that a subordinate deals with his immediate superior only.

This communication 'loop' will be larger if there is:

(a) A formal grievance procedure, that is, a channel for official complaints; and

(b) A formal suggestion procedure, that is, a system of encouraging suggestion for improvement from employees.
Because reporting upwards is usually very restrictive, there are many inherent communication problems and it is probable that bosses will be told either what they want to hear or what the subordinates want them to hear. The whole-hearted, well-informed support of all employees involved in producing information is essential to the success of a system. Filling-in time sheets, for example, can be done with widely differing attempts at accuracy by the people concerned.

**Horizontal Communication**

Horizontal communication is between people at the same hierarchical level in the organisation. It is necessary in two ways:

(a) **Formally:** To co-ordinate the work of several people and perhaps several departments, who have to co-operate to carry out a certain operation. For example, a production department manager or foreman might need to work in co-operation with a service department manager or foreman; and an accountant may require the help of a management scientist or statistician;

(b) **Informally:** To furnish emotional and social support to an individual or a course.

It is important that formal co-operation should not lead to a situation where a manager accuses another of boundary crossing. Horizontal communications should be an organised procedure or should be made only as a request for assistance, or as a response to such a request.

The information requirements of superiors and subordinates do not always coincide. What a subordinate wants to know is not always what a superior is prepared to convey to him and vice versa. The greater this conflict, the more the likelihood of horizontal communication as an escape value and also to get some essential work done which would not otherwise be properly performed.

### 2.8 TIMING OF INFORMATION

Information which is not available until after a decision is made will be useful only for comparisons and longer-term control.

The time value of information may be gauged by:

(a) The latest event (time) which the information covers, and

(b) The comparison control stage for which it will be used.
For example, weekly planning meeting in week two requires information about production in week one in order to influence control action by week three at the latest.

The criteria for the time value of information apply to both regular information (daily, weekly, monthly, etc) and adhoc information (which is gathered on request or at irregular intervals). In planning for the future, for example, management gives consideration to the 'planning horizon' on what resources will be required. Future planning calls for forecasts about the situation at that future date. To make the planning decision, management must have the information it requires first. If the information is late, there will be a delay in implementing the future plan.

Information prepared too frequently can be a serious disadvantage. If for example, a decision is taken at a monthly meeting about a certain aspect of a company's operations, information to make the decision is only required once a month, and weekly reports would be a time consuming waste of effort.

If control information is provided later than it should be, perhaps because control reports are too infrequent, then the consequence would be unnecessary losses that could have been avoided and would thus be a much more difficult job to get actual results back on the course for achieving targets.

Confidence/Risk

Information must be trusted by the managers who are expected to use it. An important problem, therefore, is how much uncertainty analysis should be incorporated into reporting systems, in order to make the information realistic. In the past, there has been a reliance on historic cost data and a reluctance to recognise uncertainty in estimating.

A pertinent issue in the design of a confidence information system is to decide from what source data should be collected and to what extent uncertainties in cost estimation and sales demand, etc. should be analysed. Historic costs provide valuable information for budgetary control but they have restricted value for both routine and once-only planning decisions.

Data generated by routine operations of the organisation can usually be collected easily and cheaply. Special information from non-routine data often requires a lot of planning and involves considerable expense, (much of it must be collected from sources outside the organisation). For this reason, accounting systems are often unable to supply non-routine data. This situation may change as data base information systems are developed with computer technology and non routine data can be stored and accessed should a special purpose arise. The use of probability distributions (perhaps from an analysis
of historic information) and expected values or sensitivity analysis, should feature in management accounting information more regularly than it does in practice at the moment.

A risk decision taker, who wishes to minimise his risk, for example, by taking a decision where the standard deviation of expected profit is low or by using the minimax cost or minimax regret criteria may value information more highly than a risk seeker, who may be content to base his decision on expected values only.

"Management accountants have the jobs of providing useful information to guide management planning and control decision and as the usefulness of quantitative decision models becomes more widely understood by managers, the demand for information as model inputs will grow" (Source: Report of the American Accounting Association Committee on Managerial Decision Model 1969).

## Sources and Comprehensiveness of Information

Production of large volume of information is not necessarily an advantage as the principle of exception reporting has already been described. Too much information will confuse rather than help the manager receiving it. Information, however, must not only be relevant and easily understood, but also needs to be detailed.

All sources from which relevant information may be obtained should be tapped and the sources may either be:

(a) Internal - from within the company; or

(b) External - from the external environment, including information about competitors.

## 2.9 VALUE OF INFORMATION

For information to have value, it must lead a decision-maker to take action which results in reducing costs, eliminating losses, increasing sales, better utilization of resources, prevention of fraud (audit requirements) or providing management with the consequences of alternative courses of action. Information which is provided but not used has no value.

A decision taken on the basis of information received has no actual value. It is only the action taken as a result of a decision which realise actual value of the information for a company.
Value may, therefore, be considered as:

(a) **Intrinsic:** Information has a value inherent in itself, for example, a company knows there is a new machine which could increase output by 30%.

(b) **Potential:** If a decision is taken to buy the machine in the example above, there is the possibility of making a certain profit and this is the potential values of the information.

(c) **Actual:** If the machine is bought, the actual extra profit earned will be the actual value of the information.

The expected value of information would be assumed to be the maximum amount, a user would be willing to pay for it. After the event, value measured in retrospect is of little value because it does not help the decision in advance as to whether the information is worth the cost of its collection. The information required for the preparation of statutory reports has a latent value because it prevents the consequences of what would happen if the company failed to produce them. The cost of collecting information bears no relation to its value. An item of information which leads to an actual increase in profit of N90 is not worth having if it costs N100 to collect it.

The cost of collecting information consists of:

(a) The costs of the MIS designers and installers; the wages and salaries of employee operating the system; professional fees, for example, consultancy fees;

(b) The costs of equipment used in the information system and supplies, such as, paper consumed; and

(c) Training costs;

Other aspects of information costs are:

(a) The cost and benefits of more accurate information; and

(b) The frequency of its provision.

**Value, Cost and Accuracy**

The greater the accuracy of information provided, the more it will cost. At high levels of accuracy, it is probable that the marginal costs of the extra accuracy will exceed its marginal benefit (value). It is most likely, therefore,
that management will be satisfied with imperfect information and would not expect perfection. The value of perfect information is the maximum amount a user would be prepared to pay for it, (Bayesian theory).

**Value and Frequency**

The value of information must relate to the frequency of its provision and to the level in the management hierarchy where it is sent and used:

(a) Front-line supervisors need more regular control information perhaps weekly or daily: and

(b) Middle managers and senior managers might need information less frequently, say monthly, half yearly or yearly.

The benefits (value) from feedback of control information are usually a once only gain. Once the fault has been identified and put right, there should be no scope for further improvement, and repeated feedback of control information should be of little value until the system gets out of control again. Arguably, continuous monitoring and reporting may be unnecessarily costly. At the very least, the principle of reporting by exception should be used.

The value of information also relates to:

(a) The ability of the receiver to understand it and use it;

(b) The purpose or decision for which it is intended to help; and

(c) The quality and availability of other information from different sources as complements.

A user will value information more if it changes his decision from what it would otherwise have been to a more optimal decision on the basis of the information provided.

2.10 **COMPUTERS (INFORMATION TECHNOLOGY)**

Computers enable more data to be processed than would be possible by manual methods, and in most mid-sized companies, a management information system depends, at least to some extent, on their use. The costs of computers are high and it is necessary to decide whether the values of information which would be obtained using them is worth the cost of their installation and operation.

Although, computers often justify their expense, there may always be some areas, where their application will be uneconomical. If a detailed study of
costs and value is made, it will be clear where computer could be used to advantage. No company should embark on a programme to develop a major computer information system except to meet a specific properly evaluated need. It is also necessary to remember that although computers can process large volumes of data quickly, the information actually reported to management should be concise and selective. A computer should be a means of transforming a mass of data into key facts on which action should be taken.

2.11 CLASSES OF REPORTS

Management Report

This refers to various statements prepared solely for the use of management, for example, the budget, sales reports, etc. Management reports have no set standards and format.

Corporate Report

(a) **Objective**: the fundamental objective of corporate reports is to communicate economic measurements or an information about the resources and performance of the reporting entity useful to those having reasonable rights to such information.

(b) **Users of corporate reports**

This includes:

(i) Management;
(ii) Existing and potential shareholders;
(iii) Existing and potential holders of debentures and loan, providers of short-term loans and finance;
(iv) Labour unions and employees, including existing, potential and past employees;
(v) Financial and investment analysts;
(vi) Government and government agencies;
(vii) Auditors;
(viii) The public at large; and
(ix) Competitors.

(c) **Corporate Reporting in Nigeria**: Under The Companies and Allied Matters Act, 1990, as amended, the directors of a company are required to prepare annually and to lay before the shareholders in general meeting, audited accounts, together with a report by the directors.

(d) **Contents of the Annual Report**: The contents of the annual report and accounts of a company can broadly be categorised as those complying with the requirements of professional bodies or industry associations, standards and other regulatory framework or laws.
In addition to information falling under broad categories, it is common to find, in a company's annual report and accounts, certain information which are published, not because it is required by law or by any professional organisation but as a matter of commercial convention and prudence. An example of this is the chairman's statement.

The published annual report and accounts of companies usually consist of the following:

(a) The Chairman's statement.
(b) The Director's report.
(c) Basic financial statements, that is:
   (i) The statement of accounting policies;
   (ii) The balance sheet;
   (iii) The profit and loss account; and
   (iv) The notes on the accounts;
(d) A statement of cash flow.
(e) The auditors' report.
(f) The Audit Committee's report.
(g) A statement of value added. In some cases, this is presented in the form of pictorial illustration.
(h) A five year financial summary.
(i) Some other information such as directors shareholdings and shareholders with more than 10% of the equity shares.
(j) An employment report.
(k) A statement of transactions in foreign currencies; and
(l) A statement of the future prospect.
2.12 SUMMARY AND CONCLUSIONS

Management accounting is but one facet of the general information system of a firm.

Information is managed in order to ensure speed, accuracy, filing and retrieval abilities, and decision making capabilities.

Various packages are utilised for the purpose of managing information and they include: executive information system which permits rapid information retrieval and work by exception reporting and ‘drilling down’ the data and sensitivity analysis which ensures the assessment of the effects of uncertainty.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

2.13 REVISION QUESTIONS

2.13.1 MULTIPLE CHOICE QUESTIONS

1. Which of the following is always a desirable quality of management accounting information?
   A Instant availability
   B Complete accuracy
   C Brevity
   D Understandability
   E Volume

2. Which of the following is CORRECT?
   A Data can be either discrete or continuous
   B Operational information gives details of long-term plans only
   C Information can only be extracted from external sources.
   D Qualitative data is numerical information only.
   E Data and information are the same thing.

3. The published annual report and accounts of companies usually consists of the following EXCEPT:
   A The Auditor's report
   B An employment report
   C A statement of the future prospect
   D The Director's report
   E A disclaimer report

4. The structure of information flow within an organisation may be:
   A Direct or indirect
   B Controllable or uncontrolled
   C Vertical or horizontal
   D Historical or futuristic
   E Variable or fixed

5. Communicating upwards in an organisation will include all EXCEPT
   A information about others and their problems
B in doctrinations of the company's goals.
C Comments about organizational practices and policies
D suggestions about what should be done and how it could be done.
E reports on what has been done.

2.13.2 SHORT ANSWER QUESTION

1. An information in a management accounting system is considered relevant and appropriate, if it is useful for ________, ________ and decision making.

2. Information flow may be ________ or ________

3. Management control information is also referred to as ________

4. Tactical information is used by management to plan organisation objective. True or False.

5. The information used by senior managers to plan the objectives of their organisations and to assess whether the objectives are being met in practice is called ________

(Refer to Suggested Solution in Appendix I, page 443)
3

COST ESTIMATION AND BEHAVIOUR

3.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

- The importance of studying cost behaviour;
- The definition of a variable cost in linear and non-linear forms;
- The techniques used in cost estimation and prediction; and
- How inflation affects costs.

3.1 IMPORTANCE OF COST BEHAVIOUR

The study of the behaviour of costs has to do with the classification of costs which form the basis for the prediction of the future level of activity. Costs can be categorised into: Variable, fixed and semi-variable.

3.1.1 The Level of Activity

The level of activity constitutes the main basis for forecasting costs especially where changes or future changes are to be measured.

The level of activity can be viewed in several ways, for example, tonnage produced, standard or predetermined hours required, bed space occupied, grammage of stock used, kilometres covered per hour, passenger per bus, etc.

3.1.2 Cost Behaviour and Range of activity level

The ability to be able to classify cost or determine the behaviour of costs and the utilization of the range of activity level to predict future cost becomes difficult because of changes in production systems/methods, technology, personnel, etc.

Therefore, in order to give effect to planning and decision making efforts, which are short-term oriented, it is necessary to look at the behaviour of costs on short term basis in order to determine the
relationship between cost and the level of activity as well as the categorisation of the costs which may also be a function of the peculiar situation.

3.2 VARIABLE COST

A variable cost (VC) is defined as:
"A cost which varies with the measure of activity”. (CIMA)

Variable Cost Behaviour

Variable cost can be analyzed into two main groups: Linear and non-linear or curvilinear.

(a) Linear Variable Cost

This is the easiest way of showing the relationship between total variable cost and output as a straight line graph thus:

![Graph showing linear variable cost]

Fig 3.1 Linear variable cost

In order to ensure easy computation and analysis, the linearity is expressed algebraically as:

\[ \text{cost} = b(x) \]

where: \( x \) = volume of output in units/hours

\( b \) = a constant representing the variable cost per unit.

**ILLUSTRATION 3-1**

The materials contained in each Assembly of WAZOBIA are:
6kgs of material A at ₦2.50 each
30 kgs of material B at ₦4.00 each
16 kgs of material C at ₦3.00 each

What is the expected variable cost of materials for producing 80 Assemblies?
**SUGGESTED SOLUTION 3-1**

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 kgs of material A at ₦2.50</td>
<td>₦15.00</td>
</tr>
<tr>
<td>30 kgs of material B at ₦4.00</td>
<td>₦120.00</td>
</tr>
<tr>
<td>16 kgs of material C at ₦3.00</td>
<td>₦48.00</td>
</tr>
<tr>
<td>TC per Assembly</td>
<td>₦183.00</td>
</tr>
<tr>
<td>Total VC = ₦183 x 80</td>
<td>₦14,640</td>
</tr>
</tbody>
</table>

(b) **Non-Linear or Curvilinear Variable Costs**

The non-linear cost curve establishes the relationship between output and variable cost as that of a curved line on a graph. This can be shown in two ways, thus:

- **convex** - where each extra unit of output causes a less than proportionate increase in cost.
- **concave** - where each extra unit of output causes a more than proportionate increase in cost.

![Fig 3.2 Non-linear variable cost](image)

Fig 3.2 Non-linear variable cost

A situation whereby an additional increase in the input of raw materials in the production process, results in a proportionate decrease in output will result in a convex cost function.

**Non-Linear Variable Costs - the Parabola**

A curve is referred to as a parabola in a situation whereby changes in the level of output brings about a uniform change in the gradient of the cost function. It can be shown algebraically thus:

\[
\text{Cost} = bx + cx^2 + dx^3 + \ldots px^n
\]

Where \(x\) = volume of output in units
b, c, d, ...... p = constants representing the variable cost per unit.

**ILLUSTRATION 3-2**

Analysis of cost and activity records for a project shows that the variable cost can be accurately represented by the function:

\[
\text{Cost} = b(x + cx^2 + dx^3)
\]

Where \( b = 10 \), \( c = 0.7 \) and \( d = 0.08 \).

**Calculate:**
(i) Variable cost when production is 20 units.
(ii) Variable cost when production is 25 units.
(iii) Is the function convex or concave?

**SUGGESTED SOLUTION 3-2**

(i) \[
\text{Cost} = 10(10 \times 20) + (0.7 \times 20^2) + (0.08 \times 20^3) = \mathbf{1120}
\]

(ii) \[
\text{Cost} = 10(10 \times 25) + (0.7 \times 25^2) + (0.08 \times 25^3) = \mathbf{1937.50}
\]

(iii) It will be seen that a slight increase in activity from 20 to 25 units results in almost doubling of variable cost. This shows that there is a more than proportionate increase in the unit cost of extra production. Therefore, the function is concave.

**3.3 FIXED COST**

A fixed cost is defined as:
"A cost which is incurred for an accounting period, and which, within certain output or turnover limits tends to be unaffected by fluctuations in the level of activity (output or turnover)” (CIMA).

A fixed cost can also be referred to as a period cost.
Since fixed costs are a function of time, they do not respond to changes in activity levels. Therefore, changes in cost are not related to changes in the volume of activity within a given range of activity. Fixed cost increased or stepped up only after a range of activity and not at every level of activity.

Even though, fixed costs can be depicted on a graph, it can also be shown algebraically as: \( = 'a' \)

Where 'a' is fixed.
3.4 SEMI-VARIABLE COSTS

This type of cost can be defined as:
“A cost containing both fixed and variable components and which is thus partly affected by a change in the level of activity”, (CIMA).

Examples of semi-variable cost are: NEPA bill, NITEL telephone bills, Water rate, and some GSM operators’ bills.

Fig 3.4: Semi-variable cost

Semi-variable costs can also be expressed algebraically by bringing together the expressions for variable cost and fixed cost thus:
Linear Semi-variable cost = a + bx:
where ‘a’ represents fixed cost, b represent the unit variable cost and x
represents the level of activity.

Non-linear semi variable cost = a + bx + c\(x^2\) + d\(x^3\) + ... + px^n

**ILLUSTRATION 3-3**

A breakdown of maintenance costs of packaging department of Uzuh Limited
shows that there is a fixed element of ₦5,000 per month and a variable
element related to hours amounting to ₦6.00 per machine hour.

What is the expected cost for a month when the planned activity level is
(i) 2,500 machine hours,
(ii) 3,000 machine hours?

**SUGGESTED SOLUTION 3-3**

(i) Total cost = a + bx
= ₦5000 + (₦6.00 x 2500)
= ₦20,000

(ii) Total cost = ₦5,000 + (₦6.00 x 3000)
= ₦23,000

(Alternatively, since the variable costs will change between 2,500 and 3,000
hours, then the total cost can be computed as follows):
= ₦20,000 + 500 (6) = ₦23,000.

**3.5 COST ESTIMATION**

Cost estimation is a term used to describe the measurement of historical cost
with a view to helping in the prediction of future costs for management
decision making, that is, historic information is analysed to provide estimates
on which to base future expectations.

Mixed costs can be separated into their fixed and variable elements, using a
variety of techniques. Some techniques are more sophisticated than others,
and, therefore, likely to be more reliable, but in practice, the simpler
techniques are more commonly applied.

**3.5.1 Techniques Used in Prediction / Estimation**

(a) The account classification method / account analysis techniques
(b) The high - low method or the range method.
(c) Scatter graph.
(d) Regression Analysis.

3.5.2 (a) Account Classification Method

This is the examination of each item of expenses which involves classifying it into variable, and fixed cost using the subjective judgment of the Accountant.

Advantages
(i) It is fast and inexpensive.
(ii) It is simple and easy to understand.
(iii) It can be revised regularly to account for changes in cost structure or cost classification.

Disadvantages
(i) The initial classification has considerable subjective element.
(ii) It relies on a single observation to determine the cost function.
(iii) It is based on past costs.
(iv) Separation of semi-variable cost into its fixed and variable component is arbitrary.

ILLUSTRATION 3-4

The following data are the actual costs of Danjuma Manufacturing Limited for the month of August 2008:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material</td>
<td>2,680</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>3,990</td>
</tr>
<tr>
<td>Supervising labour</td>
<td>300</td>
</tr>
<tr>
<td>Factory Rent and Rates</td>
<td>700</td>
</tr>
<tr>
<td>Fuel and Power</td>
<td>1,140</td>
</tr>
<tr>
<td>Costing office</td>
<td>670</td>
</tr>
<tr>
<td>Maintenance</td>
<td>330</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1,200</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1,560</td>
</tr>
</tbody>
</table>

The production for the month of August were 220 units. You are required to:
(a) Determine the variable cost per unit.

(b) Determine the total fixed cost using Account Analysis Method.

(c) Determine what the costs would be in September, if the production is 150 units.

**SUGGESTED SOLUTION 3-4**

Accounts classification method/Account analysis technique

<table>
<thead>
<tr>
<th></th>
<th>Total Cost</th>
<th>Fixed Cost</th>
<th>Variable Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Material used</td>
<td>2,680</td>
<td>-</td>
<td>2,680</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>3,990</td>
<td>-</td>
<td>3,990</td>
</tr>
<tr>
<td>Supervisory labour</td>
<td>300</td>
<td>300</td>
<td>-</td>
</tr>
<tr>
<td>Factory Rent &amp; Rates</td>
<td>700</td>
<td>700</td>
<td>-</td>
</tr>
<tr>
<td>Costing office</td>
<td>670</td>
<td>670</td>
<td>-</td>
</tr>
<tr>
<td>Fuel &amp; Power</td>
<td>1,140</td>
<td>-</td>
<td>1,140</td>
</tr>
<tr>
<td>Maintenance</td>
<td>330</td>
<td>-</td>
<td>330</td>
</tr>
<tr>
<td>Depreciation</td>
<td>1,200</td>
<td>1,200</td>
<td>-</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>1,560</td>
<td>1,560</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,570</strong></td>
<td><strong>4,430</strong></td>
<td><strong>8,140</strong></td>
</tr>
</tbody>
</table>

(a) Variable cost per unit  \[= \frac{8140}{220} = \text{N} 37 \text{ per unit}\]

(b) Total fixed cost  \[= \text{N} 4,430\]

(c) Cost Function  \[= a + bx\]
\[= 4430 + 37x\]
\[= 4430 + (37 \times 150)\]
\[= 4430 + 5550\]
\[= \text{N} 9,980\]

(b) **High-Low Method / Range Method**

By this method, a check is made of historic costs in previous accounting periods, and the costs in the two particular periods are selected for cost estimation, namely:

(i) the period with the highest volume of output;
(ii) the period with the lowest volume of output (Note: the periods with the highest/lowest output may not be the periods of highest or lowest cost).

Where inflation makes the costs in each period incomparable, costs should be adjusted to the same level by means of a price level index.

The difference between the total cost of the high output and the total cost of the low output will be the variable cost of the difference in output level.

**ILLUSTRATION 3-5**

The costs of operating the maintenance department of a computer manufacturer, for the last five months is as follows:

<table>
<thead>
<tr>
<th>Month: Jan</th>
<th>Cost</th>
<th>Production volume (standard hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb</td>
<td>125,000</td>
<td>7,000</td>
</tr>
<tr>
<td>Mar</td>
<td>104,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Apr</td>
<td>121,000</td>
<td>8,000</td>
</tr>
<tr>
<td>May</td>
<td>125,000</td>
<td>8,500</td>
</tr>
</tbody>
</table>

What cost should be expected in month 6 when output is expected to be 10,000 standard hours? Ignore inflation.

**SUGGESTED SOLUTION 3-5**

(i) High output

*Output*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>Cost</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>High output</td>
<td></td>
<td>8,500 hours: total cost</td>
<td>125,000</td>
</tr>
<tr>
<td>Low output</td>
<td></td>
<td>5,000 hours: total cost</td>
<td>104,000</td>
</tr>
<tr>
<td>Total Variable cost of</td>
<td>3,500</td>
<td>=</td>
<td>21,000</td>
</tr>
</tbody>
</table>

Variable cost per standard hour

\[ \frac{N21,000}{3,500} = N6.00 \]

(ii) Substituting in either the high or low cost:

<table>
<thead>
<tr>
<th></th>
<th>High (8,500)</th>
<th>Low (5,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost</td>
<td>125,000</td>
<td>104,000</td>
</tr>
<tr>
<td>Variable costs (8,500 x 6)</td>
<td>51,000</td>
<td>(5,000 x N6)</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>74,000</td>
<td>74,000</td>
</tr>
</tbody>
</table>

(iii) Estimated total cost of 10,000 standard hours of output:
<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs</td>
<td>74,000</td>
</tr>
<tr>
<td>Variable costs (10,000 x 6)</td>
<td>60,000</td>
</tr>
<tr>
<td></td>
<td><strong>134,000</strong></td>
</tr>
</tbody>
</table>

**Advantages of High and Low Method**

(i) It is relatively simple to operate.

(ii) It is a quick and inexpensive method of determining the underlying relationship of cost and level of activity.

(iii) It is not subjective.

**Disadvantages of High and Low Method**

(i) It ignores any information between the two extreme observations.

(ii) When the extreme points are not typical, the function calculated will reflect an abnormal rather than normal cost function (i.e. a situation whereby there is no relationship between the level of activity and the costs).

(iii) It is not fully representative, because it does not make use of the whole of the available data.

**ILLUSTRATION 3-6**

You have been asked to prepare an analysis between fixed and variable costs in your department. The power costs do not seem to fit into either category easily. The details are as follows:

<table>
<thead>
<tr>
<th>Week</th>
<th>Power cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3,600</td>
</tr>
<tr>
<td>2</td>
<td>3,950</td>
</tr>
<tr>
<td>3</td>
<td>3,050</td>
</tr>
<tr>
<td>4</td>
<td>3,380</td>
</tr>
<tr>
<td>5</td>
<td>3,870</td>
</tr>
<tr>
<td>6</td>
<td>4,020</td>
</tr>
<tr>
<td>7</td>
<td>2,095</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Machine hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,000</td>
</tr>
<tr>
<td>9,000</td>
</tr>
<tr>
<td>6,500</td>
</tr>
<tr>
<td>7,400</td>
</tr>
<tr>
<td>8,600</td>
</tr>
<tr>
<td>9,200</td>
</tr>
<tr>
<td>3,700</td>
</tr>
</tbody>
</table>

**You are required to:**

(i) Separate the cost, finding the closest estimate of the element and the variable cost per machine hours, using High and low method.
(ii) Estimate the total cost likely in week 8 if the expected level of machine hours is 8,000.

SUGGESTED SOLUTION 3-6

(i) | Level of activity | Cost |
    | Hrs. | N |
    | Highest | 9,200 | 4,020 |
    | Lowest | 3,700 | 2,095 |
    | Total Variable | 5,500 | 1,925 |

The variable cost per unit = \( \frac{1,925}{5,500} = N\ 0.35 \)

Using the linearity cost function of \( Y = a + bx \), the fixed cost element can be determined by either using the highest level data or lowest level data.

For this solution, let us use the highest level:

\[ Y = a + bx \]

\[ 4020 = a + 0.35 \times 9,200 \]

\[ 4020 = a + 3,220 \]

Therefore \( a = 4,020 - 3,220 = 800 \)

The cost function is \( Y = 800 + 0.35x \)

(ii) The total cost likely in week 8 can be determined thus:

\[ Y = a + bx \]

\[ Y = 800 + 0.35 \times 8,000 \]

\[ Y = 800 + 2,800 \]

\[ Y = N\ 3,600 \]

ILLUSTRATION 3-7

Musa Youth Chairman Limited has the following total costs at two activity level:

Activity Levels (Units) 17,000 22,000
Total Cost (N) 140,000 170,000

Variable cost per unit is constant in this range of activity and there is a step up of N 5,000 in the total fixed costs when activity exceeds 18,000 units.

Required:
What is the total cost at an activity level of 20,000 units?
SUGGESTED SOLUTION 3-7

MUSA YOUTH CHAIRMAN LIMITED

<table>
<thead>
<tr>
<th>Units</th>
<th>Costs N</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>22,000 (N170,000 - N5,000)</td>
</tr>
<tr>
<td>Low</td>
<td>17,000</td>
</tr>
<tr>
<td>Total Variable Cost of</td>
<td>5,000</td>
</tr>
</tbody>
</table>

The variable cost per unit = \[ \frac{25,000}{5,000} = 5.00 \]

At 17,000 units Total Fixed Costs = N140,000 - (N5 x 17,000) = N140,000 - N85,000 = N55,000

OR

At 22,000 units, Total Fixed Costs = N170,000 - (N5 x 22,000) = N170,000 - N110,000 = N60,000

Therefore, total cost at 20,000 units

= Total Fixed Costs + Total Variable Costs

= N60,000 + (N5 x 20,000)

= N60,000 + N100,000

= N160,000

The Effect of Inflation

When two or more years are compared to determine the variable cost and fixed cost for estimation, it is likely that the price index might have changed, hence, there is need to adjust for the effect of inflation before arriving at the variable cost and fixed cost for prediction purposes.

ILLUSTRATION 3-8

Production and cost data of Aliyu Jari Limited have been recorded over two years thus:

<table>
<thead>
<tr>
<th></th>
<th>Last year</th>
<th>Current year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>60,000 units</td>
<td>64,000 units</td>
</tr>
<tr>
<td>Total costs</td>
<td>N1,820,000</td>
<td>N1,961,400</td>
</tr>
</tbody>
</table>

Between last year and the current year, there has been 5% cost inflation.
**Required:**

(i) Calculate the real fixed and variable costs.

(ii) Estimate what the total cost will be next year when it is expected that there will be a 4% cost push inflation and output will be 70,000 units.

**Suggested Solution 3-8**

(i) Eliminate the inflation effects from data supplied:

Current year cost in real terms = \( \frac{\text{Current year actual costs}}{\text{Inflation rate} + 1} \)

\[ \frac{1,961,400}{1.05} = \text{₦1,868,000} \]

Find the fixed/variable cost from the real cost and production differences

<table>
<thead>
<tr>
<th>Production units</th>
<th>Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current year</td>
<td>64,000</td>
</tr>
<tr>
<td>Last year</td>
<td>60,000</td>
</tr>
<tr>
<td>Difference</td>
<td>4,000</td>
</tr>
</tbody>
</table>

(ii) Variable cost per unit = \( \frac{48,000}{4,000} = \text{₦12} \)

Fixed cost:

- High: \( \text{₦1,868,000} \)
- Total Variable Cost \( (64000 \times \text{₦12}) \): \( \text{₦768,000} \)
- Fixed cost: \( \text{₦1,100,000} \)

(iii) Cost of 70,000 units = \( \text{₦1,100,000} + \text{₦12} \times 70000 \) = \( \text{₦1,940,000} \)

Taking inflation into account = \( \text{₦1,940,000} \times 1.04 \times 1.05 = \text{₦2,118,480} \)

**Illustration 3-9**

Nyong Ltd. has computed its total factory overhead at high and low levels of activity to be as follows:

<table>
<thead>
<tr>
<th>Levels of activity</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Labour</td>
<td>50,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Total Factory cost</td>
<td>142,000</td>
<td>176,250</td>
</tr>
</tbody>
</table>
Assume that, the factory overhead cost above consists of direct materials, rent and maintenance expenses, the company has analysed at the 50,000 direct labour hours of activity and has determined that at that level the cost exist in the following proportions:

\[
\begin{array}{cc}
\text{Indirect materials (variable)} & 50,000 \\
\text{Rent (fixed)} & 60,000 \\
\text{Maintenance} & 32,000 \\
\hline
\text{Total} & 142,000
\end{array}
\]

For planning purposes, the company wants to break the maintenance cost into its variable and fixed elements.

Required:
(i) Determine how much of the N176,250 factory overhead cost at the high level of activity above consist of the maintenance cost.

(ii) By means of high and low points method of cost analysis, determine the cost function for the maintenance cost.

**SUGGESTED SOLUTION 3-9**

\[
\begin{array}{cc}
\text{(i) Indirect material} & \frac{(N50,000 \times 75,000)}{50,000} = 75,000 \\
\text{Rent (fixed)} & 60,000 \\
\text{Maintenance cost} & = N(176,250 - 135,000) \\
& = N 41,250 \\
\hline
\text{Total} & 142,000
\end{array}
\]

(ii) Using the high and low points' method, the cost function can be determined thus:

<table>
<thead>
<tr>
<th>Level of Activity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>75,000</td>
</tr>
<tr>
<td>Low</td>
<td>50,000</td>
</tr>
</tbody>
</table>

The rate of variability = \( \frac{N8,750}{25,000} = 0.35 \)

(iii) The total cost is:

\[ y = a + bx \]

\[ 41,250 = a + 0.35(75,000) \]

\[ a = 41,250 - 26,250 = N 15,000 \]
the cost function for the maintenance cost, therefore, becomes:
$$y = 15,000 + 0.35(x)$$

(c) **Scatter Graph Technique**

This is a visual technique which co-ordinates the cost and the level of activity of historical records for a period of time and are plotted on a graph. At the point of interception with the cost axis, the fixed cost emerges. The gradient of the line represents the rate of change of cost with activity level which is variable cost.

![Graph](image)

Thus: variable element = ₦8.50

Therefore, the estimated cost function using the line of best fit

$$= 100 + 8.5x$$, where \( x \) = units of output.

The scatter graph technique is simple and convenient but clearly no claims can be made for its accuracy.

(d) **Regression Analysis Technique**

This is a statistical technique that is based on historical data. If it involves one independent variable, it is called "Simple Regression; whereas when the use of more than one independent variables is involved, it is referred to as "Multiple Regression". However, the least square regression analysis is determined by the formulae as follows;

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

\( x \) = independent variable  
\( y \) = dependent variable  
\( \sum \) = Summation  
\( n \) = is the number of pairs of data for \( x \) and \( y \)

**Advantages of Regression Analysis**

(i) Line of best fit can be easily recognised and could be extended through the use of multiple regression analysis.

(ii) It uses the whole data, unlike the accounts classification and high and low methods.

(iii) It assists in the use of computers and electronic calculation.

**Disadvantages of Regression Analysis**

(i) A reasonable number of observations are required.

(ii) The elimination of non-random variables can reduce the available data and frustrate any attempt to fix the curve statistically to the observation.

(iii) A true relationship may not be linear, it may be curvi-linear.

**ILLUSTRATION 3-10**

Costs in the repairs and maintenance department of Hanatu Sambo Ltd in previous periods have been recorded as follows:

<table>
<thead>
<tr>
<th>Period</th>
<th>Output (Standard hours of production)</th>
<th>Repair and maintenance costs (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,400</td>
<td>6,400</td>
</tr>
<tr>
<td>2</td>
<td>2,300</td>
<td>6,400</td>
</tr>
<tr>
<td>3</td>
<td>2,500</td>
<td>6,460</td>
</tr>
<tr>
<td>4</td>
<td>2,700</td>
<td>6,600</td>
</tr>
<tr>
<td>5</td>
<td>2,000</td>
<td>5,900</td>
</tr>
<tr>
<td>6</td>
<td>2,860</td>
<td>7,000</td>
</tr>
</tbody>
</table>

(i) Use the least squares technique to estimate the fixed and variable costs.

(ii) What should be the budget estimate for repairs and maintenance if output of 3,000 standard hours is predicted?
SUGGESTED SOLUTION 3-10

(i) Standard hours
(00s hours) (₦’000)

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>XY</th>
<th>X²</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.00</td>
<td>59.00</td>
<td>1180</td>
<td>400.00</td>
</tr>
<tr>
<td>23.00</td>
<td>64.00</td>
<td>1472</td>
<td>529.00</td>
</tr>
<tr>
<td>24.00</td>
<td>64.00</td>
<td>1536</td>
<td>576.00</td>
</tr>
<tr>
<td>25.00</td>
<td>64.60</td>
<td>1615</td>
<td>625.00</td>
</tr>
<tr>
<td>27.00</td>
<td>66.00</td>
<td>1782</td>
<td>729.00</td>
</tr>
<tr>
<td>28.60</td>
<td>70.00</td>
<td>2002</td>
<td>817.96</td>
</tr>
</tbody>
</table>

\[ \sum X = 147.6 \quad \sum Y = 387.6 \quad \sum XY = 9587 \quad \sum X^2 = 3676.96 \]

Given that \( a = \) fixed cost, \( b = \) variable cost, there are six pairs of data and so \( n = 6 \)

\[
b = \frac{6(9587) - (147.6)(387.6)}{6(3676.96) - (147.6)^2} = \frac{312.24}{276} = 1.13
\]

\[
a = \frac{387.6}{6} - \frac{(1.13)(147.6)}{6} = 64.60 - \frac{27.80}{100}
\]

\[
= 3,680
\]

Solution \( y = 3,680 + 1.13x \)

Where \( x \) is in hours and \( y \) is in ₦

Thus for budget output of 3,000 standard hours, costs would be estimated as:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed</td>
<td>3,680</td>
</tr>
<tr>
<td>Variable (3,000 x 1.13)</td>
<td>3,390</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7,070</strong></td>
</tr>
</tbody>
</table>

Linear regression analysis by this 'least squares' method is attempting to find a line of best fit that identifies a straight line equation from a given number of pairs of data.
Correlation describes the extent to which the value of $y$ is related to the value of $x$ based on the pairs of data used to estimate the line of best fit. Perfect correlation means that all the pairs of data lie in a straight-line.

3.6 SUMMARY AND CONCLUSIONS

Costs frequently do not behave in regular manner and a cost function may be linear, curvi-linear or stepped at different activity levels. Therefore, the ability to forecast costs is a vital part of supplying information for planning and decision making.

There are basically four ways to cost prediction or estimation. These are account analysis, scatter-graph, high and low (range method) and linear regression analysis method.

The usage of any statistical technique requires a confirmation of its applicability and usefulness.

Costs can be separated into either fixed or variable. However, cost classification has its own drawbacks since variable costs are not always variable, fixed costs can and do change and thus many costs are semi fixed or semi-variable.

When long term forecasting is required, extrapolation from historical data become less relevant and judgment and qualitative factors become increasingly relevant.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

3.7 REVISION QUESTIONS

3.7.1 MULTIPLE CHOICE QUESTIONS

1. Cost behaviour analysis focuses on:
   A How costs react to changes in profit
   B How costs change over time
   C How costs react to changes in activity levels
   D How cost react to revenue
   E None of the above.

2. The relevant range is:
   A a relatively wide range of sales where total variable costs remain the same.
   B a relatively wide range of sales where all costs remain the same.
   C a relatively narrow range of production where total variable costs remain the same.
4. An hospital requires one nurse for each ten (10) patients, this is an example of a ________ cost.
   A fixed cost
   B variable cost
   C step cost
   D missed cost
   E committed cost

5. Advantages of the least square method over the high-low method include all the following EXCEPT
   A A statistical method is used to mathematically derive the cost functions
   B Only two points are used to develop the cost function
   C The square differences between actual observation and the time (cost function) are minimized.
   D All the observations have an effect on the cost functions.
   E Representative and objective is objective in nature.

6. The following information was available about supplies cost for the first three months of the year.

<table>
<thead>
<tr>
<th>Month</th>
<th>Volume (Production)</th>
<th>Supplies (Cost) (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1,400</td>
<td>6,370</td>
</tr>
<tr>
<td>February</td>
<td>3,200</td>
<td>14,200</td>
</tr>
<tr>
<td>March</td>
<td>1,200</td>
<td>5,400</td>
</tr>
</tbody>
</table>

Using the high low method, an estimate of supplies cost at 3000 units of production would be:
   A ₦13,050
   B ₦13,200
   C ₦13,320
   D ₦13,300
   E ₦13,500

7. Abdul-Azeez Company developed a cost function for manufacturing overhead costs of \( Y = 20,000 + 8x \). Estimated manufacturing overhead costs of 5,000 units of production would be.
   A ₦65,000
   B ₦60,000
   C ₦44,000
   D ₦40,000
   E ₦90,000
3.7.2 SHORT ANSWERS QUESTIONS

(1) Where a relationship between variable cost and output can be shown on a graph is called ____________

(2) State the three linear cost functions.

(3) ____________ is a statistical method of obtaining the unique cost estimating equation that best fits a set of data points.

(4) High and low method of cost analysis is also refers to as __________

(5) ________ is a cost which contains both fixed and variable components and so is partly affected by changes in the level of activity.

(Refer to Suggested Solution in Appendix I, page 443)
4

COST CONTROL AND COST REDUCTION

4.0 LEARNING OBJECTIVES

After reading this chapter, readers will be able to understand the:

♦ Concepts of cost control and cost reduction;
♦ Main differences between cost control and cost reduction;
♦ Similarities between cost control and cost reduction;
♦ Factors considered for cost reduction purposes; and
♦ Various cost reduction techniques.

4.1 COST CONTROL

Cost control involves all methods of controlling costs within a pre-determined target. Examples of cost control techniques are budgetary control and standard costing.

Cost control actions lead to a reduction in excessive spending, for example, when material wastage is higher than budgeted or productivity level is below the agreed standard. Both budgets and standards reflect current costs and conditions, and not necessarily the cost and conditions which would minimise costs. Therefore:

(a) Standard costing and variance analysis is often an inadequate means of controlling costs (although it is an effective means of control).

(b) Standards set may be generous and incorporate low standards of efficiency. This can be referred to as introduction of budget slack variable into the system.

(c) Budgets may include contingency allowances.

Cost control process involves setting targets and receiving feedback information in order to ensure that actual performance are in line with set target and, if not, take corrective actions.
4.2 COST REDUCTION

This is an active and dynamic concept which attempts to extract more from the factors of production without loss of effectiveness.

Cost reduction activities are planned efforts to reduce expenditure. They should preferably be continuous, and long term, so that short term cost reductions are not soon reversed and forgotten. The major difficulties with cost reduction programmes are:

(a) Resistance by employees to the pressure to reduce costs, usually because the nature and purpose of the campaign has not been properly explained to them, and they feel threatened by the change.

(b) Application may be limited to a small area of the business, for example, one department with the result that costs are reduced in one cost centre only to re-appear as an extra cost in another cost centre.

(c) Efforts to cut materials or labour costs may erode confidence in the established systems for estimating material usage and labour efficiency standards.

(d) Cost reduction campaigns are often introduced as a rushed, desperate measure instead of a carefully organised, well thought out exercise.

4.3 SIMILARITIES AND DIFFERENCES BETWEEN COST CONTROL AND COST REDUCTION

They are similar as they both:

(a) Ensure the efficient utilization of resources.

(b) Involve the pre-setting of a target after an initial cost analysis.

The differences include:

(i) Cost control is an on-going process while cost reduction is on ad-hoc basis.

(ii) Cost control is static with the basic objectives of containing cost within pre-set target while cost reduction aims to reduce costs from some pre-determined target without reducing the benefits derived from the product made or service rendered.

(iii) They both have quite distinct objectives and different techniques are used to achieve them.
4.4 THE SCOPE OF COST REDUCTION

The scope of cost reduction embraces activities of the entire company, from production to marketing and at all levels within the organization from the operatives to top levels.

Costs reduction efforts include:

(a) Material costs
   (i) Quantity discounts or cash discounts for early payment to suppliers may be negotiated at favourable discount rates;
   (ii) Inventory control policy might need improvement;
   (iii) Value analysis may be carried out;
   (iv) Procedures for reducing material wastage in production should be instituted.

(b) Labour costs
   (i) Labour efficiency may be improved by work study
   (ii) Unit labour costs and unit overhead costs may be reduced by having production efficiency rewarding plan with the employees.
   (iii) Total costs may be reduced by replacing labour intensive jobs with automated related jobs.

(c) Finance costs
   (i) Where there is a reason to allow for discount, it should be done based on the consideration for the cost of finance.
   (ii) Bank overdraft expenses may be better reduced by effective cash monitoring efforts.

(d) Rationalisation Measures
   As a company expands in activities, there may be duplication of efforts in the different facets of its operations. However, this duplication can be removed by ensuring that resources are concentrated in the firm.

4.5 FACTORS TO BE CONSIDERED FOR REDUCING COSTS

The following factors are to be considered if cost reduction is to be meaningful:

(a) Efficient business may not be able to avoid undue expenses;
(b) Inconsistency of management may add to costs;
(c) Employees may want to resist change;
(d) Faultless system may be costly;
(e) Avoidance of elaborate procedures;
(f) Cost reduction efforts can be enhanced by allowing for creative ideas;
(g) The sources of costs must be given adequate and prompt attention;
(h) Short-term action should be related to long-term objectives;
(i) Cost reduction should be maintained; and
(j) Communication of company policy and objectives in the context of cost reduction.

The following explanatory notes have been provided to clarify some key terms necessary for understanding cost reduction factors.

(i) **Undue Expenses**

Undue expenses can be removed without having to compromise the quality of the items of production or units of service provided. Consumers can only appreciate buying goods of better quality. Nonetheless, a lowering of the standard may ensure the reduction of costs but at the expense of the quality of goods.

(ii) **Management Inconsistency**

Cost reduction programme requires the support and commitment of the top management and this has to be on a regular and consistent basis in order to avoid complacency not minding whether the business climate is harsh or friendly.

(iii) **Resistance To Change By Employees**

Employees may want to react to change negatively as a result of past beliefs or norms. This can be addressed by ensuring that existing systems or work environment situations are constantly reviewed and friendly employees are involved at every stage in order to gain their confidence and support. With this, negative efforts will be eliminated and costs reduced.

(iv) **Faultless System**

A faultless system may be a desired one, but efforts should be made to ensure that it is not over blown so that unnecessary controls are removed.
(v) **Avoidance of Elaborate Procedures**

Elaborate procedures, if allowed in a company, may bring about costly operations at the expense of ensuring that employee capabilities are recognised which could lower costs.

(vi) **Creative Ideas**

Since issues can be approached from different ways, ideas and contributions from everyone involved in cost reduction programme must be allowed in order to eliminate wastes. Creative ideas can be enhanced by ensuring that employees are given good incentives to work and the work environment must be friendly so that any scheme put in place can be successful.

(vii) **Areas of Cost Reduction**

For cost reduction activities to be meaningful, the sources for incurring these costs such as finance, marketing, production, human resources, engineering, maintenance, etc. need be considered in terms of the material, labour and overhead costs involved in the areas mentioned. There is a need for using an integrated approach whereby costs are not considered in isolation, but their inter-relatedness is given some consideration. The managers are, therefore, expected to exchange ideas that will allow for goal congruence to be attained.

(viii) **Maintaining Cost reduction**

Cost reduction can be sustained or maintained by ensuring that there is consistent control of costs in place with the aid of budgetary control techniques.

(ix) **Short-term action should be related to long term objectives**

A cost reduction campaign should have a long term aim as well as short term objectives.

- In the short term, only variable costs, for the most part, are susceptible to cost reduction efforts. Many fixed costs (for example, depreciation and rent) are unavoidable.
- Some fixed costs are avoidable, in the short term for example, advertising or sales promotion expenditure. These are called ‘discretionary fixed costs’.
- In the long term, most costs can either be reduced or avoided. This includes fixed costs as well as variable cost expenditure items.
(x) Communication

Information to employees must be such that they are timely, relevant, focused and less costly. Information will be valued, where employees are convinced that their future is guaranteed and prospects can be ascertained at the same time. Good and equitable personnel manual must also be in place.

4.6 COST REDUCTION TECHNIQUES

Cost reduction techniques include:

4.6.1 Value Analysis

Value analysis also called value engineering is an assessment process carried out by a team during the design stages of a product with the aim of designing a product or methods of rendering a service which meets the essential design objectives at minimum cost.

Four aspects of value analysis that should be considered are:

(a) Cost Value - that is, cost of sale

(b) Exchange Value - that is, market value

(c) Use Value - that is, what the product does, the purposes it fulfils. Value analysis attempts to provide the same (or a better) utilisation value at the lowest cost.

(d) Esteemed Value - that is, the prestige the customer attaches to the product. Value analysis attempts to maintain or enhance the prestige of a product at the lowest cost.

Value Analysis is a formal system developed after the second world war, when shortages of materials forced manufacturers to look for cheaper methods of production. It was found that cheaper production could be achieved with no loss in quality or value. From this value analysis as the systematic investigation of every source of cost and technique of production with the aim of getting rid of all unnecessary costs. An unnecessary cost is an additional cost incurred without adding use, exchange or esteemed value to a product.

Value analysis (value engineering) embraces the investigation of specification, design, planning, buying, manufacturing, testing, sales and distribution of a product or service. Its methods include:
(a) Organisation and methods study;

(b) A study of comparative costs; and

(c) Assess newly available materials.

Three areas of special importance are:

(a) **Product design:** The designer should be cost-conscious and avoid unnecessary complications;

(b) **Components and materials cost:** The purchasing department should be wary of being in the habit of routine buying decisions. Buyers ought to be fully aware of technological changes, and significant changes in material prices that new technology creates; and

(c) **Production methods:** These ought to be reviewed continually, on a product-by-product basis.

Value analysis can be applied to services, or aspects of office work, or to management information systems. (for example, the value of information, reports. etc.)

**The stages in value analysis**

A value analysis study should be carried out by a team of experts, preferably with varying backgrounds, which blends experience, skill and imagination.

The stages in value analysis are:

(a) **Select a product or service for study:** The product selected should be one which accounts for a high proportion of the organizations’ cost since the greatest cost savings should be obtained from high cost areas. The choice should also have regard to the expected future life of the product and the stage of its “life cycle” that it has reached.

(b) **Obtain and record information:** The questions to be asked include in what is the product or service supposed to do? Would it succeed? What are the costs of the product or service? Are there alternative ways of making or providing it? What do these alternatives cost?
(c) **Analysis**: Each aspect of the product or service should now be analysed. Value is an important consideration here, and total value might be defined as the sum of a product’s or service’s:

(i) **Use value** - that is, the ability of the product to perform the function for which it was designed at the lowest possible cost:

(ii) **Esteemed value** - that is, the regard, esteem or prestige that customers associate with the product or service.

Value is ‘the minimum cost which must be expended in production to create the appropriate use and esteem factors.’ The aim of a value analysis study is therefore to achieve a required ‘total value’, but in achieving that value, to minimise the ratio of:

\[
\begin{align*}
\text{Value Obtained} & \\
\text{Total Cost of production} & 
\end{align*}
\]

Any cost reduction must be achieved without the loss of any effective use or esteem value (or at least, cost savings must exceed any loss in value suffered, and customers would then have to be compensated for the loss in use or esteem value in the form of a lower selling price).

Types of questions to be asked and answered in the analysis stage are:

(i) Are all the parts necessary?

(ii) Can the parts be obtained or made at a lower cost?

(iii) Can standardised parts be used?

(iv) Are all the features of the product or service necessary?

(v) Can any of the features be incorporated at a lower cost?

(vi) Does the value provided by each feature justify its cost?

(vii) Can the process of making the product or providing the service be performed at a lower cost?

(d) **Consider new options**: From the analysis, a variety of options can be devised. This is the ‘new ideas’ stage of the study, and alternative options would require new ideas for eliminating unnecessary parts or features, combining several features into one, standardising certain components or features, or introducing new methods of operation or new sources of supply.
(for example, external purchase of components instead of the in-house manufacture).

(e) Draw up a shortlist of options and evaluate them.

(f) Report on the study to the manager/committee responsible for taking decision, and include a recommendation.

(g) Implement the decision.

(h) After a defined period, evaluate the outcome and measure savings.

Value analysis should be an inter-disciplinary exercise, involving a management accountant but also managers concerned with method study and measurement, estimating, engineering, planning, production, purchasing, marketing, etc.

4.6.2 Work Study: This involves the determination of the most efficient means of using input resources such as labour, materials and machinery. It is a technique for improving efficiency and rendering waste in factories and can be applied in many areas including factory layout, and work flow, material handling, tool design, scheduling, workplace methods and layout. Work study comprises method study and measurement.

(a) **Method Study:** This is that part of work study which is aimed at improving methods, or establishing a correct method for a job or process to economise its human effort and make more efficient use of men, materials and machines. The procedure normally includes the selection of work to be studied, relevant facts or method used, examining the facts logically, developing a more effective method and installing and maintaining this method as a standard practice.

(b) **Work Measurement:** This is the application of techniques designed to establish the time for a qualified work to carry out a specified job at a defined level of performance. Although, method study can also examine the more effective use of manpower, measurement is distinct in that it aims to make improvements in the labour planning and control, and through incentive schemes the managing of organisation. Thus, it is complementary to and can assist the former by examining the times that alternative methods of carrying out a work assignment would take. Thus, it can help to ascertain a balanced allocation of manpower resources between the
various stages in the production of a product or service. In work measurement, time study may be used to examine performance, after considering time allowances for such things as relaxation. Frequently, statistical sampling techniques will be used in the analysis especially with the large production units where otherwise it would be impossible to consider each person and operation on an individual basis.

4.7 STANDARDISATION AND VARIETY REDUCTION

An examination of product components and final products can be carried out with the objectives of optimising their range. In this case, special consideration will be given to unprofitable products bearing in mind that such unprofitable products may be necessary to ensure that the organisation has a complete product range to offer to its customers. The intention as far as components of a product are concerned is to simplify and standardise them as much as possible. This may all appear to be a subset of value analysis. Although the two techniques are inter-linked, there is the distinction that rationalisation is relevant in the consideration of standardisation of products and variety reduction.

4.8 SUMMARY AND CONCLUSIONS

Cost control is the regulation of the costs of operating a business and it is concerned with keeping expenditure within acceptable limits whereas cost reduction is a planned, positive approach at reducing expenditure where it is in excess. It entails focus on material costs, labour costs, finance costs and rationalization measures.

Cost reduction techniques are value engineering analysis or value and work study.

Value engineering or analysis embraces the investigation of specification, design, buying, manufacturing, testing, sales and distribution.

Work study is a technique of management which is applied to existing procedures and problem areas to eliminate wastes and improve efficiency. It incorporates both method study and work measurement in order to achieve the most efficient and economic utilisation of resources.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)
4.9 REVISION QUESTIONS

4.9.1 MULTIPLE CHOICE QUESTIONS

1. Cost control and cost reduction
   A Means the same thing
   B Are the opposite of each other
   C Are two distinct management tools
   D Are used during crisis situation
   E Are aimed at exposing fraudulent managers.

2. Life cycle costing tracks and accumulates the actual costs from the beginning to the end of a _________
   A Company
   B Product
   C Process
   D Cost centre
   E Contract

3. Which of the following techniques can be used in a costs reduction programme?
   A Standard Costing
   B Budgetary Control
   C Marginal Costing
   D Variety Reduction
   E Value Reduction

4. Costs of quality are those costs incurred to prevent poor quality from occurring. They include:
   A Prevention Costs
   B Appraisal Costs
   C Internal failure cost
   D External failure cost
   E Expected failure cost

5. Which of the following is not a component of value under value analysis technique?
   A Cost Value
   B Exchange value
   C Usage Value
   D Esteem Value
   E Consumer Value

4.9.2 SHORT ANSWER QUESTIONS

1. The process of regulating costs of operation of a business and keeping the expenditure within an acceptable limits is ________

2. A planned positive approach to reducing expenditure because of its excessiveness is ________

3. State the main objectives of method study.
4. A cost reduction technique which is concerned with new products at the design state before production commences is known as __________.

5. A cost reduction technique which attempts to cut down the manufacturing cost of a product without reducing its quality, performance or value to the customer is called __________.

6. A technique of management which is applied to existing procedure and problem areas to eliminate waste and improve efficiency is known as __________.

(Refer to Suggested Solution in Appendix I, page 443)
5.0 LEARNING OBJECTIVES

After studying this chapter, readers will be able to understand:

- Marginal costing techniques and the preparation of operating statements using marginal and absorption costing techniques;
- The principles of carrying out the cost-volume-profit (CVP) analysis for decision making;
- Break-even charts and profit graphs;
- The limiting factor and its effect on decision process; and
- The applications of the concepts of relevant cost, opportunity cost, incremental cost, and differential cost to decision-making.

5.1 DEFINITION OF MARGINAL COSTING

CIMA defines marginal costing “as a decision making technique used to determine the effect of cost on changes in the volume of time and output in a multi-product firm especially in the short run”. Thus, it is a technique which emphasises the variable cost of a product, that is, the direct material, direct labour, direct expenses and other variable overheads. It demands that fixed costs of the relevant period are written off in full against the contribution. The contribution is the difference between the sales value and the variable or marginal cost of a product in a given period of time.

5.1.1 Marginal Costing Statement Format

The format showing the components of a marginal costing statement is as shown below:

<table>
<thead>
<tr>
<th>Component</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (a)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Direct material</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Direct labour</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Direct expenses</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Prime cost</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Production variable costs</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Production marginal cost (b)</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Contribution - (a-b)</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>
Fixed costs are excluded from the cost structure and therefore written off in the period.

5.1.2 Merits of Marginal Costing

Marginal costing is a technique which is of utmost importance to management decision making efforts. The following reasons are pertinent to this assertion:

(a) Profit volume ratio helps management to decide which products are most profitable.

(b) Contribution margin helps to decide whether to:

(i) accept or reject a special order,
(ii) close down a line of product or business,
(iii) determine product profitability,
(iv) determine product mix using linear programming technique,
(v) make or buy or lease decisions on an item of plant and equipment, and
(vi) decide further processing decision particularly in relation to joint product cost.

(c) It assists in the pricing decision making process.

(d) Contribution approach can be used to forecast the units to be produced and sold.

(e) It facilitates the stock valuation for final accounts purposes.

5.1.3 Demerits of Marginal costing

The difficulties associated with marginal costing include:

(a) The analysis of costs into fixed and variable costs may be subjective for the purpose of costs classification.

(b) It places emphasis on the short run effects of costs, whereas, fixed costs will vary in the medium and long term.

(c) It is impossible to determine strategic or long term decision given a product total cost data without considering fixed costs.

(d) It focuses attention on the contribution level. The tendency to exclude fixed costs by the management may be disastrous.
5.2 ABSORPTION COSTING

‘Absorption costing is a technique of costing stocks in which all production costs such as variable and fixed are included as part of the cost of items’. (Statement of Accounting Standard (SAS) No. 4 - Stocks).

Absorption costing, therefore, is a technique in which all costs are absorbed into production, hence operating statements, prepared using this approach, does not distinguish between fixed and variable costs. It is an approach which allocates all production costs into individual products. Fixed production overheads are absorbed into products by establishing overhead absorption rate. This may result in over or under absorbed overhead, which is less or more than recovery of fixed overheads at planned or predetermined activity level.

5.2.1 (a) Absorption costing: standard cost (where there is no opening and closing stock) card-format

<table>
<thead>
<tr>
<th>Per Unit</th>
<th>$</th>
<th>$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td></td>
<td>$x</td>
</tr>
<tr>
<td>Direct Materials</td>
<td>$x</td>
<td></td>
</tr>
<tr>
<td>Direct Labour</td>
<td>$x</td>
<td></td>
</tr>
<tr>
<td>Direct Expenses</td>
<td>$x</td>
<td></td>
</tr>
<tr>
<td>Prime Cost</td>
<td></td>
<td>$x</td>
</tr>
<tr>
<td>Production Variable Overhead</td>
<td></td>
<td>$x</td>
</tr>
<tr>
<td>(i) Marginal Cost</td>
<td></td>
<td>$x</td>
</tr>
<tr>
<td>Fixed Production overhead cost</td>
<td></td>
<td>$x</td>
</tr>
<tr>
<td>(ii) Total production cost of sales (Absorption cost)</td>
<td></td>
<td>$(x)$</td>
</tr>
</tbody>
</table>
| Gross Profit |    | $XX$

(b) Absorption Costing Operating Statement (with opening & closing stocks).

<table>
<thead>
<tr>
<th>$N$</th>
<th>$N$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$x$</td>
</tr>
<tr>
<td>Opening Stock (valued at Absorption cost)</td>
<td>$x$</td>
</tr>
<tr>
<td>Cost of Production (valued at Absorption cost)</td>
<td>$x$</td>
</tr>
<tr>
<td>Less: Closing Stock (valued at absorption cost)</td>
<td>$x$</td>
</tr>
<tr>
<td>Total Cost of sales</td>
<td></td>
</tr>
<tr>
<td>Gross Profit</td>
<td></td>
</tr>
</tbody>
</table>
5.2.2 Advantages of Absorption costing
(a) It recognises the importance of fixed cost.
(b) It avoids fictitious losses being reported by representing product cost at full factory cost to bring the product to a point where it is ready for use.
(c) It assists in arriving at total cost of production which is a basis for selling price decision process.
(d) It matches costs with revenues since fixed production cost are considered in the product cost.
(e) It represents current market trends and, therefore, it is widely accepted especially for tax purposes.

5.2.3 Disadvantages of Absorption costing
(a) It does not help in decision-making.
(b) Production may be very difficult since there is element of fixed cost in the product cost.
(c) Calculation of under or over absorbed overhead may be problematic.
(d) It overbears the product cost with management administrative inefficiency which may be partly represented in fixed cost.
(e) It does not conform with the matching principle which stipulates that all costs (fixed and variable) must be matched against revenue in the period concerned for determination of profit.

5.3 MARGINAL AND ABSORPTION COSTING COMPARED

5.3.1 Marginal Costing
Marginal Costing is a useful technique for studying the effects of changes in volume and type of output in a multi-product business. It is an accounting technique which determines the marginal cost by distinguishing between fixed and variable costs. The primary purpose of marginal costing is to provide information to management on the effects on costs and revenues of changes in the volume and type of output in the short run.

It can also be used in the system for recording and collecting costs. In this case, stocks are valued at variable cost and fixed costs are treated as period costs in profit statements.

5.3.2 Absorption costing
Absorption costing is the approach used in all published accounts and all financial accounting statements. It emphasizes a functional
classification of costs, for example, manufacturing, selling and
distribution and financial costs.

In contrast, marginal costing or the contribution approach, highlights
the behaviour of costs and classifies them accordingly by identifying
variable costs and fixed costs.

5.3.3 Further distinctions between the two techniques are presented
in tabular form below:

Marginal Costing and Absorption Costing Techniques:

<table>
<thead>
<tr>
<th>Marginal Costing</th>
<th>Absorption Costing</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Fixed overheads are written off in a period. Treated as period costs.</td>
<td>a. Fixed overheads are absorbed into production, such that part of fixed cost is carried to subsequent year by way of its inclusion in closing stock.</td>
</tr>
<tr>
<td>b. Only variable costs are regarded as product cost.</td>
<td>b. Fixed Production overheads form part of the product cost.</td>
</tr>
<tr>
<td>c. Contribution is the main feature of the operating statement (sales less marginal cost) = Contribution</td>
<td>c. Contributions are treated as funds into which fixed cost are absorbed to arrive at profit.</td>
</tr>
<tr>
<td>d. Distinction is made between fixed and variable costs.</td>
<td>d. No distinction is made between fixed and variable costs.</td>
</tr>
<tr>
<td>e. Stocks are valued at variable costs which exclude fixed costs.</td>
<td>e. Stocks are valued at total production cost including fixed production overhead costs.</td>
</tr>
<tr>
<td>f. It is used for decision making purposes.</td>
<td>f. It is used for routine purposes.</td>
</tr>
</tbody>
</table>

It is imperative to say that the marginal costing approach (also known as the contribution approach) highlights the total contribution which forms a fund out of which fixed costs must be paid. The contribution per unit will be the same irrespective of the level of output. This approach does not attempt to imply a fixed overhead rate per unit
rather fixed overheads do not change with the level of output, and therefore, should only be stated in total.

**ILLUSTRATION 5-1**

AGBATI Limited produces COLA wine which is bottled and sold in cases. The normal annual level of production on which the fixed production overhead absorption is based is 80,000 cases. Data for the last financial year ended 31 December, 2009 were as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>90,000 cases</td>
</tr>
<tr>
<td>Sales</td>
<td>75,000 cases</td>
</tr>
<tr>
<td></td>
<td>Per Case</td>
</tr>
<tr>
<td>Sales</td>
<td>N1,500</td>
</tr>
<tr>
<td>Cost:</td>
<td></td>
</tr>
<tr>
<td>Direct Material</td>
<td>500</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>400</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>200</td>
</tr>
<tr>
<td>Fixed Production Overhead</td>
<td>N1,560,000</td>
</tr>
</tbody>
</table>

Variable Selling and distribution cost 10% of sales revenue.

Fixed selling and distribution cost N150,000.

**Required:**

Prepare profit statements for the year ended 31 December, 2009 based on:

(i) Marginal Costing
(ii) Absorption Costing
### Suggested Solution 5-1

(i) **AGBATI LIMITED**

**Profit Statement for the Year Ended 31 December, 2009**

Based on Marginal Costing

<table>
<thead>
<tr>
<th></th>
<th>₦’000</th>
<th>₦’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (₦1,500 x 75,000)</td>
<td></td>
<td>112,500</td>
</tr>
<tr>
<td>Less: Marginal Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Material (₦500 x 75,000)</td>
<td>37,500</td>
<td></td>
</tr>
<tr>
<td>Direct Labour (₦400 x 75,000)</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Variable Overhead (₦200 x 75,000)</td>
<td>15,000</td>
<td>82,000</td>
</tr>
<tr>
<td>Factory Contribution</td>
<td></td>
<td>30,000</td>
</tr>
<tr>
<td>Less: Variable, Selling and Distribution (10% x ₦112,500)</td>
<td></td>
<td>11,250</td>
</tr>
<tr>
<td>Total Contribution</td>
<td></td>
<td>18,750</td>
</tr>
<tr>
<td>Less: Fixed Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production</td>
<td>1,560</td>
<td></td>
</tr>
<tr>
<td>Selling and Distribution</td>
<td>150</td>
<td>1,710</td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td></td>
<td><strong>17,040</strong></td>
</tr>
</tbody>
</table>

(ii) **Profit Statement for the Year Ended 31 December, 2009**

Based on Absorption Costing

<table>
<thead>
<tr>
<th></th>
<th>₦’000</th>
<th>₦’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (₦1,500 x 75,000)</td>
<td></td>
<td>112,500</td>
</tr>
<tr>
<td>Less: Production cost (₦1,119.50 x 90,000) (w. i)</td>
<td></td>
<td>100,755.00</td>
</tr>
<tr>
<td>Less: Costing Stock (₦1,119.50 x 15,000)</td>
<td>16,792.50</td>
<td>83,962.50</td>
</tr>
<tr>
<td>Less: Under absorption (₦19.50 x 10,000)</td>
<td>195.00</td>
<td>83,767.50</td>
</tr>
<tr>
<td>Gross Profit</td>
<td></td>
<td>28,732.50</td>
</tr>
<tr>
<td>Less: Selling and Distribution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable (10% x ₦112,500)</td>
<td>11,250</td>
<td></td>
</tr>
<tr>
<td>Fixed</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td></td>
<td><strong>11,400.00</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>17,332.50</strong></td>
</tr>
</tbody>
</table>
Workings:
Calculation of Production Cost per Unit

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>500</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>400</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>200</td>
</tr>
<tr>
<td>Fixed Overhead (₦1,560 / 80,000)</td>
<td></td>
</tr>
</tbody>
</table>

**ILLUSTRATION 5-2**

Modadeola Nigeria Limited produced “Pomade” in 2004, and made the following data available. As a management accountant, you are required to present to the management of Modadeola Nigeria Limited the profit based on
(a) marginal costing, and
(b) absorption costing.

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price</td>
<td>20.00 per unit</td>
</tr>
<tr>
<td>Variable manufacturing cost</td>
<td>8.00 per unit</td>
</tr>
<tr>
<td>Fixed manufacturing cost</td>
<td>20,000.00</td>
</tr>
<tr>
<td>Selling and administrative cost</td>
<td>Fixed 10,000</td>
</tr>
<tr>
<td></td>
<td>Variable 4.00 per unit</td>
</tr>
<tr>
<td>Units produced</td>
<td>20,000 units</td>
</tr>
<tr>
<td>Units sold</td>
<td>19,500 units</td>
</tr>
</tbody>
</table>

**SUGGESTED SOLUTION 5-2**

**MODADEOLA NIGERIA LIMITED**

(a) Absorption Costing Statement

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Unit</td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>20</td>
</tr>
<tr>
<td>Less: Cost of goods sold</td>
<td>390,000</td>
</tr>
<tr>
<td>Variable manufacturing costs 20,000 units</td>
<td>8</td>
</tr>
<tr>
<td>Fixed manufacturing cost</td>
<td>1</td>
</tr>
<tr>
<td>Less: Closing stock (500 units)</td>
<td>9</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>214,500</td>
</tr>
<tr>
<td>Less: Selling and administrative costs</td>
<td>88,000</td>
</tr>
<tr>
<td>Net profit</td>
<td>126,500</td>
</tr>
</tbody>
</table>

(b) Marginal Costing Statement

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>390,000</td>
</tr>
<tr>
<td>Variable manufacturing costs of production (20,000 units at ₦8)</td>
<td>160,000</td>
</tr>
</tbody>
</table>
Less: closing stock (500 units at N8) 4,000
Variable manufacturing cost of goods sold 156,000
Add: Variable selling and administrative costs 78,000
Variable cost of goods sold 234,000
Contribution 156,000
Less: fixed costs:
  manufacturing cost 20,000
  selling and administrative cost 10,000
  30,000
Profit 126,000

The difference in the operating statement of both techniques of N500, relates to the valuation of the closing stock (N4,500 - N4,000).

ILLUSTRATION 5-3

The following data in kilograms were taken from the records of Najaatu Bala Rabiu Limited:

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>30,000</td>
<td>38,000</td>
<td>27,000</td>
</tr>
<tr>
<td>Sales</td>
<td>30,000</td>
<td>27,000</td>
<td>38,000</td>
</tr>
<tr>
<td>Opening stock</td>
<td>-</td>
<td>-</td>
<td>11,000</td>
</tr>
<tr>
<td>Closing stock</td>
<td>-</td>
<td>11,000</td>
<td>-</td>
</tr>
</tbody>
</table>

The firm makes a single product, the financial details of which are as follows (based on a normal activity level of 30,000 kgs):

<table>
<thead>
<tr>
<th></th>
<th>Cost per kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material</td>
<td>N4.50</td>
</tr>
<tr>
<td>Direct labour</td>
<td>N1.00</td>
</tr>
<tr>
<td>Production overheads = (300% of labour)</td>
<td>N3.00</td>
</tr>
<tr>
<td>Selling price per kg = N9</td>
<td>N5.50</td>
</tr>
</tbody>
</table>

Administrative overheads are fixed at N25,000 and also one third of the production overheads are fixed.

Prepare separate operating statements based on marginal costing and absorption costing techniques.
### Suggested Solution 5-3

**Naajatu Bala RabiU Limited**

Operating Statements Using Marginal Costing

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>N 270,000</td>
<td>N 243,000</td>
<td>N 342,000</td>
</tr>
<tr>
<td>Marginal Prod. Cost</td>
<td>N 135,000</td>
<td>N 171,000</td>
<td>N 121,500</td>
</tr>
<tr>
<td>Add: Opening Stock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less: Closing Stock</td>
<td></td>
<td></td>
<td>(N 49,500)</td>
</tr>
<tr>
<td>Marginal Costing of Sales</td>
<td>N 135,000</td>
<td>N 121,500</td>
<td>N 171,000</td>
</tr>
<tr>
<td>Contribution</td>
<td>N 135,000</td>
<td>N 121,500</td>
<td>N 171,000</td>
</tr>
<tr>
<td>Less: Fixed costs</td>
<td>N 55,000</td>
<td>N 55,000</td>
<td>N 55,000</td>
</tr>
<tr>
<td>Profit</td>
<td>N 80,000</td>
<td>N 66,500</td>
<td>N 116,000</td>
</tr>
</tbody>
</table>

Note: Stocks are valued at Marginal Cost.

Operating Statements Using Absorption Costing

<table>
<thead>
<tr>
<th></th>
<th>Period 1</th>
<th>Period 2</th>
<th>Period 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>N 270,000</td>
<td>N 243,000</td>
<td>N 342,000</td>
</tr>
<tr>
<td>Total Cost of Prod.</td>
<td>N 165,000</td>
<td>N 209,000</td>
<td>N 148,500</td>
</tr>
<tr>
<td>Opening Stock</td>
<td>--</td>
<td>N 60,500</td>
<td>(N 60,500)</td>
</tr>
<tr>
<td>-Closing Stock</td>
<td>--</td>
<td>N 60,500</td>
<td>--</td>
</tr>
<tr>
<td>= Total Cost of Sales</td>
<td>N 165,000</td>
<td>N 148,500</td>
<td>N 209,000</td>
</tr>
<tr>
<td>= Gross Profit</td>
<td>N 105,000</td>
<td>N 94,500</td>
<td>N 133,000</td>
</tr>
<tr>
<td>less Admin. Overheads</td>
<td>N 25,000</td>
<td>N 25,000</td>
<td>N 25,000</td>
</tr>
<tr>
<td>= Profit</td>
<td>N 80,000</td>
<td>N 69,500</td>
<td>N 108,000</td>
</tr>
<tr>
<td>Over/(under) recovery of fixed overheads</td>
<td>--</td>
<td>N 8,000</td>
<td>(N 3,000)</td>
</tr>
<tr>
<td>Profit</td>
<td>N 80,000</td>
<td>N 77,500</td>
<td>N 105,000</td>
</tr>
</tbody>
</table>

Note:
(a) Stocks valued at total cost at the normal production level of 30,000 kgs.
(b) Alternatively, the over/(under) recovery of fixed overheads could be reconciled at the year end.
5.4 MARGINAL COSTING AND DECISION MAKING

Decision making is defined as making choices between future and uncertain alternatives. It must be emphasised that all decision making relate to the future and that a decision is a choice between alternatives in pursuit of an objective. Where no alternatives exist, no decision can be made and nothing can be done today that will alter the past. These fundamentals of decision making are of critical importance in determining what information the management accountant should supply to the decision maker.

5.4.1 The decision process

The overall decision process can be divided into stages:

(a) Definition of objective(s);

(b) Consideration of alternatives;

(c) Evaluation of alternatives in the light of the objective(s); and

(d) Selection of the course of action.

5.4.2 Types of decision

Decision making is concerned with ‘cost and revenues’ or ‘costs/benefits analysis’. The assumption that level of activity will remain constant within the relevant range of output will not be maintained. However, variation in unit variable costs or fixed costs might occur. Various types of decisions are:

(a) **Routine planning decisions**: These relate to budgeting decisions whereby fixed and variable costs are analyzed together with revenues over a period.

(b) **Short-run problem decisions**: These refer to unforeseen decisions of a non-recurring nature, so that revenue and costs are obtained within a relatively short time.

(c) **Investment or disinvestment decisions**: These refer to decision of long-term consequences. It allows for the concept of time value of money and the appreciation of discounted cash flow techniques.

(d) **Long-range decisions**: These relate to infrequently reviewed decisions. They are decisions made once, meant to provide a continuing solution to a recurring problem, for example, deciding, or reviewing the channel of distribution of the company’s products.
(e) **Control decisions:** These are cautious decisions with a view to evaluating the benefits expected such that they exceed the costs of investigation. They are more like “think before you act” circumstances.

### 5.4.3 Relevant cost

Any cost that is useful for decision making is often referred to as a relevant cost. A cost is said to be relevant provided there is a future cash flow arising from a direct consequence of a decision.

(a) **Relevant cost are future costs**

(i) A decision is about the future; it cannot alter what has been done already. In a famous passage, the economist, Jevons (1871) wrote ‘the fact that labour once spent has no influence on the future of any article; it is gone and lost forever. In commerce, bygones are forever bygones, and we are always starting clear at each moment, judging the values of things with a view to future utility’.

(ii) The concept that bygones are bygones refers not only to labour, but also to all historic costs of materials, machinery and other items.

(iii) Costs that have been incurred include:

- cost that have already been paid; and
- costs that are the subject of legally binding contracts, even if payments due under the contract have not yet been made.

It is necessary to advise the readers that past costs are only useful as long as they provide information for forecasting.

(b) **Relevant costs are cash flows**

(i) Decisions are most often taken which will maximize the ‘satisfaction’ of a company’s shareholders. Note that the time value of money affects the worth of cash flows from project over a longer period, and all short-run decisions are assumed to improve the shareholders’ satisfaction if they increase net cash inflows. ‘The decision rule will be to accept opportunities that increase the value of future cash resources and to reject those that decrease it.’ (Arnold 1963)
(ii) Only cash flow information is required. In essence, any cost or charge that fails to reflect additional cash spending should be excluded. These include:

- Depreciation as a fixed overhead incurred.
- Notional rent or interest, as fixed overhead incurred.
- All overheads are absorbed. Fixed overhead absorption is always irrelevant. Interestingly, variable overhead costs are usually relevant, because they would be incurred at the same rate that they are absorbed.

(c) A relevant cost is one which arises as a direct consequence of a decision. Thus, only costs which will differ under some or all of the available opportunities should be considered; relevant costs are, therefore, sometimes referred to as incremental costs or differential costs.

Thus, if an employee is expected to have no other work to do during the next week, but will be paid a basic wage of $100 per week for attending work and doing nothing, his manager might decide to give him a job which earns only $40. The net gain is $40, and the $100 is irrelevant to the decision, although it is a future cash flow, it will be incurred anyway, whether the employee is given work or not.

Relevant costs were slow to be accepted by the accounting profession, and did not properly feature in accounting textbooks until the early 1960’s. Economists have been aware of them for a much longer time; and they are simply the application of common sense and economic wisdom. Parker (1963), wrote that intelligent business men at an early date were aware intuitively of the notions of avoidable cost and opportunity cost, and of irrelevance of cost which are the same under all alternatives.

5.4.4 Differential costing

This is a term used in the preparation of adhoc information when all the cost and income differences between the various options being considered are highlighted so that clear comparisons can be made of all the financial consequences. In one sense, differential costing is a wider concept than marginal costing because all cost changes are considered, both fixed and variable, whereas the presumption when marginal cost is used is that only variable cost changes.
5.4.5 Differential and incremental costs

A differential cost is the difference in the cost of alternative choices. If option A will cost an extra ₦300 and option B will cost an extra ₦360, the differential cost is ₦60, with option B being more expensive. A differential cost is the difference between the incremental cost of each option.

5.4.6 Historical cost information

Although, historical costs (also called past costs, sunk cost, irrevocable costs on committed cost) are irrelevant for decision making, historical cost data can be useful for decision making. [“Historical costs are themselves irrelevant to the decision, although they may be the best available basis for predicting future costs.” (Horngren, 2004)]

5.4.7 Opportunity Costs

Relevant cost may also be expressed as opportunity costs.

An opportunity cost is the benefit of the next best alternative that is forgone:

(a) If the choice is between choosing option A or doing nothing, the opportunity cost of A is the extra cash expenditure incurred. For choosing option A, Arnold (1963), calls this an external opportunity cost, but it is, quite simply, incremental cost.

(b) If the choice is between choosing option B or C, the opportunity cost of A would be described as the benefit forgone from the more profitable of the two other choices, B or C. Arnold calls this an internal opportunity cost, which arises whenever there are mutually exclusive options, or limiting factors/scare resources for production. It is this type of opportunity cost which is more widely known by the general term, ‘opportunity cost’.

Illustration 5-4

Suppose a company, James Jov Limited, is considering whether to launch a new product, with a unit sales price of ₦10 and estimated sales volume of 1,000 units per annum. The incremental fixed costs would be ₦3,000. The only variable costs are materials. James Jov Limited currently buys 7,000 kilograms of materials each year at a price of ₦3 per kilogram. The new product would use 3 kilogram of the material per unit, and if annual purchases are raised to 10,000 kilograms, the supplier has promised a 10% discount on quantities purchased.
Should the new product launch be undertaken?

**SUGGESTED SOLUTION 5-4**

The external opportunity costs are the incremental costs.

<table>
<thead>
<tr>
<th>Description</th>
<th>Incremental Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of 10,000 kgs of materials (₦30,000 less 10%)</td>
<td>27,000</td>
</tr>
<tr>
<td>Current cost of 7,000 kg (at ₦3)</td>
<td>21,000</td>
</tr>
<tr>
<td>Incremental cost of 3,000 kg</td>
<td>6,000</td>
</tr>
<tr>
<td>Additional Fixed Costs</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Total Incremental Costs</strong></td>
<td><strong>9,000</strong></td>
</tr>
</tbody>
</table>

Since the budgeted extra revenue of ₦10,000 is greater than the total incremental costs, the new product launch should be undertaken.

An Internal Opportunity cost is the benefit a firm would obtain from its next best opportunities only if the particular course of action is rejected.

(a) Suppose James Jov manufactures openers by either of two methods: by hand or by machine. To manufacture an opener by hand incurs incremental cash expenditure of ₦8 per unit, labour is freely available. To make an opener by machine takes one hour, and incurs incremental cash expenditure of ₦6. However, if the machines are not used, they can be hired out to earn net revenue of ₦4 per hour. An opener sells for ₦16,000.

The benefit (net revenue) from manufacturing by machine is ₦(16-6) = ₦10 per unit, but it is better to make by hand. There is an opportunity cost, the net revenue of ₦(16-8) = ₦8 per unit from making by hand, plus ₦4 per unit/hour from being able to hire out idle machinery.

<table>
<thead>
<tr>
<th>Description</th>
<th>Incremental Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surplus per unit from manufacture by machine</td>
<td>10</td>
</tr>
<tr>
<td>Internal opportunity costs (8 + 4)</td>
<td>12</td>
</tr>
<tr>
<td>Deficit per unit from manufacture by machine</td>
<td>(2)</td>
</tr>
<tr>
<td>instead of by hand</td>
<td></td>
</tr>
</tbody>
</table>

(b) Suppose James Jov has an item of material in stock which could be sold to a customer for ₦200. If it is not sold, it will be used in the manufacture of a product, which sells for ₦600 after incurring additional cash expenditure of ₦250.

The decision should be to make the product, because the
revenue obtainable exceeds the total of external and internal opportunity costs.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue from product</td>
<td>N</td>
<td>600</td>
</tr>
<tr>
<td>External opportunity costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Incremental costs)</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td>Internal opportunity cost</td>
<td>200</td>
<td>450</td>
</tr>
<tr>
<td>Net benefit from production</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

Internal opportunity cost arises where there are mutually exclusive opportunities to choose between, but they are more significantly involved in decisions affecting scarce resource, that is, constraints on production and sales activity.

**ILLUSTRATION 5-5**

A one year contract has been offered which will utilize an existing machine that is only suitable for such contract work. The machine cost N25,000 five years ago and has been depreciated N4,000 per year on a straight line basis and thus has a book value of N5,000. The machine could be sold now for N8,000 or in 1 year’s time for N1,000. Four types of materials would be needed for the contract as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>in stock</th>
<th>Units required for Contract</th>
<th>Current Purchase Price of Stock</th>
<th>Buying-in Price</th>
<th>Price per Unit</th>
<th>Current Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>1,200</td>
<td>300</td>
<td>1.80</td>
<td>1.50</td>
<td>1.20</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>200</td>
<td>1,100</td>
<td>0.70</td>
<td>2.80</td>
<td>2.10</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>3,000</td>
<td>600</td>
<td>0.50</td>
<td>0.80</td>
<td>0.60</td>
<td></td>
</tr>
<tr>
<td>Z</td>
<td>1,800</td>
<td>1,200</td>
<td>1.80</td>
<td>2.00</td>
<td>1.90</td>
<td></td>
</tr>
</tbody>
</table>

W and Z are in regular use within the firm. X could be sold if not used for the contract and there are no other uses for Y, which has been deemed to be obsolete. What are the relevant costs in connection with the contract. (ignoring time value of money)?

**SUGGESTED SOLUTION 5-5**

Machine costs.
The historic cost, as a sunk cost, is not relevant. The depreciation details given relate to accounting conventions and are not relevant. The relevant cost is the opportunity cost caused by the reduction in resale value over the one year duration of the contract, that is, N8,000 - 1,000 = N7,000.
Material costs

W
Although there are sufficient units in stock the use of 300 units for the contract would necessitate the need for replenishment at the current market price. Therefore, Relevant cost = 300 x N 1.50 = N 450

X
The contract requires 1,100 but only 200 is left in stock. The balance of 900 units required would be bought at the current buying in price of N 2.80.

Relevant cost = 200 x N 2.10 = N 420
900 x N 2.80 = 2,520

N 2,940

Y
If the 600 units were used on the contract they could not be sold so the opportunity cost is the current resale price of N 0.60 per unit.
Relevant cost = 600 x N 0.60 = N 360

Z
Similar reasoning applies to W, that is replenishment at current buying-in price.
Therefore, Relevant cost = 1,200 x N 2 = N 2,400

It will be seen from the above illustration that the recorded historical cost which is the ‘cost’ using normal accounting conventions, is not the relevant value in any of the circumstances considered.

ILLUSTRATION 5-6

Olorede Joseph Manufacturing Ltd has recently rented a new factory and intends to produce a newly developed man-made fibre - “Texlon”. The company previously had two other large mills. The combined installed capacity of the three mills will enable the company to provide a wide range of products to its numerous customers.

It is planned to produce “Texlon” in the new mill, first on a single shift and six months later a double shift will be introduced. Three months thereafter, a treble shift will become operational. The production, cost and selling price per unit are as follows:
The managing director has requested for the following information:

(i) The break-even units per week of each shift.
(ii) What is the total unit cost for each shift at break-even and full capacity?
(iii) What is the profit/loss for each shift at 50 per cent of the installed capacity (or increased capacity)?
    - Single shift 750 units
    - Double shifts 2000 units
    - Treble shift 3250 units
(iv) What is the profit per week at full capacity for each of the three shifts and the unit variable and fixed cost?

**SUGGESTED SOLUTION 5-6**

<table>
<thead>
<tr>
<th></th>
<th>Single Shift</th>
<th>Double Shift</th>
<th>Treble Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sales price per unit (s)</strong></td>
<td>N 5</td>
<td>N 5</td>
<td>N 5</td>
</tr>
<tr>
<td><strong>Variable cost per unit (v)</strong></td>
<td>N 3.00</td>
<td>N 3.20</td>
<td>N 3.50</td>
</tr>
<tr>
<td><strong>Contribution (s-v) (a)</strong></td>
<td>N 2.00</td>
<td>N 1.80</td>
<td>N 1.50</td>
</tr>
<tr>
<td><strong>Total Fixed cost (TFC) (b)</strong></td>
<td>N 2,000</td>
<td>N 2,520</td>
<td>N 3,030</td>
</tr>
<tr>
<td><strong>Breakeven (a / b)</strong></td>
<td>1,000</td>
<td>1,400</td>
<td>2,020</td>
</tr>
</tbody>
</table>

(ii) Single Shift | Double Shift | Treble Shift |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total cost at B/E Point</strong></td>
<td>N 5,000</td>
<td>N 7,000</td>
</tr>
<tr>
<td><strong>Variable Costs</strong></td>
<td>N 3,000</td>
<td>N 4,480</td>
</tr>
<tr>
<td><strong>Fixed Cost</strong></td>
<td>N 2,000</td>
<td>N 2,520</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>N 5,000</td>
<td>N 7,000</td>
</tr>
<tr>
<td><strong>Break even units</strong></td>
<td>1,000</td>
<td>1,400</td>
</tr>
<tr>
<td><strong>Unit cost</strong></td>
<td>N 5.00</td>
<td>N 5.00</td>
</tr>
</tbody>
</table>

At full capacity:

<table>
<thead>
<tr>
<th></th>
<th>Single Shift</th>
<th>Double Shift</th>
<th>Treble Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable Cost</strong></td>
<td>N 4,500</td>
<td>N 8,000</td>
<td>N 14,000</td>
</tr>
<tr>
<td><strong>Fixed Cost</strong></td>
<td>N 2,000</td>
<td>N 2,520</td>
<td>N 3,030</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td>N 6,500</td>
<td>N 10,520</td>
<td>N 17,030</td>
</tr>
</tbody>
</table>
5.4.8 Acceptance or rejection of a special order

By this is meant the acceptance or rejection of an order which utilises spare capacity, but which is only available if a lower than normal price is quoted. The procedure is illustrated by the following example.

**ILLUSTRATION 5-7**

Tahir Umar Company which manufactures rubber soles for use in its production cycle, has the following unit cost for production of 40,000 units:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Labour</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Direct Material</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
Manufacturing overheads \[\frac{36}{74} \]

75% of the manufacturing overhead is fixed. Michael Buba Ltd has offered to sell 40,000 units of the rubber soles to Tahir Umar Ltd for N55 per unit. If Tahir Umar accepts the offer, part of the facilities presently used to manufacture the rubber soles could be rented to Kaftani Ltd at a rent of N72,000. Also, N10 per unit of the fixed overhead costs applied to the rubber soles would be avoided.

The Managing Director, Mallama Danbaba has called you to advise him on whether or not to accept the offer. You are also required to state other matters that should be considered before taking the decision.

SUGGESTED SOLUTION 5-7

EVALUATION OF MICHAEL BUBA LTD’S OFFER

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buba Ltd’s Quotation (N55 x 40,000)</td>
<td>2,200,000</td>
<td></td>
</tr>
<tr>
<td>Less Incremental Outlay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Materials (N8 x 40,000)</td>
<td>320,000</td>
<td></td>
</tr>
<tr>
<td>Direct Labour (N30 x 40,000)</td>
<td>1,200,000</td>
<td></td>
</tr>
<tr>
<td>Valuable manufacturing overhead (25% of N36 x 40,000)</td>
<td>360,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1,880,000</td>
<td></td>
</tr>
<tr>
<td>Applicable fixed overhead (N10 x 40,000)</td>
<td>400,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,280,000</td>
<td></td>
</tr>
<tr>
<td>Opportunity cost - rent to Kaftani Ltd</td>
<td>72,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,352,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(152,000)</td>
<td></td>
</tr>
</tbody>
</table>

Decision:

Since Buba Michael Ltd’s quotation of N2,200,000 is less than the cost of producing within (N2,352,000), it is hereby recommended that the offer should be accepted from Buba Michael Ltd subject to other qualitative factors.

However, there are several other factors which would need to be considered before a final decision is taken. These include:

(a) Will the acceptance of one order at a lowered price lead other customers to demand lower prices as well?
(b) Is this special order the most profitable way of using the spare capacity?
(c) Will the special order present future usage of the idle capacity for full price business?
(d) Is it absolutely certain that fixed costs will not alter?

5.4.9 Discontinuance of a product line

If a company has a range of products, one of which is deemed to be unprofitable, it may consider discontinuing with the item from its range.

ILLUSTRATION 5-8

Glory Aseye Malunfashi Ltd. produces three products for which the following operating statement has been produced:

<table>
<thead>
<tr>
<th></th>
<th>Product A</th>
<th>Product B</th>
<th>Product C</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>N 128,000</td>
<td>N 200,000</td>
<td>N 180,000</td>
<td>N 508,000</td>
</tr>
<tr>
<td>Total Costs</td>
<td>144,000</td>
<td>152,000</td>
<td>136,000</td>
<td>432,000</td>
</tr>
<tr>
<td>Profit/(Loss)</td>
<td>(16,000)</td>
<td>48,000</td>
<td>44,000</td>
<td>76,000</td>
</tr>
</tbody>
</table>

The total cost comprises $\frac{2}{3}$ variable and $\frac{1}{3}$ fixed.

The directors consider that as product A shows a loss it should be discontinued.

Based on the above cost data, should Product A be dropped? What other factors should be considered?

SUGGESTED SOLUTION 5-8

**GLORY ASEYE MALUMFASHI LTD.**

Product A

Sales                      N 128,000
Less Total Variable Cost  
($\frac{2}{3}$ x N 144,000)  \[ 96,000 \]
Total Contribution         \[ 32,000 \]

**Decision:**

Product A is showing a positive total contribution of N 32,000, hence it should not be dropped. If product A is mistakenly dropped, the total profit of the business (N 76,000) will go down by the positive contribution of A (N 32,000) to N 44,000.
Other factors to be considered include:

(i) Is product A jointly demanded with any of the other products? If so, then sales of other products will be affected. This will also lead to loss of profit.

(ii) Loss of goodwill will result if customers of product A cannot see the product in the market.

(iii) What will be the fate of workers that manufacture product A? Are they going to be re-trained or retrenched?

(iv) What would happen to the plant and equipment used in manufacturing Product A, particularly if it is of a specialized nature and not readily marketable?

5.4.10 Key Budget Factor / Limiting Factor

Key budget factor sometimes known as a limiting factor or principal budget factor. This is a factor which is a binding constraint upon the organisation, that is, the factor which restricts indefinite expansion or unlimited profits. It may be sales, availability of finance, skilled labour, supplies of material or lack of space. Where a single binding constraint can be identified, then the general objective of maximising contribution can be achieved by selecting the alternative which maximises the contribution per unit of key factor. It will be apparent that from time to time, the key factor in an organisation will change. For example, a firm may have a shortage of orders. It overcomes this by appointing salesmen and then finds that there is a shortage of machinery capacity. The expansion of the productive capacity may introduce a problem of lack of space and so on.

The ‘maximising contribution per unit of the limiting factor’ rule can be of value, but can only be used where there is a single binding constraint and where the constraint is continuously divisible, that is, it can be altered one unit at a time. Where several constraints apply simultaneously, the simple maximising rule given above cannot be applied because of the interaction between constraints.

In such circumstances, mathematical techniques can be used to establish the optimal position. One of the more important mathematical techniques that can be used for such problems is known as Linear programming (LP). This is explained in chapter fourteen (14) of this study pack.
Rules governing the limiting factor(s)

(a) When there is no key limiting factor, use contribution margin

(b) If there’s only one key limiting factor, use contribution per key limiting factor.

(c) If there is more than one limiting factor, use linear programming.

**ILLUSTRATION 5-9**

<table>
<thead>
<tr>
<th>Products</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Price</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Direct material (₦2/kg)</td>
<td>10</td>
<td>66</td>
<td>45</td>
</tr>
<tr>
<td>Direct wages (₦4/hr)</td>
<td>40</td>
<td>22</td>
<td>60</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>20</td>
<td>11</td>
<td>30</td>
</tr>
</tbody>
</table>

Variable overheads are recovered at the rate of ₦2 per direct labour hour. Total fixed overheads are estimated at ₦60,000.

You are required to:

(a) Calculate the priority ranking of the products:
   (i) When the market for sales is limited to volume
   (ii) When the supply of labour is limited
   (iii) When the market for sales is limited by value

(b) Calculate the maximum profit and the sales units when the total raw material available is 30,000 kg and the maximum sales potential for each product is as follows:

   (X) 800 units  (Y) 700 units  (Z) 900 units
SUGGESTED SOLUTION 5-9

(a) i. Using sales volume as a limiting factor:

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales price</td>
<td>100</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>Variable cost:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Materials</td>
<td>10</td>
<td>66</td>
<td>45</td>
</tr>
<tr>
<td>Direct Wages</td>
<td>40</td>
<td>22</td>
<td>60</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>20</td>
<td>70</td>
<td>11</td>
</tr>
<tr>
<td>Contribution</td>
<td>30</td>
<td>51</td>
<td>65</td>
</tr>
<tr>
<td>Ranking</td>
<td>3rd</td>
<td>2nd</td>
<td>1st</td>
</tr>
</tbody>
</table>

(ii). Using Labour as a limiting factor:

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour hrs/Unit</td>
<td>10</td>
<td>5.5</td>
<td>15</td>
</tr>
<tr>
<td>C/L hrs</td>
<td>30</td>
<td>51</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>5.5</td>
<td>15</td>
</tr>
</tbody>
</table>

(iii). Using Sales Value as a limiting factor:

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/Sales x Value</td>
<td>30 x 100 / 100</td>
<td>51 x 100 / 150</td>
<td>65 x 100 / 200</td>
</tr>
<tr>
<td>PV Ratio=</td>
<td>30%</td>
<td>34%</td>
<td>33%</td>
</tr>
<tr>
<td>FC x PV Ratio=</td>
<td>60,000 x 0.3</td>
<td>60,000 x 0.34</td>
<td>60,000 x 0.33</td>
</tr>
<tr>
<td>=</td>
<td>N 18,000</td>
<td>N20,400</td>
<td>N19,800</td>
</tr>
<tr>
<td>Ranking</td>
<td>3rd</td>
<td>1st</td>
<td>2nd</td>
</tr>
</tbody>
</table>

(iv). Material as limiting factor:

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material / Unit</td>
<td>5</td>
<td>33</td>
<td>22.5</td>
</tr>
<tr>
<td>C/Mat</td>
<td>30/5</td>
<td>51/33</td>
<td>65/22.5</td>
</tr>
<tr>
<td>=</td>
<td>6</td>
<td>1.54</td>
<td>2.89</td>
</tr>
<tr>
<td>Material required</td>
<td>X=800 x 5</td>
<td>= 4,000 materials</td>
<td>Y=700 x 33</td>
</tr>
</tbody>
</table>
Allocation schedule for the 30,000 materials available

<table>
<thead>
<tr>
<th>Rank</th>
<th>Product</th>
<th>Materials Required</th>
<th>Materials Allocated</th>
<th>Comm. Allocation</th>
<th>Balance Available</th>
<th>Working Recommended</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>X</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
<td>26,000</td>
<td></td>
<td>800</td>
</tr>
<tr>
<td>2nd</td>
<td>Z</td>
<td>20,250</td>
<td>20,250</td>
<td>24,250</td>
<td>5,750</td>
<td></td>
<td>900</td>
</tr>
<tr>
<td>3rd</td>
<td>Y</td>
<td>23,100</td>
<td>5,750</td>
<td>30,000</td>
<td>NIL</td>
<td>5750</td>
<td>33</td>
</tr>
</tbody>
</table>

**ILLUSTRATION 5-10**

BABA AGBA produces from products L, E, W and S which have the following costs per unit.

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>E</th>
<th>W</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

Direct Materials (at ₦10/kg) 15 10 12.50 20
Direct Labour (at ₦12/hr) 12 12 18.00 18
Overheads (at ₦6/Labour hr) 6 6 9.00 9
Total Cost 33 28 39.50 47

Contributions per unit 10 15 12.00 20

Maximum demand per month 3,000 2,000 1,500 2,500

Only 15,000 kilograms of material and 10,250 labour hours are available. What is the optimal production plan given that the company wish to maximise contribution?

**SUGGESTED SOLUTION 5-10**

Step I: Identify the key factor between material and labour hour.

(i) Materials required for maximum demand

\[= (1.5 \times 3,000) + (1 + 2,000) (1.25 \times 1,500) + (2 \times 2,500)\]

\[= 4,500 + 2,000 + 1,875 + 5,000\]

Materials available

\[15,000\]

Surplus / Excess

\[1,650\]

There is enough material to meet maximum demand, so materials are not a limiting factor.

(ii) Labour Requirements for maximum demand:

\[= (1 \times 3,000) + (1 \times 2,000) + (1.5 \times 1,500) + (1.5 \times 2,500)\]

\[= 3,000 + 2,000 + 2,250 + 3,750\]

Labour hours available

\[10,250\]

Deficit

\[750\]
Labour hour is a limiting factor

**Step 2: Identify the order of ranking for allocation**

<table>
<thead>
<tr>
<th>Product</th>
<th>L</th>
<th>E</th>
<th>W</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution per unit</td>
<td>N10</td>
<td>N15</td>
<td>N12</td>
<td>N20</td>
</tr>
<tr>
<td>Labour hours per unit</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Contributions per hour</td>
<td>N10</td>
<td>N15</td>
<td>N8</td>
<td>N13.33</td>
</tr>
<tr>
<td>Ranking</td>
<td>3rd</td>
<td>1st</td>
<td>4th</td>
<td>2nd</td>
</tr>
</tbody>
</table>

**Step 3:** Prepare Allocation table for 10,250 hours

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Product</th>
<th>Demand</th>
<th>Labour Hours / unit</th>
<th>Labour Hours Allocated</th>
<th>Cum Labour Hour</th>
<th>Balance</th>
<th>Production Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>2,000</td>
<td>1</td>
<td>2,000</td>
<td>2,000</td>
<td>8,250</td>
<td>2,000</td>
</tr>
<tr>
<td>2</td>
<td>S</td>
<td>2,500</td>
<td>1.5</td>
<td>3,750</td>
<td>5,750</td>
<td>4,500</td>
<td>2,500</td>
</tr>
<tr>
<td>3</td>
<td>L</td>
<td>3,000</td>
<td>1</td>
<td>3,000</td>
<td>8,750</td>
<td>1,500</td>
<td>3,000</td>
</tr>
<tr>
<td>4</td>
<td>W</td>
<td>1,500</td>
<td>1.5</td>
<td>1,500</td>
<td>1,020</td>
<td>--</td>
<td>1,000 (w1)</td>
</tr>
</tbody>
</table>

(W 1) Product W = Hours Allocated ÷ hours per unit = 1,500 / 1.5 = 1,000 units.

**Step 4:** Select the optimal product mix from step 3 above.

<table>
<thead>
<tr>
<th>Product</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>3,000</td>
</tr>
<tr>
<td>E</td>
<td>2,000</td>
</tr>
<tr>
<td>W</td>
<td>1,000</td>
</tr>
<tr>
<td>S</td>
<td>2,500</td>
</tr>
</tbody>
</table>

### 5.4.11 Make or buy decisions

Management is usually faced with the decision on whether to make a component part within or to buy from outside supplier. A decision is relevant particularly in a situation whereby the company has the capacity to produce/make such component.

In general, the relevant cost comparison is between the marginal cost of manufacture and the buying-in price. However, when manufacturing the component displaces existing production, the lost contribution must be added to the marginal cost of production of the component before comparison with the buying-in price.
ILLUSTRATION 5-11

Bayelsa Imota Ltd manufactures component OMJ and the costs for the current production level of 150,000 units are:

<table>
<thead>
<tr>
<th>Cost/unit</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>10.00</td>
</tr>
<tr>
<td>Labour</td>
<td>5.00</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>7.00</td>
</tr>
<tr>
<td>Fixed overheads</td>
<td>15.00</td>
</tr>
<tr>
<td><strong>Total cost</strong></td>
<td><strong>37.00</strong></td>
</tr>
</tbody>
</table>

Component OMJ could be bought in from an outside supplier, SAB Ltd, for ₦31 and, if so, the production capacity utilised at present would be unused.

Assuming that all other factors are constant, should ABC be manufactured internally or bought from the outside supplier?

SUGGESTED SOLUTION 5-11

BAYELSA IMOTA LTD

Cost of buying from SAB Ltd per unit = ₦31
Cost of producing within:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials</td>
<td>10.00</td>
</tr>
<tr>
<td>Labour</td>
<td>5.00</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>7.00</td>
</tr>
<tr>
<td><strong>Marginal cost product</strong></td>
<td><strong>22.00</strong></td>
</tr>
</tbody>
</table>

**Decision:** The component ABC should be manufactured internally because the cost of producing within (₦22) is less than the cost of buying from outside supplier (₦31 per unit).

ILLUSTRATION 5-12

The management of FABREKOKO Industries has been evaluating whether the company should continue manufacturing a component or buy it from an outside supplier. A ₦100 cost per component was determined as follows:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>15</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>40</td>
</tr>
<tr>
<td>Variable Manufacturing O/H</td>
<td>10</td>
</tr>
<tr>
<td>Fixed Manufacturing Overhead</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>
The company uses 4000 components per year. After Santos Limited submitted a bid of N$50 per component, some members of management felt they could reduce costs by buying from outside and discontinue production of the component.

If the component is obtained from Santos Limited, Fabrekoko’s unused production facilities could be leased to another company for N$50,000 per year.

**Required:**

(a) Determine the maximum amount per unit that Fabrekoko Limited could pay to an outside supplier.

(b) Indicate if the company should make or buy the component and the total naira difference in favour of that alternative.

(c) Assume the company could eliminate a production supervisor with a salary of N$10,000 of the component is purchased from an outside supplier, indicate if the company should make or buy the component and the total naira difference associated with our decision.

**Suggested Solution 5-11**

(a) Maximum amount per unit

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>15.00</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>40.00</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>10.00</td>
</tr>
<tr>
<td>Opportunity Cost ($50,000/4,000)</td>
<td>12.50</td>
</tr>
<tr>
<td></td>
<td><strong>77.50</strong></td>
</tr>
</tbody>
</table>

(b) Savings or Deficit from making 4,000 units

<table>
<thead>
<tr>
<th></th>
<th>N’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier’s quotation (N$80 x 4,000)</td>
<td>320</td>
</tr>
<tr>
<td>Less: Relevant Cost of Production</td>
<td></td>
</tr>
<tr>
<td>Direct Materials (N$15 x 4,000)</td>
<td>60</td>
</tr>
<tr>
<td>Variable Overhead (N$10 x 4,000)</td>
<td>40</td>
</tr>
<tr>
<td>Direct Labour (N$40 x 4,000)</td>
<td>160</td>
</tr>
<tr>
<td>Rental Income (Opportunity Cost)</td>
<td>50</td>
</tr>
<tr>
<td>Savings from making the component</td>
<td><strong>10</strong></td>
</tr>
</tbody>
</table>
### Alternately

<table>
<thead>
<tr>
<th></th>
<th>Buy</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier’s quotations</td>
<td>(320,000)</td>
<td>-</td>
</tr>
<tr>
<td>Direct Materials</td>
<td>-</td>
<td>(60,000)</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>-</td>
<td>(160,000)</td>
</tr>
<tr>
<td>Variable Manufacturing O/H</td>
<td>-</td>
<td>(40,000)</td>
</tr>
<tr>
<td>Rental</td>
<td>50,000</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>(270,000)</strong></td>
<td><strong>(260,000)</strong></td>
</tr>
</tbody>
</table>

(c) **Savings or Deficit from making the 4,000 units**

<table>
<thead>
<tr>
<th></th>
<th>N,000</th>
<th>N,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier’s quotation (N 80 x 4,000)</td>
<td>320</td>
<td></td>
</tr>
<tr>
<td>Less: Relevant Cost of making:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct materials (N 15 x 4,000)</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Direct Labour (N 40 x 4,000)</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Variable Overhead (10 x 4,000)</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Avoidance Fixed Manufacturing O/H</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Rental Revenue (Opportunity Cost)</td>
<td>50</td>
<td>340</td>
</tr>
<tr>
<td>Deficit from making the component</td>
<td></td>
<td><strong>(20)</strong></td>
</tr>
</tbody>
</table>

Decision: Buy

### Alternately,

<table>
<thead>
<tr>
<th></th>
<th>Buy</th>
<th>Make</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside supplier’s price (N 80 x 4,000)</td>
<td>(320)</td>
<td>-</td>
</tr>
<tr>
<td>Direct material (N 15 x 4,000)</td>
<td>-</td>
<td>(60)</td>
</tr>
<tr>
<td>Direct Labour (40 x 4,000)</td>
<td>-</td>
<td>(160)</td>
</tr>
<tr>
<td>Variable O/H (10 x 4,000)</td>
<td>-</td>
<td>(40)</td>
</tr>
<tr>
<td>Avoidable fixed manufacturing O/H</td>
<td>-</td>
<td>(30)</td>
</tr>
<tr>
<td>Rental Revenue</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>(270)</strong></td>
<td><strong>(290)</strong></td>
</tr>
</tbody>
</table>

#### 5.5 COST-VOLUME-PROFIT (CVP) ANALYSIS

Cost-Volume-Profit Analysis otherwise known as Break-Even Analysis refers to a technique that assists in decision making by employing the marginal costing concept and is used to measure the effect on profit as a result of changes in volume of activities, cost and prices. It also facilitates planning in the sense that CVP analysis could assist to predict future cost levels and sales as related to a range of level of activity. It demonstrates how the profit will be affected as a result of changes in any of the variables that make up the profit function. Its use requires the separation of the total cost function into their, variable and fixed portion, as required in the application of marginal costing principles.
The profit-volume ratio is a very useful figure which indicates the relationship of contribution to turnover. The formula used to calculate it is:

$$\frac{\text{Contribution}}{\text{Sales}} \times 100 \times \frac{1}{1}$$

It is common practice to express this measurement in percentage form, so the usual version is:

$$\frac{s - v}{s} \times 100$$

The profit-volume ratio may be used to measure the relative contribution of a product or a company for various periods. It is popularly called P/V Ratio.

5.5.1 Application of the P/V ratio

Management may request information towards solving a variety of problems which require calculations and involving profit-volume ratios, for example:
(a) What is the company’s break-even point?
(b) What would be the profit on sales volume NX?
(c) What volume of sales would be required to achieve a planned level of profit?
(d) What volume of sales would be required to maintain the present level of output, if selling price were reduced, by 10%?

The use of P/V ratio and graphs can provide answers to such problems, although, it is again assumed that these answers are guides only and may not be accurate. However, they do at least provide a measuring tool which can form the basis of decision making.

5.5.2 Basic assumptions of C-V-P-Analysis

The basic assumptions associated with C - V - P technique are:

(a) All costs could be categorised as either variable cost or fixed cost.
(b) Semi-Variable cost can be segregated into both the variable and its fixed component.
(c) Selling price per unit is constant.
(d) Variable cost per unit is constant.
(e) Total fixed cost remains unchanged, regardless of output.
(f) Parity of production and sales. That is, there is no closing stock of goods since production equals sales.
(g) Only one product is involved and in case of a multi-product organisation, there is a constant sales mix.
(h) Level of technology and efficiency remains the same.
(i) Volume is the only independent variable that affects cost.
(j) Risk and uncertainty are non-existent.
(k) There is a relevant range.

5.5.3 Limitations of the basic assumptions

In a true life situation, the basic assumptions of CVP analysis as discussed above, tend only to be valid over a limited range of activity. As a result of this reason, care must be exercised when using only break even analysis as a basis for decision making or the presentation of information.

The basic assumptions of CVP have the following deficiencies:

(a) It might be difficult to separate some costs into their fixed and variable cost portions.
(b) The selling price per unit is assumed to be constant. This is not realistic because of possibility of discounts.
(c) The variable cost per unit is assumed to be constant. This is not realistic because quantity discount could result in decrease in material cost and labour cost per unit could fall whenever the learning curve theory becomes applicable.
(d) Fixed cost is assumed to remain unchanged. This is not true because in reality, fixed cost moves in a step-like manner. Also in the long run all costs are variable.
(e) It is assumed that production is equal to sale, hence no closing stock. This assumption looks unrealistic because a business is a going concern and invariably stocks are carried from one period to the other.
(f) The assumption of one product or constant mix of product is not realistic because most organizations produce variety of products and invariably actual mix turn out to be radically different from the expected level of activity. This may be due to a host of factors such as the tastes of the consumers and the economic realities of the day.
(g) The assumption that there is no change in level of technology and efficiency is untenable since innovations are taking place regularly in all spheres of business endeavours.

5.5.4 Applications of the CVP model

(a) To determine the break even point in units.
\[
\text{Total Fixed Cost (TFC)} = \frac{\text{Contribution per Unit (CPU) or Contribution Margin (CM)}}{\text{CM}}
\]

(b) Break even point in sales value (N)

\[
= \frac{\text{Total Fixed Cost (TFC)}}{\text{Contribution Margin Ratio (CMR)}}
\]

(c) Number of units to sell to make a targeted profit (N)

\[
\frac{\text{TFC} + \text{Targeted Profit}}{\text{CPU or CM}}
\]

(d) The sales value in N required to achieve a targeted profit

\[
= \frac{\text{TFC} + \text{Targeted Profit}}{\text{CMR}}
\]

Note: Targeted profit is assumed to be profit before tax (PBT). However, if the targeted profit is profit after tax, there is need to gross-up the profit after tax to profit before tax, using the formula below:

\[
\text{Profit before tax (PBT)} = \frac{\text{Profit after tax (PAT)}}{1 - \text{tax rate}}
\]

That is, if tax rate is 30%, PBT = \(\frac{\text{Profit tax}}{1 - 0.30} = \frac{\text{PAT}}{0.70}\)

### ILLUSTRATION 5-13

The directors of Unik-Tee & Company Limited wish to know the volume of sales required to achieve a profit of N20,000. Selling price are not expected to change. The following information is given:

- One product only is produced.
- Fixed overheads for the period are N40,000
- The profit-volume ratio is 60%

### SUGGESTED SOLUTION 5-13

UNIK-TEE & COMPANY LIMITED

\[
\text{Sales Volume required} = \frac{\text{TFC} + \text{Targeted Profit}}{\text{P/V ratio}}
\]
ILLUSTRATION 5-13

Yinka Limited is considering a reduction in the price of its product by 10% because it is felt that such a step may lead to a greater volume of sales. It is thought that there is no prospect of a change in fixed costs or variable cost per unit. The director wishes to maintain profit at the present level, so the loss which will be incurred by reducing the selling price must be offset by a gain due to increased volume of sales. You are given the following information:

<table>
<thead>
<tr>
<th>Sales (10,000 units)</th>
<th>N200,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable costs</td>
<td>N 15 per unit</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>N 40,000</td>
</tr>
</tbody>
</table>

State the volume of sales required to maintain the existing profit.

SUGGESTED SOLUTION 5-13

YINKA LIMITED

The present level of profit = N200,000 - (150,000 + 40,000) = N10,000

and the P/V Ratio is

\[
\frac{S - V}{S} = \frac{50,000}{200,000} = 25\%
\]

If the selling price were reduced with no corresponding increase in sales volume, the profit-volume ratio would be:

Sales = 180,000
VC = 150,000
Total Contribution = 30,000

CMR = \[ \frac{S - V}{S} = \frac{30,000}{180,000} \times 100 = 16.67\% \]

It is not expected that fixed costs will change. The Director wishes profit to remain at its present level. So, the volume of sales required is

\[
= \frac{TFC + \text{Profit}}{P/V \text{ or CM Ratio}} = \frac{N40,000 + 10,000}{0.1667} = N300,000 \text{ (approx.)}
\]
The Profit-Volume Graph

The profit volume graph - is a development of the break - even chart and portrays the relationship of profit to volume. It requires the same basic data as the Break - Even Chart (BEC) and suffers from the same limitations with BEP chart. But if these limitations are borne in mind, they provide a valuable aid to management in making decisions concerning volumes of output.

Construction of profit - volume chart will involve the following processes:

(a) Draw a vertical line and select a point in between it to represent point O, that is, the point at which neither profit nor loss is made.

(b) From point O, draw the horizontal line to the right and scale appropriately for sales.

(c) Also scale the upper vertical line for profit and the lower line for losses.

(d) On the vertical axis, the area below the sales line represents fixed cost and that above it represents profit.

(e) Profits are plotted for the required fixed costs and for profit and a line is drawn to connect the two points.

The P/V graph or profit/volume graph is similar to the break - even chart, and records the profit or loss at each level of sales. It is a straight line graph, drawn most simply by recording:

(i) The loss at zero sales, which is full amount of fixed cost and

(ii) The profit (loss) at the budgeted level of sales; and joining up the two points.

ILLUSTRATION 5-14

From the data given below, you are required to present on graph paper a cost-profit volume graph to show the expected company performance based on a budget for one year. 

\[ \text{N 000's} \]

<table>
<thead>
<tr>
<th>Sales</th>
<th>600</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marginal cost</td>
<td>350</td>
</tr>
<tr>
<td>Fixed cost</td>
<td>150</td>
</tr>
</tbody>
</table>

Determine the break-even point and the margin of safety.
(ii) Discuss briefly the limitations of profit-volume graph.

**SUGGESTED SOLUTION 5-14**

(i) The data given can be rearranged thus:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>600,000</td>
</tr>
<tr>
<td>Less Marginal cost</td>
<td>350,000</td>
</tr>
<tr>
<td>Contribution</td>
<td>250,000</td>
</tr>
<tr>
<td>Less Fixed cost</td>
<td>150,000</td>
</tr>
<tr>
<td>Profit</td>
<td>100,000</td>
</tr>
</tbody>
</table>

The P/V graph is shown below:

(ii) A P/V graph plots the profit/loss line at an angle which depends on the contribution/sales ratio which, in the example above is

\[
\frac{250,000}{600,000} = 41.6\% \text{(Note: not drawn to scale)}
\]

**ILLUSTRATION 5-15**

University of Namoda has just developed a new microcomputer in the rapidly expanding home market. As a management accountant, you are consulted as to the viability of marketing this computer.

In conjunction with the manager of research and development, the production manager, the buyer and the sales manager, you have been able to ascertain the following estimate:
Sales Level | Profit
-------------|--------
Units        | N
12,000      | (30,000)
15,000      | 150,000
18,000      | 330,000

The selling price will be N150.

You are required to:

(i) Prepare a contribution/sales graph (sometimes known as profit-volume graph), using the information given above, and read off the margin of safety;

(ii) Calculate the estimated profit if the probabilities for each sales level are:

<table>
<thead>
<tr>
<th>Sales Level</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td></td>
</tr>
<tr>
<td>12,000</td>
<td>0.2</td>
</tr>
<tr>
<td>15,000</td>
<td>0.5</td>
</tr>
<tr>
<td>18,000</td>
<td>0.3</td>
</tr>
</tbody>
</table>

| 1.0         |

**SUGGESTED SOLUTION 5-16**

(i) From the information supplied, the contribution and fixed costs can be readily calculated.

\[
\text{Contribution/unit} = \frac{N330,000 - 150,000}{18,000 - 15,000} = N60
\]

\[
\text{Fixed Costs} = 12,000 \times N60 + N30,000 = N750,000
\]

The contribution/graph can now be drawn.
Estimated profit
Expected sales = (12,000 x 0.2) + (15,000 x 0.5) + (18,000 x 0.3) = 15,300 units

\[
\begin{array}{c|c|c}
\text{N} & \text{N} \\
\hline
\text{Sales} = 15,300 \times N150 & 2,295,000 & \text{Sales} = 15,000 \times N150 = 2,250,000 \\
\text{less Variable Costs @ N90} & 1,377,000 & \text{less Fixed costs @ N90} = 750,000 \\
\text{= Contribution} & 918,000 & \text{Less Profit} = 150,000 \\
\text{less Fixed Costs} & 750,000 & \\
\text{Profit} & N168,000 & \text{Total V/C @ N1,350,000} \\
\end{array}
\]

Note: Variable cost = Selling price less contribution/unit
= N(150 - 60) = N90

ILLUSTRATION 5-17

Ukpong Nigeria Limited currently makes and sells 7,000 units of their product each year. Fixed costs are N18,000 per annum, the variable cost of sales N8 per unit and sales revenue N11 per unit. By changing the production process, it is thought that variable costs could be reduced by N0.20 per unit, although fixed costs would rise as a consequence by N1,300.

(a) How would the change affect
   (i) Budgeted profit; and
   (ii) The break-even point and margin of safety, assuming that there would be no changes in the sales price and demand for the product?

(b) At what level of sales volume would the change-over be profitable? Ignore risk.
### SUGGESTED SOLUTION 5-17

**Ukpong Nigeria Limited**

<table>
<thead>
<tr>
<th></th>
<th>Current System</th>
<th>Proposed System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution (7,000 x N3)</td>
<td>21,000</td>
<td>22,400</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>18,000</td>
<td>19,300</td>
</tr>
<tr>
<td>Profit</td>
<td>₦3,000</td>
<td>₦3,100</td>
</tr>
</tbody>
</table>

Break-even point

<table>
<thead>
<tr>
<th></th>
<th>₦18,000</th>
<th>₦19,300</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>₦3</td>
<td>₦3.2</td>
</tr>
<tr>
<td></td>
<td>6,000 units</td>
<td>6,031.25 units</td>
</tr>
</tbody>
</table>

Margin of safety

\[
\text{Margin of safety} = \frac{1,000}{7,000 \text{ units}} = 14.34\% \\
\text{or } \frac{969}{7,000 \text{ units}} = 13.8\%
\]

The new scheme offers a higher profit of ₦3,100 but the break-even point is higher at 6031 units and the MOS lower at 969 units.

**b)** The New scheme becomes, more preferable, ignoring the risk factor, at sales volumes of less than 7,000 units.

<table>
<thead>
<tr>
<th></th>
<th>₦3,100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit at 7,000 units, current scheme</td>
<td></td>
</tr>
<tr>
<td>Contribution at 7,000 units, current scheme</td>
<td>₦3,000</td>
</tr>
<tr>
<td>Increase in contribution at 7,000 units</td>
<td>₦100</td>
</tr>
</tbody>
</table>

### ILLUSTRATION 5-17

Abubakar Lawal Limited, Kano produces a single product with a selling price of ₦20 and a variable cost of ₦12. Fixed costs are ₦120,000 per annum.

You are required to determine the following:

**a)** Break even point in units and in ₦ sales value

**b)** What number of units will be sold to achieve a profit of ₦40,000
per annum?
(c) If the tax rate is 40%, how many units will be sold to make profit of ₦20,000 after tax per annum.

SUGGESTED SOLUTION 5-17

Abubakar Lawal Limited
SP = ₦20 per unit
VC = ₦12 per unit
TFC = ₦120,000

(a) Break-even point in units

\[
\text{Break even point} = \frac{TFC}{CM}
\]

\[
CM = SP \cdot VC = ₦20 \cdot ₦12 = ₦8
\]

Therefore, Break even point = \( \frac{120,000}{8} \)

= 15,000 units

Break even point in ₦ sales value

\[
= \frac{TFC}{CMR}
\]

Where CMR = \( \frac{SP - VC}{SP} \)

= ₦ \( \frac{20 - 12}{20} \)

= ₦ \( \frac{8}{20} \)

= 0.4 or 40%

Therefore, Break-even point = \( \frac{120,000}{0.4} \)

= ₦300,000

(b) Sales Qty to achieve ₦40,000 profit

\[
= \frac{\text{FixedCost + Profit}}{\text{Contribution per unit}}
\]

\[
= \frac{(120,000 + 40,000)}{20 - 12}
\]

= 20,000 units
(c) **Tax rate** = 40%
Targeted profit = ₦20,000 after tax
Units to achieve a targeted profit

\[
\text{TFC + TARGETED PROFIT} = \frac{\text{CM}}{}
\]

However,

\[
\text{Profit before tax} = \frac{\text{Profit after tax}}{1 - \text{tax rate}}
\]

\[
= \frac{20,000}{0.6} = ₦33,333
\]

Units to be sold to achieve a profit after tax of ₦20,000 (profit before tax of ₦33,333)

\[
= ₦ \frac{120,000 + 33,333}{8}
\]

\[
= ₦ \frac{153,333}{8} = 19,167 \text{ units.}
\]

**Note:** Where tax rate is not specified, assume profit given to be profit before tax.

**ILLUSTRATION 5-18**

Lorlor Nwankwo Nigeria Limited’s tentative budget for product “SUBA” for 2009 is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (2500 units at ₦40 a unit)</td>
<td>100,000</td>
<td></td>
</tr>
<tr>
<td>Manufacturing cost of goods sold:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct labour</td>
<td>15,000</td>
<td></td>
</tr>
<tr>
<td>Direct materials</td>
<td>14,000</td>
<td></td>
</tr>
<tr>
<td>Variable factory O/H</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>fixed factory O/H</td>
<td>5,000</td>
<td>44,000</td>
</tr>
<tr>
<td>Gross profit</td>
<td></td>
<td>56,000</td>
</tr>
<tr>
<td>Selling expense</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Variable</td>
<td>6,000</td>
<td></td>
</tr>
<tr>
<td>- Fixed</td>
<td>10,000</td>
<td>(16,000)</td>
</tr>
<tr>
<td>Administrative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Variable</td>
<td>5,000</td>
<td></td>
</tr>
</tbody>
</table>
- Fixed 10,000 (15,000) \\
Operating income  \\nN25,000

Required:

(a) How many units of product “SUBA would have to be sold to break even?

(b) What is the margin of safety?

(c) What would the operating income be if projected sales increase by 20%?

(d) If a targeted profit after tax of N75,000 is to be made, advise the management on the level of sales that should be achieved in order to meet the targeted profit.

Assume company income tax rate of 20%.

SUGGESTED SOLUTION 5-18

LORLOR NWANKWO NIGERIA LIMITED

(W1) Computation of Total Variable Cost

\[
\begin{array}{l}
\text{N} \\
\text{Direct labour} & 15,000 \\
\text{Direct materials} & 14,000 \\
\text{Variable factory O/H} & 10,000 \\
\text{Selling expenses} & 6,000 \\
\text{Admin expenses} & 5,000 \\
\hline
\text{Total Variable Cost} & 50,000
\end{array}
\]

(W2) Computation of Total Fixed Cost

\[
\begin{array}{l}
\text{N} \\
\text{Fixed factory O/H} & 5,000 \\
\text{Selling expenses} & 10,000 \\
\text{Admin expenses} & 10,000 \\
\hline
\text{Total Fixed Cost} & 25,000
\end{array}
\]

\[
\begin{align*}
\text{TFC} &= \text{N}25,000 \\
\text{TVC} &= \text{N}50,000 \\
\text{SP} &= \text{N}40 \\
Q &= 2,500 \text{ units}
\end{align*}
\]

Therefore, VC per unit = \( \frac{TVC}{Q} \)
\[
\begin{align*}
&= \frac{50,000}{2,500} = \text{N20} \\
\text{Therefore, CM} &= \text{SP - VC} \\
&= \text{N40 - N20 = N20}
\end{align*}
\]

(a) Break even point = \[
\frac{\text{TFC}}{\text{CM}} = \frac{25,000}{\text{N20}} = 1,250 \text{ units}
\]

(b) Margin of safety in units = Anticipated sales - Break even sales \\
= 2,500 - 1,250 = 1,250 \text{ units}

Margin of safety in N value = 1,250 x N40 \\
= N50,000

(c) When projected sales increase by 20% the variable cost component too will increase by 20% but the fixed cost component is assumed to remain unchanged.

\[\begin{array}{l}
\text{N} \\
\text{New sales level = N100,000 x 1.2 = 120,000} \\
\text{New total variable cost = N50,000 x 1.2 = 60,000} \\
\text{New contribution} = 60,000 \\
\text{Less total fixed cost} = 25,000 \\
\text{New operating income} = \text{N35,000}
\end{array}\]

Alternatively,

\[\begin{array}{l}
\text{N} \\
\text{New total contribution = N20 x 2500 x 1.2 = 60,000} \\
\text{Less total fixed cost} = 25,000 \\
\text{New operating income} = 35,000
\end{array}\]

(d) Profit after tax = N75,000 \\
Tax rate = 20\% \\
Therefore, Profit before tax = \frac{\text{PAT}}{1 - t} \\
= \frac{75,000}{0.8} = \text{N93,750}

Level of sales in N to achieve a targeted profit \\
= \frac{\text{TFC + Targeted Profit}}{\text{CMR}}
Where CMR = \( \frac{SP - VC}{SP} \)

\[ = \frac{40 - 20}{40} = \frac{20}{40} = 0.5 \]

Therefore, level of sales to achieve a targeted profit

\[ = \frac{25,000 + 93,750}{0.5} \]

\[ = \frac{118,750}{0.5} = \text{₦} 237,500 \]

To achieve a targeted profit of ₦ 75,000 after tax (or ₦ 93,750 before tax) in units:

\[ = \frac{237,500}{SP} \]

\[ = \frac{237,500}{40} \]

\[ = 5,938 \text{ units} \]

**ILLUSTRATION 5-19**

The Zobiwa Shoes Company sells five different styles of ladies' slippers with identical purchase costs and selling prices. The company is trying to find out the profitability of opening another store which will entail the following expenses and revenues:

<table>
<thead>
<tr>
<th>₹</th>
<th>₹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price</td>
<td>300.00</td>
</tr>
<tr>
<td>Less: Purchase Cost</td>
<td>195.00</td>
</tr>
<tr>
<td>Salesmen's Commission</td>
<td>15.00</td>
</tr>
<tr>
<td></td>
<td>210.00</td>
</tr>
</tbody>
</table>

The annual fixed expenses are:

<table>
<thead>
<tr>
<th>₹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rent</td>
</tr>
<tr>
<td>Salaries</td>
</tr>
<tr>
<td>Advertisement</td>
</tr>
<tr>
<td>Other Fixed Expenses</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Consider each of the following questions separately. You are required to:

(a) Calculate the annual breakeven point in units and in value. Also, determine the profit or loss if 3,500 units of slippers are sold.
(b) The sales commission is to be discontinued and instead a fixed amount of ₦90,000 is to be incurred on fixed salaries. A reduction in selling price of 5% is also proposed. What will be the breakeven point in units?

(c) It is proposed to pay the store manager an additional ₦5.00 per pair as commission. The selling price is also proposed to increase by 5%. What then would be the breakeven point in units?

(d) Refer to the data given above; if the store manager was to be paid ₦30.00 commission more on each pair of slippers sold in excess of the breakeven point. What would be the store’s net profit if 5,000 pairs were sold?

SUGGESTED SOLUTION 5-19

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price</td>
<td>300.00</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Cost</td>
<td>195.00</td>
<td></td>
</tr>
<tr>
<td>Salesman Commission</td>
<td>15.00</td>
<td>210.00</td>
</tr>
<tr>
<td>Contributions per unit</td>
<td></td>
<td>90.00</td>
</tr>
</tbody>
</table>

\[
\text{CMR} = \frac{\text{Contribution}}{\text{Sales}} = \frac{90}{300} = 0.3 \text{ or } 30\% 
\]

Therefore, BEP (Sales) = \[
\frac{\text{Total Fixed Cost}}{\text{Contribution Margin Ratio}} = \frac{360,000}{0.3} = ₦1,200,000
\]

BEP (Units) = \[
\frac{\text{Total Fixed Cost}}{\text{Contribution Margin}} = \frac{360,000}{90,000} = 4,000 \text{ units}
\]
### Income Statement based on 3,500 units

- **Sales** (₦300 x 3,500) 1,050,000
- Less: Variable Costs (₦210 x 3,500) 735,000
- **Total Contribution** 315,000
- Less: Total Fixed Costs 360,000
- **Loss** (45,000)

### Alternatively:

BEP (units) - (Actual Sales) x Contribution Margin Per Unit

(44,000 - 3,500) x ₦90 = (₦45,000)

**(b)** Revised Selling Price (95% x ₦300) 285.00
Less: Purchase Cost (Variable) 195.00
Contribution Margin per Unit 90.00

Therefore, BEP (units) = \( \frac{\text{Existing FC} + \text{Additional FC}}{\text{Contribution Margin}} \)

= \( \frac{360,000 + 90,000}{90} \)

= 5,000 units

**(c)** Revised Selling Price (1.05 x ₦300) 315.00
Less: Variable Costs:
- Purchase Cost 195.00
- Salesmen’s Commission \( (₦15.00 + ¥5.00) \) 20.00
Contribution margin per unit 100.00

Therefore, BEP (units)

= \( \frac{\text{Fixed Costs}}{\text{Contribution Margin}} \)

= \( \frac{360,000}{100} \)

= **3,600 units**
(d) **Income Statement based on 5,000 units**

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Revenue (₦ 300 x 5,000)</td>
<td>1,500,000</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase Costs (₦ 195 x 5,000)</td>
<td>975,000</td>
<td></td>
</tr>
<tr>
<td>Salesmen Commission:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEP (units) (4,000 x ₦ 15)</td>
<td>60,000</td>
<td></td>
</tr>
<tr>
<td>Excess (1,000 x ₦ 30)</td>
<td>30,000</td>
<td>1,065,000</td>
</tr>
<tr>
<td>Total Contribution</td>
<td></td>
<td>435,000</td>
</tr>
<tr>
<td>Less: Total Fixed Costs</td>
<td>360,000</td>
<td></td>
</tr>
<tr>
<td>Net Profit</td>
<td>75,000</td>
<td></td>
</tr>
</tbody>
</table>

**ILLUSTRATION 5-20**

The following data were collected from Adebogun Tobi Ltd:

- Total fixed cost = ₦ 6,000
- Variable cost = ₦ 3 per unit
- Selling price = ₦ 5 per unit
- Present sales level = 5000 units

You are required to:

(a) construct a break even chart.

(b) determine from the chart

(i) Break even point (or cost-volume-profit);
(ii) Estimated profit or loss at sale volume of 5000 units; and

(iii) Margin of safety.

**SUGGESTED SOLUTION 5-21**

![Break Even Chart]

**TR**

**TC**

**Profit = ₦ 4,000**

**BEP**

**Level of Activity**
Note: TR = Total revenue  
TC = Total cost  
TFC = Total fixed cost

From the above chart:

(i) Break even point = 3,000 units or ₦15,000 sales value  
(ii) Profit at output of 5,000 units = ₦4,000  
(iii) Margin of safety = 2,000 units or ₦10,000 sales value.

5.6 MULTI-PRODUCT BREAK-EVEN ANALYSIS

Organisations typically produce and sell variety of products and services. To perform break-even analysis in a multi-product organisation, however, a constant product sales mix must be assumed or all products must have the same C/S ratio.

Such an assumption allows us to calculate a weighted average contribution per mix, the weighting being on the basis of the quantities of each product in the constant mix. This means that the unit contribution of the product that makes up the largest proportion of the mix has the greatest impact on the average contribution per mix. The only situation when the mix products does not affect the analysis is when all of the products have the same ratio of contribution to sales.

The breakeven point in a multi-product organisation for a standard mix of products is calculated as fixed costs divided by contribution per mix. This can be achieved by using the following basic steps:

(a) Calculate the contribution per unit for each product;
(b) Compute the contribution per mix;
(c) Calculate the breakeven point in terms of the number of mixes;
(d) Compute the breakeven point in terms of the number of units of the products; and
(e) Calculate the breakeven point in terms of revenue.
ILLUSTRATION 5-21

Ekiti-Kete Industries Ltd manufactures two products – rice flour and beans flour.

The following data are projected for the coming year:

<table>
<thead>
<tr>
<th></th>
<th>Rice flour</th>
<th></th>
<th>Bean flour</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Kg</td>
<td>100,000</td>
<td>100,000</td>
<td>80,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Fixed cost</td>
<td>20,000</td>
<td></td>
<td>56,000</td>
<td></td>
</tr>
<tr>
<td>Variable cost</td>
<td>60,000</td>
<td></td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>80,000</td>
<td></td>
<td>86,000</td>
<td></td>
</tr>
<tr>
<td>Net profit</td>
<td>20,000</td>
<td></td>
<td>14,000</td>
<td></td>
</tr>
</tbody>
</table>

You are required to compute the:

(i) Break-even sales in kilogram for the rice flour assuming that the facilities are not used jointly;
(ii) Break-even sales in Naira for beans flour, assuming that the facilities are not used jointly;
(iii) Composite quantity contribution margin, assuming that consumers purchase composite quantity of sixty kilograms of rice flour and forty kilograms of beans flour;
(iv) Break-even quantity of both products, assuming that consumers purchase composite sixty kilograms of rice flour and forty kilograms of beans flour;
(v) Composite contribution margin ratio, assuming that a composite quantity is defined as one kilogram of rice flour and one kilogram of beans flour; and
(vi) Break-even sales in Naira, assuming that rice flour and beans flour become one-kilogram complement and that there is no change in the company’s costs. (ICAN NOV. 2005).

SUGGESTED SOLUTION 5-21

(i) Break-even sales in kg = \( \frac{20,000}{0.40} \) = 50,000kgs

(ii) Break-even sales in Naira = \( \frac{56,000}{0.875} \times 1.25 \) = 80,000kgs

<table>
<thead>
<tr>
<th></th>
<th>Rice flour</th>
<th>Beans flour</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales price</td>
<td>( \text{₦1.00} )</td>
<td>( \text{₦1.250} )</td>
<td>( \text{₦2.250} )</td>
</tr>
<tr>
<td>Variable cost</td>
<td>( \text{₦0.60} )</td>
<td>( \text{₦0.375} )</td>
<td>( \text{₦0.975} )</td>
</tr>
<tr>
<td>Unit Contribution</td>
<td>( \text{₦0.40} )</td>
<td>( \text{₦0.875} )</td>
<td>( \text{₦1.275} )</td>
</tr>
</tbody>
</table>
Sales Mix | 60% | 40% | 100%
---|---|---|---
Composite quantity contribution margin = \((¥ 0.40 \times 0.60) + (¥ 0.875 \times 0.40) = ¥ 0.59\)

(iv) Break-even point for both products = \(\frac{76,000}{0.59} = 128,814 \text{ kgs}\)

Individually Rice = 60% (128,814) = 71,288 kgs
Beans = 40% (128,814) = 51,526 kgs

(v) \(\frac{\text{Composite Contribution Margin Ratio}}{\text{N 1275}} = \frac{\text{N 2250}}{} = 0.57\)

(vi) Break-even point in Naira = \(\frac{¥ 7600}{0.57} = ¥ 133,333\)

5.7 SUMMARY AND CONCLUSIONS

Marginal costing is a decision making technique used to determine the effect on profit due to cost and volume changes from time to time in a multi-product firm especially in the short run. Emphasis is on the variable cost of a product and the fixed cost is written off in full against the contribution and treated as period cost.

The various areas where the marginal costing technique is applicable are in: make or buy, accept or reject situations, deleting a segment, special pricing decisions, etc.

Cost-Volume-Profit analysis, also known as Break-even analysis, is used to measure the effect on profit as a result of changes in both revenue and cost parameters.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

5.8 REVISION QUESTIONS

5.8.1 MULTIPLE CHOICE QUESTIONS

1. Ade Limited has fixed costs of N60,000 per annum. It manufactures a single product which it sells for N20 per unit. Its Contribution margin ratio is 40%. Ade Limited’s break-even point is:
   A  1,200
   B  1,800
   C  3,000
   D  5,000
   E  7,500.
2. Zaria Plc makes a single product which it sells for N16 per unit. Fixed costs are N76,800 per month and the product has a contribution to sales of 40%. In a period when sales were N224,000, Zaria plc’s margin of safety in units was:
   A  2,000
   B  6,000
   C  8,000
   D  12,000
   E  14,000.

3. Ariara Plc produces a single service to its customers. An analysis of its budget for the year ending 31 December, 2002 shows that in period 4, when the budgeted activity was 5,220 service units with a sales value of N42 each, the margin of safety was 19.575%. The budgeted fixed contribution to sales ratio of the service is 40%. Budgeted fixed costs in period 4 were nearest to:
   A  N1,700
   B  N71,000
   C  N70,500
   D  N176,000
   E  N96,000.

4. The following extract is taken from the production cost budget of Sunday Ebang Limited:

<table>
<thead>
<tr>
<th>Production Units</th>
<th>2,000</th>
<th>3,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production Cost</td>
<td>N11,100</td>
<td>N12,900</td>
</tr>
</tbody>
</table>

The budget cost allowance for an activity level of 4,000 units is:
   A  N7,200
   B  N14,700
   C  N22,200
   D  N14,200
   E  N32,200.

5. The make-up of a company’s cost structure changes so that the contribution per unit increases, but the total cost remains exactly the same. The operational gearing (also referred to as operational leverage ) would:
   A  Increase
   B  Decrease
   C  Stay the same
   D  Probably decrease
   E  Probably increase.

5.8.1 SHORT ANSWER QUESTIONS

1. What is differential cost?
2. What are the formulae for: break-even point (units); break-even point (sales value)?
3. Define relevant cost.
4. A company fixed cost is N100,000 and has two products. The sales and contribution sales ratio are:

<table>
<thead>
<tr>
<th>Product</th>
<th>Sales</th>
<th>P/V Ratio</th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>N300,000</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>N 80,000</td>
<td>50%</td>
<td></td>
</tr>
</tbody>
</table>

Determine the variable cost for products A and B.

5. Explain the term “Opportunity Cost”.

(Refer to Suggested Solution in Appendix I, page 443)
6

PRICING DECISIONS

6.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

♦ The factors which affect pricing decisions;
♦ Objectives of pricing decisions;
♦ The relationship between selling price, demand, output and price;
♦ The various pricing methods and their applications;
♦ The use of differential calculus to find the optimal price; and
♦ Different pricing policies and their description.

6.1 INTRODUCTION

The issue in pricing is the determination of selling prices. In many profit-oriented organisations, pricing constitutes a major policy decision issue. It may be possible for the Accountant to make a useful contribution by providing the decision making arm of the company with costs which are relevant for the pricing decision under review. There are contrary opinions between the marketers and accountants when it comes to the issue of pricing in the sense that the former claim that accountants do not understand the importance of competitive pricing while the latter are strongly of the opinion that marketers ignore costs when setting prices.

However, management accounting statements for pricing decisions are based on the adoption of total or full or absorption costing technique which shows product costs assume a normal level of output or normal mix of products. Nonetheless, the contribution or marginal costing technique which is another form of approach to pricing, provides a better basis for pricing decisions than the absorption technique in that it offers information about cost-volume-profit relationship which thus makes it convenient to derive pricing formulae.

There is no direct relationship between selling prices and product costs because of competition and elasticity of consumer demand. Therefore, profits
will be a product of a good combination of selected factors which include price, volume and product mix.

**FACTORS IN PRICING DECISIONS**

The main factors in pricing decisions are as follows:

(a) Pricing objectives;
(b) Relationship between price and output;
(c) Selling price/demand relationship; and
(d) Other factors.

### 6.1.1 Pricing Objectives

The pricing objectives of companies fall into three categories. These are to:

(a) Achieve a target return on investment;
(b) Stabilise price and output; and
(c) Realise a target market share.

### 6.1.2 Relationship Between Price and Output

The element of price is always instrumental to level of demand. In most cases, the lower the selling price for an item, the higher is the quantity demanded. Therefore, a company should consider the relationship between price and demand when deciding on an efficient or optimal plan of action. However, the level of profit made by a company is a function of the output levels agreed for the company’s products. It is reasonable to say that changes in output affect both total revenue and total costs, which are the determinants of the profit level to be made at a given point in time.

### 6.1.3 Relationship Between Selling Price and Demand

The relationship between the selling price for a set of items and the quantity demanded at that price is influenced by a number of factors, among which are:

(a) Variation in quality;
(b) Advertising and other promotional techniques;
(c) Buyers choice; and
(d) Pricing and advertising policy decisions of competitors.

6.1.4 Other Factors

The other factors, which interfere in pricing decisions, and at the same time exercise fundamental effect include:

(a) **Overall company goals:** These may include target return objectives such as return on investment, sales margin, cost reduction maximisation; and non-profit oriented-objectives which may include increase in firm status or goodwill.

(b) **Costs:** These play an indirect role in that they secure the profitability of alternative prices to be determined and also ensure a comparison of the profit margin at a present price with expected return. However, costs play a direct role in setting prices in tactical situation, that is, contribution pricing.

(c) **Demand:** This factor cannot be overlooked in the pricing decisions of a firm. It is based on two economic principles, that is, the law of demand and supply, and the price elasticity of demand.

(d) **Legal:** This is considered from the point of view of Government interfering in price control, anti-monopoly measures, interest rates, taxation, and so on.

(e) **Social Responsibility:** The social impact of a firm that sells on national scale or basis is expected to be felt in the price charged on the goods.

6.2 PRICING METHODS

The various pricing methods encountered in practice are:

(a) Full cost based or cost – plus method;
(b) Marginal cost based method;
(c) Minimum price method;
(d) Mark up based method;
(e) Theoretical pricing policy or demand analysis; and
(f) Others.
6.2.1 Full Cost based or Cost - Plus Method

This is a traditional approach to pricing products whereby the selling price is determined by:

(a) Calculating the full cost of the product; and
(b) Adding a percentage mark-up for profit.

The full cost method varies in its approach to pricing decisions. It may:

(a) Be a fully absorbed production cost only;
(b) Include some opportunity costs such as the opportunity cost of production resources that is in short supply;
(c) Include some absorbed administration, selling and distribution overheads.

Generally, the percentage profit mark-up does not have to be rigid, but can be varied to suit particular circumstances.

Full cost based method has been frequently condemned by a number of authors. According to John Sizer, full cost appears to be used by many firms as a starting point in selling pricing decisions while marginal judgment determines the size of the full cost plus. It is therefore unrealistic to use full cost as a starting point since the size of the full cost plus is determined subjectively.

6.2.1.1 Benefits of Full Cost Pricing Method

(a) Since the size of the profit margin can be varied at management’s discretion, a price in excess of cost should ensure that a company working at normal capacity will cover all its fixed cost and subsequently make a profit. Also, companies may benefit from full cost based method when they:

(i) Carry out large contract which must make a sufficient profit margin to cover a fair share of fixed cost;

(ii) Must justify their prices to potential customers, that is, for government contracts; and
(iii) Find it difficult to estimate expected quantity at different selling price.

(b) It is a simple, quick and cheap method of pricing.

6.2.1.2 Problems of Full Cost Pricing Method

(a) There is the need to adjust prices to market conditions.

(b) Budgeting output volume is a very difficult task which is a key factor in determining the fixed overhead absorption rate and in circumstances where more than one product is produced.

(c) It fails to allow for competition, that is, a company may need to match the prices of rival firms when the competitors take a price cutting or price raising decision.

(d) Since the selling price is part of the marketing mix of the company’s policy, rigid price setting may be too restrictive for marketing management.

6.2.2 Marginal Cost Based Pricing Method

Under this method, a profit margin is added either to marginal cost of production or to marginal cost of sales. This method is often called mark-up pricing. Generally, typical mark-up on variable cost will be higher than the typical profit margin on full cost otherwise selling price may fail to cover fixed cost. Whereas, full cost plus approach to pricing draws attention to profit margin, a variable cost approach to pricing, draws attention to contribution which is a better pointer of profit.

Advantages of Marginal Cost Based Pricing Method

(a) It draws management’s attention to contribution and the effect of higher or lower sales volume on profit.

(b) It is a simple method to understand and easy to calculate.

(c) The mark-up can be varied to reflect market conditions.

(d) In practice, mark-up pricing is more applicable in business where there is readily identifiable basic variable cost, for example, retail industries.
Disadvantages of Marginal Cost Based Pricing Method

(a) The size of the mark-up can be varied.

(b) The method ignores fixed overhead in pricing decision. The selling price must be sufficiently high to ensure that a profit is made after recovering fixed cost, thereby leaving most companies in a position of arbitrary charge on the marginal cost.

ILLUSTRATION 6-1

Uchenna Agwu Limited produced product X for which the following estimates have been made:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>12</td>
</tr>
<tr>
<td>Direct Labour (2 hours @ ₦5)</td>
<td>10</td>
</tr>
<tr>
<td>Variable production overhead-machine ½hr @₦6/hr</td>
<td>3</td>
</tr>
</tbody>
</table>

Products fixed overhead are budgeted based on 12,000 machine hours at ₦144,000 per month and because of the shortage of available machine capacity, the company will be restricted to 8,000 hours of machine time per month. The fixed purchased absorption rate will be based on direct labour hour rate. However, budgeted direct labour hour per month is 24,000 hours. It is estimated that the company could obtain a minimum contribution of ₦14 per machine hour producing another item other than product X. The direct costs estimate are not certain as to material usage rates and direct labour cost may be subject to an error of plus or minus 15%. Machine time estimates are similarly subject to an error of plus or minus 10%. The company wishes to make a profit of 30% on full production cost from the product.

Required:
What price should be charged using the full cost plus method under the following circumstances?

(a) Exclude machine time opportunity cost and ignore possible errors.

(b) Include machine time opportunity cost and ignore possible costing errors.

(c) Exclude machine time opportunity cost but make a full provision for possible under estimation of cost.
(d) Include machine time opportunity cost and make a full allowance for possible under estimation cost.

**SUGGESTED SOLUTION 6-1**

**UCHENNA AGWU LIMITED**

(a) Excluding Machine time opportunity cost and possible errors.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>12.0</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>10.0</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>3.0</td>
</tr>
<tr>
<td>Fixed Overhead</td>
<td>12.0</td>
</tr>
<tr>
<td></td>
<td>37.0</td>
</tr>
<tr>
<td>Add mark up (30% x N37.00)</td>
<td>11.1</td>
</tr>
<tr>
<td></td>
<td>48.1</td>
</tr>
</tbody>
</table>

(b) Full production cost

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity cost</td>
<td>7.0</td>
</tr>
<tr>
<td>(1/2 @N14/machine)</td>
<td>44.0</td>
</tr>
<tr>
<td>Add mark up (30% x N44.00)</td>
<td>13.2</td>
</tr>
<tr>
<td></td>
<td>57.2</td>
</tr>
</tbody>
</table>

(c) Excluding machine time opportunity cost but making a full provision for possible underestimation of cost.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Materials</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Direct Labour</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22.0</td>
<td></td>
</tr>
<tr>
<td>Possible error @15%</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Variable production overhead</td>
<td>25.30</td>
<td></td>
</tr>
<tr>
<td>Possible error 10%</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>Fixed Overhead</td>
<td>12.0</td>
<td></td>
</tr>
<tr>
<td>Possible error @15%</td>
<td>1.8</td>
<td>13.80</td>
</tr>
<tr>
<td>Full cost</td>
<td>42.40</td>
<td></td>
</tr>
<tr>
<td>Markup (30% x N42.40)</td>
<td></td>
<td>12.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55.12</td>
</tr>
</tbody>
</table>
ILLUSTRATION 6-2

Mohammed Tanimu Sule Limited budgets to make 50,000 units of its product. The variable cost of a unit is N5 and annual fixed cost are expected to be N150,000.00. The Financial Director of Dusti Limited has suggested that a profit margin of 25% on full cost should be charged for every unit sold. The Marketing Director has challenged the wisdom of this suggestion and has produced the following estimates of sales demand.

<table>
<thead>
<tr>
<th>Price Per Unit</th>
<th>Demand (Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N4</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>42,000</td>
</tr>
<tr>
<td>10</td>
<td>38,000</td>
</tr>
<tr>
<td>11</td>
<td>35,000</td>
</tr>
<tr>
<td>12</td>
<td>32,000</td>
</tr>
<tr>
<td>13</td>
<td>27,000</td>
</tr>
</tbody>
</table>

You are to assume a production sales level of 50,000 units.

Required:

(a) What will be the profit for the year if cost plus price were charged with a 25% profit mark up?

(b) What would be the profit for the year if a profit maximising price were charged?

SUGGESTED SOLUTION 6-2

MOHAMMED TANIMU SULE LTD

(a) N

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable cost</td>
<td>5</td>
</tr>
<tr>
<td>Fixed cost</td>
<td>3</td>
</tr>
<tr>
<td>Full cost</td>
<td>8</td>
</tr>
<tr>
<td>Markup</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
### Pricing Decisions

<table>
<thead>
<tr>
<th>Total sales (38,000 units @ ₦10)</th>
<th>₦380,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less: Cost of sales:</td>
<td></td>
</tr>
<tr>
<td>Production (50,000 units @ ₦8)</td>
<td>₦400,000</td>
</tr>
<tr>
<td>Less: Closing stock</td>
<td></td>
</tr>
<tr>
<td>₦8 x (50,000 – 38,000)</td>
<td>₦96,000</td>
</tr>
<tr>
<td></td>
<td>₦304,000</td>
</tr>
<tr>
<td></td>
<td>₦76,000</td>
</tr>
</tbody>
</table>

#### (b) Price | Unit Contribution | Demand Units | Total Contributions |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>4</td>
<td>42,000</td>
<td>168,000</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>38,000</td>
<td>190,000</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
<td>35,000</td>
<td>210,000</td>
</tr>
<tr>
<td>*12</td>
<td>7</td>
<td>32,000</td>
<td>224,000*</td>
</tr>
<tr>
<td>13</td>
<td>8</td>
<td>27,000</td>
<td>216,000</td>
</tr>
</tbody>
</table>

The company should sell 32,000 units at a price of ₦12 since this gives the highest contribution of ₦224,000.

<table>
<thead>
<tr>
<th>Total Sales</th>
<th>₦384,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>₦400,000</td>
</tr>
<tr>
<td>Closing Stock</td>
<td>₦144,000</td>
</tr>
<tr>
<td></td>
<td>₦256,000</td>
</tr>
<tr>
<td></td>
<td>₦128,000</td>
</tr>
</tbody>
</table>

#### 6.2.3 Minimum Price Method

A minimum price is the price that would have to be charged so as to cover:

(a) The incremental cost of producing and selling the item; and

(b) The opportunity cost of the resource consumed in making and selling the item.

A minimum price is generally, a no gain no loss situation. Basically, two essential points about minimum price should be considered:

(a) It is based on relevant cost; and

(b) It is very much unlikely that a minimum price will actually be charged because if it is charged, it will not provide the business with any incremental profit. However, the minimum price of an item would generally show an absolute minimum below which the price should not be fixed.
The incremental profit is that which would be obtained from any price that is actually charged in excess of the minimum, for example, the minimum price is N200 and the actual price charged is N240, then the incremental profit on the sale would be N40.

However, if there are no scarce resources, and a company has spare capacity, the minimum price of a product would be an amount which equates the incremental cost of incremental contribution towards profit.

**ILLUSTRATION 6-3**

A firm was required to submit a quotation for a special contract job. Cost estimates were made as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material -D 75,000 kgs at 20k per kg</td>
<td>15,000</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>-E 25,000 kgs at 40k per kg</td>
<td>10,000</td>
</tr>
<tr>
<td>Labour -3,000 hours at N2.25 per hour</td>
<td>6,750</td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>9,750</td>
</tr>
<tr>
<td><strong>Total Cost (external opportunity cost)</strong></td>
<td><strong>41,500</strong></td>
</tr>
</tbody>
</table>

**Required:**

What is the minimum price to be quoted by the firm?

**SUGGESTED SOLUTION 6-3**

1. If the company has no scarce resources, the minimum price will be N41,500, the total incremental costs to the firm. Any price in excess of N41,500 will be an incremental contribution towards fixed costs and profit.

2. If there are scarce resources and a company makes more than one product, minimum price would include an allowance for the opportunity cost of using the resources to make and sell the product (instead of using the resource on the next most profitable product).

**ILLUSTRATION 6-4**

Using the same data in the previous example and assuming that the firm does not have skilled labour to undertake the special contract job without delaying other production activities. The contribution expected
from other production activities, after charging labour costs is ₦5,500. What is the minimum price to be quoted by the firm?

**SUGGESTED SOLUTION 6-4**

The minimum price to be quoted by the firm is as follows:

- Material -D 75,000 kgs at 20k per kg: ₦15,000
- E 25,000 kgs at 40k per kg: ₦10,000
- Labour -3,000 hours at ₦2.25 per hour: ₦6,750
- Variable Overhead: ₦9,750
- Contribution lost on production delay (internal opportunity cost): ₦5,500
- Total Cost (internal and external opportunity cost): ₦47,000

Therefore, the minimum price of ₦47,000 is the sum of both internal and external opportunity cost. Any price above ₦47,000 will create an incremental contribution to fixed costs and profit.

**ILLUSTRATION 6-5**

Omoh Iruobe Limited has been asked to quote a price for one off contract. Management have drawn up the following schedule:

<table>
<thead>
<tr>
<th>Costs</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract price (cost plus 20%)</td>
<td>60,780</td>
</tr>
<tr>
<td>Materials:</td>
<td></td>
</tr>
<tr>
<td>A (300kg at ₦10/kg)</td>
<td>3,000</td>
</tr>
<tr>
<td>B (1000 litres at ₦7/litre)</td>
<td>7,000</td>
</tr>
<tr>
<td>C (550kg at ₦3/kg)</td>
<td>1,650</td>
</tr>
<tr>
<td>Labour:</td>
<td></td>
</tr>
<tr>
<td>Department 1 (1,500 hrs at ₦8/hr)</td>
<td>12,000</td>
</tr>
<tr>
<td>Department 2 (2,000 hrs at ₦10/hr)</td>
<td>20,000</td>
</tr>
<tr>
<td>Overheads:</td>
<td></td>
</tr>
<tr>
<td>Absorbed on a budgeted</td>
<td></td>
</tr>
<tr>
<td>Labour Hour basis (3,500 hrs x ₦2)</td>
<td>7,000</td>
</tr>
<tr>
<td><strong>Total Costs</strong></td>
<td>50,650</td>
</tr>
</tbody>
</table>

The following is also relevant:

1. Material A. The cost of ₦10 is the original purchase cost incurred some years ago. This material is no longer in use by the company and if not used in the contract then it would be sold for scrap at ₦3 per kg.

2. Material B. This is in continuous use by the business. ₦7 is the historic cost of the material although current supplies are being purchased at ₦6.50.
(3) Material C, Omoh Iruobe Ltd. has 300kg of this material in stock and not used for the contract then they would be used as a substitute for material D in another production process costing N7/kg. 2kg of C replaces 1kg of D.

(4) Department 1: This department has spare labour capacity sufficient for the contract and labour would be retained.

(5) Department 2: This department is currently working at full capacity. Omoh Iruobe Ltd. could get the men to work overtime to complete the contract paid at time and a half, or they could divert labour hours from the production of other units that currently average N3 contribution per labour hour.

(6) Overheads. These are arbitrarily absorbed at a predetermined rate. There will be no incremental costs incurred.

Required

Calculate the minimum contract price that Omoh Iruobe Ltd. could accept to break even, using relevant costing techniques.

**SUGGESTED SOLUTION 6-5**

**OMOHI IROUBE LIMITED**

**RELEVANT COST STATEMENT**

<table>
<thead>
<tr>
<th>Items</th>
<th>Notes</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material A</td>
<td>1</td>
<td>900</td>
</tr>
<tr>
<td>Material B</td>
<td>2</td>
<td>6,500</td>
</tr>
<tr>
<td>Material C</td>
<td>3</td>
<td>2,050</td>
</tr>
<tr>
<td>Department 1</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Department 2</td>
<td>5</td>
<td>26,000</td>
</tr>
<tr>
<td>Overheads</td>
<td>6</td>
<td>-</td>
</tr>
<tr>
<td><strong>Minimum Contract Price</strong></td>
<td>7</td>
<td><strong>35,450</strong></td>
</tr>
</tbody>
</table>

**Notes:**

1. The historical cost of ₦10 is not relevant, as it is a sunk cost. The relevant cost is the opportunity cost relating to the scrap proceeds, that is, 300kg x ₦3 = ₦900

2. Again, the historical cost is not relevant, as it is a sunk cost. Since the material is in continuous use in the business, the relevant costs is the current replacement cost of the material = 1,000 litres x ₦6.50 = ₦6,500.

3. Since there is only 300kg in stock, 250kg would need to be purchased at the current replacement cost = 250 x ₦4 = ₦1,000. If the current stock of 300kg is not used for the contract,
it would be used to replace material D in an alternative production process.

Therefore, the relevant cost for the stock of 300kg is \(300 \times \text{₦} \frac{7}{2} = \text{₦}1050\). bearing in mind the 2-for-1 substitution.
\(\text{Total relevant cost for material C = ₦1,000 + ₦1050 = ₦2050}\)

4. Since there is spare capacity in this department, there is no relevant cost.

5. For this department, the two alternatives need to be considered:
\(\text{Cost of working overtime = } 2,000 \times \text{₦10} \times 1.5 = \text{₦}30,000\)
\(\text{Cost of diverting labour = } 2,000 \times (\text{₦10} + \text{₦3}) = \text{₦}26,000\)

It would be cheaper to divert the labour from the other productions process, so the relevant cost for department 2 is ₦26,000

6. There will be an increase in overhead expenditure for the relevant costs.

7. The minimum price is the price that just covers the relevant costs of the contract.

6.2.4 Pricing Based on mark Up/Unit of Limiting Factor

When a business is looking at full capacity and it is restricted by a shortage of resources from expanding output further, by deciding on what target it will like to earn. It could, therefore, establish a mark up per unit of limiting factor.

ILLUSTRATION 6-6

Vokito Services Ltd. produces a window cleaning services to offices and factories. Business is very brisk but the company is restricted from expanding its activities further by a shortage of window cleaners. The workforce consists of 12 window cleaners each of whom works 35 hours a week. They are paid ₦4 per hour. Other variable expenses are 50 kobo per hour and fixed cost is ₦5,000 per week. The company wishes to make a contribution of at least ₦15 per man hour.

Required:

(i) Determine the minimum charge per hour for window cleaning.
(ii) What is the resulting profit?
SUGGESTED SOLUTION 6-6
VOKITO SERVICES LTD.

(i) Minimum charge per man/her

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct wages</td>
<td>4.00</td>
</tr>
<tr>
<td>Other variable expenses</td>
<td>0.50</td>
</tr>
<tr>
<td>Contribution/man hour</td>
<td>15.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19.50</strong></td>
</tr>
</tbody>
</table>

(ii) Resulting Profit

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Contribution/week (12 x 35 x 15)</td>
<td>6,300</td>
</tr>
<tr>
<td>Less fixed cost</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td><strong>1,300</strong></td>
</tr>
</tbody>
</table>

6.3 DEMAND ANALYSIS (OR THEORETICAL PRICING POLICY)

Generally, demand analysis theory is based on the idea that a connection can be made between price, quantity demanded and sold as well as total revenue (TR). In a perfect competitive market, demand varies with price and so if a realistic estimate can be made of demand, at different price levels, it should therefore be possible to determine:

(a) A profit maximising price; and

(b) A revenue maximising price.

However, in practice, business organisations, make pricing decisions on the basis of demand conditions and competition in the market. On the other hand, most businesses enjoy a monopoly situation in the market. This is because they develop a unique marketing mix. The significance of a monopoly situation is that the business does not have to follow the market price, that is, it is not a price taker and therefore has more say and flexibility in the prices it sets. In a perfect competitive market, at higher prices, demand for products or services will be lower. Basically, there will be a selling price at which the business can maximise its profit. This is the price level at which marginal cost (MC) is equal to the marginal revenue (MR), that is, the cost of making an extra unit of output which is equal to the revenue obtained from selling it.

ILLUSTRATION 6-7

Hamid Tahir Kabir sells a product which has a variable cost of N8/unit. The demand at the current price of N13 is 3400 units. It has been estimated by the marketing department that the sales volume would fall by 100 units for each addition of 25k to the selling price.
**Required:**

Determine the optimal price which maximises contribution.

**SUGGESTED SOLUTION 6-7**

<table>
<thead>
<tr>
<th>HAMID TAHR KABIR LIMITED</th>
<th>Contribution/Unit (₦13 - ₦18)</th>
<th>Sales Volume</th>
<th>Total Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Price</td>
<td>₦</td>
<td>₦</td>
<td>₦</td>
</tr>
<tr>
<td>₦13.00</td>
<td>5.00</td>
<td>3,400</td>
<td>17,000</td>
</tr>
<tr>
<td>₦13.25</td>
<td>5.25</td>
<td>3,300</td>
<td>17,325</td>
</tr>
<tr>
<td>₦13.50</td>
<td>5.50</td>
<td>3,200</td>
<td>17,600</td>
</tr>
<tr>
<td>₦13.75</td>
<td>5.75</td>
<td>3,100</td>
<td>17,825</td>
</tr>
<tr>
<td>₦14.00</td>
<td>6.00</td>
<td>3,000</td>
<td>18,000</td>
</tr>
<tr>
<td>₦14.25</td>
<td>6.25</td>
<td>2,900</td>
<td>18,125</td>
</tr>
<tr>
<td>₦14.50</td>
<td>6.50</td>
<td>2,800</td>
<td>18,200</td>
</tr>
<tr>
<td>*₦14.75</td>
<td>6.75</td>
<td>2,700</td>
<td>18,225*</td>
</tr>
<tr>
<td>₦15.00</td>
<td>7.00</td>
<td>2,600</td>
<td>18,200</td>
</tr>
</tbody>
</table>

Therefore, the optimal price is ₦14.75 because it gives a total contribution of ₦18,225.

**ILLUSTRATION 6-8**

Dandago Binta manufactures one product. It has recently commissioned a marketing research firm to estimate the quantity of the product likely to be demanded annually at different selling prices.

The results are as follows:

<table>
<thead>
<tr>
<th>Price (₦)</th>
<th>Demand (Units)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>12,000</td>
</tr>
<tr>
<td>40</td>
<td>10,000</td>
</tr>
<tr>
<td>60</td>
<td>8,000</td>
</tr>
<tr>
<td>80</td>
<td>6,000</td>
</tr>
<tr>
<td>100</td>
<td>4,000</td>
</tr>
</tbody>
</table>

The company is currently charging a price of ₦40 and is selling 10,000 units annually. Variable cost amount to ₦20 per unit. produced and sold, and the company incurs fixed costs of ₦40,000 per annum.

**Required:**

Determine the optimal selling price of the company’s product.
SUGGESTED SOLUTION 6-8

DANDAGO BINTA

Determination of optimal selling price:

<table>
<thead>
<tr>
<th>Level of activity (units)</th>
<th>12,000</th>
<th>10,000</th>
<th>8,000</th>
<th>6,000</th>
<th>4,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Selling Price</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>100</td>
</tr>
<tr>
<td>Variable Cost</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Contribution</td>
<td>0</td>
<td>20</td>
<td>40</td>
<td>60</td>
<td>80</td>
</tr>
<tr>
<td>Contribution Margin</td>
<td>0</td>
<td>200,000</td>
<td>320,000</td>
<td>360,000</td>
<td>320,000</td>
</tr>
</tbody>
</table>

Optimal selling price is at N80 for 6,000 units; maximising contribution of N360,000. Readers should note that fixed cost is irrelevant for the purpose of decision making, assuming all other factors to remain constant.

ILLUSTRATION 6-9

SALMON BINTA KABIR Limited produces a fast moving toy called rubber beads. The company sold 10,000 units of the toy last year with the following results:

<table>
<thead>
<tr>
<th>Sales</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing cost of goods sold:</td>
<td></td>
</tr>
<tr>
<td>Direct material</td>
<td>28,000</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>30,000</td>
</tr>
<tr>
<td>Overhead (60% variable)</td>
<td>40,000</td>
</tr>
<tr>
<td>Gross Profit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>112,000</td>
</tr>
</tbody>
</table>

Selling and administration expenses:

| Variable                           | 18,000  |
| Fixed                              | 48,000  | (66,000) |
| Profit                             |         |
|                                   | 46,000  |

The Marketing Manager is preparing the forecast for 2011 and has made the following estimates of the demand at various potential prices:

<table>
<thead>
<tr>
<th>Price</th>
<th>N20</th>
<th>N19</th>
<th>N18</th>
<th>N17</th>
<th>N16</th>
<th>N15</th>
<th>N14</th>
<th>N13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demand(Units)</td>
<td>1,200</td>
<td>15,000</td>
<td>20,000</td>
<td>30,000</td>
<td>35,000</td>
<td>45,000</td>
<td>50,000</td>
<td>55,000</td>
</tr>
</tbody>
</table>

The existing plant has a single machine with a capacity of 15,000 units. Machines can be acquired to meet any increased demand for the company’s product but the addition of each machine increases existing fixed costs by N60,000.
Required:
At what price should the toys be sold and why?

SUGGESTED SOLUTION 6-9

SALMON BINTA KABIR
The optimal selling price should be the price that gives the highest contribution towards the recovery of general fixed overhead.

<table>
<thead>
<tr>
<th>Selling Price</th>
<th>Variable Cost/Unit</th>
<th>Contribution Unit</th>
<th>Demand Unit</th>
<th>Total Variable</th>
<th>Incremental Total Fixed Cost</th>
<th>Total Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>10</td>
<td>10</td>
<td>12,000</td>
<td>120,000</td>
<td>-</td>
<td>120,000</td>
</tr>
<tr>
<td>19</td>
<td>10</td>
<td>9</td>
<td>15,000</td>
<td>135,000</td>
<td>-</td>
<td>135,000</td>
</tr>
<tr>
<td>18</td>
<td>10</td>
<td>8</td>
<td>20,000</td>
<td>160,000</td>
<td>60,000</td>
<td>100,000</td>
</tr>
<tr>
<td>17</td>
<td>10</td>
<td>7</td>
<td>30,000</td>
<td>210,000</td>
<td>60,000</td>
<td>150,000</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>6</td>
<td>35,000</td>
<td>210,000</td>
<td>120,000</td>
<td>90,000</td>
</tr>
<tr>
<td>15</td>
<td>10</td>
<td>5</td>
<td>45,000</td>
<td>225,000</td>
<td>130,000</td>
<td>105,000</td>
</tr>
<tr>
<td>14</td>
<td>10</td>
<td>4</td>
<td>50,000</td>
<td>200,000</td>
<td>180,000</td>
<td>20,000</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>3</td>
<td>55,000</td>
<td>165,000</td>
<td>180,000</td>
<td>(150,000)</td>
</tr>
</tbody>
</table>

Decision: Highest contribution of N150,000 towards recovery of general fixed overheads occurs at price of N17 per unit. The toys should therefore be sold at a price of N17 each.

(Wi) Variable Cost Per Unit

<table>
<thead>
<tr>
<th></th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Material</td>
<td>28,000</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>30,000</td>
</tr>
<tr>
<td>Variable Overhead (60% x 40,000)</td>
<td>24,000</td>
</tr>
<tr>
<td>Variable Selling</td>
<td>18,000</td>
</tr>
<tr>
<td>Total Variable Cost for 10,000 units</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Therefore, variable cost per unit = \( \frac{N100,000}{10,000} = N10 \)

(Wii) Incremental Total Fixed Cost

Since the existing machine has a capacity of 15,000 units, then an additional machine will not be required at that level and below. However, in order to satisfy the demand of 20,000 units and 30,000 units respectively, extra single machine costing N60,000 will be required. At the level of 35,000 units and 45,000 units respectively, additional two machines will be required costing N120,000 (N60,000 x 2) etc.
6.3.1 Other Pricing Methods

The other pricing methods that may be adopted by companies are as follows:

(a) **Intuitive Pricing:** This involves pricing by the “feel of the market” and can vary from a pure guess to a well informed attempt to interpret part data and future trends. It is occasionally used to adjust the cost-plus price according to the management’s perception of likely demand, competition, etc.

(b) **Experimental Pricing:** This involves the selection of a sample test markets to create a statistical model which is used to manipulate the price among markets in order to arrive at a price which maximises profits. It can be used when there is a pricing decision concerning a new product.

(c) **Incremental Cost Pricing:** It is based on the concept that a price should be such that incremental cost is less than the incremental revenue.

(d) **Pricing in a Multi-product Situation:** naturally, companies are seen not to be producers of only one but a multiple of products. However, two issues are of importance in a multi-product environment, namely:

(i) Pricing substitute goods, for example, pharmaceuticals where two methods are in use.

(ii) Pricing complementary goods such as bread and butter - since the demand for the product is positively correlated, a decrease in price of one product increases the demand for its complement.

(e) **Demand Oriented Pricing:** It is the attitude of customers influencing pricing decisions, that is, the price a customer is willing to pay for a product and not simply a consequence of the product itself.

6.4 PRICE DISCRIMINATION

Price discrimination is the ‘sales of technically similar products at prices which are not proportional to their marginal costs’.

This is possible if a firm’s management can establish separate market segments for the same basic product, and prevent contact between (‘seal
off’) the different segments, so that a different price can be charged for the same product in each segment.

There are several ways, in practice, by which price discrimination may be exercised:

(a) Through negotiation with individual customers. For example, A might buy a video cassette recorder from firm X for ₦600 cash, whereas customer B might buy the same item and negotiate a cash discount of say 20%;

(b) On the basis of quantities purchased: bulk purchase discounts are a well-established form of price discrimination which offers favourable prices to large customers.

6.5 SUMMARY AND CONCLUSIONS

Pricing is to ensure the determination of selling prices with the objective of achieving a target return on investment; stabilise output and realisation of a target market share.

The factors that influence pricing decisions include the pricing objectives, relationships between price and output, selling price/demand relationships, costs, government interference and overall company goals.

The chapter also covers the main pricing methods, which include full cost based or cost plus; marginal cost based, minimum price, pricing based in mark-up and demand analysis.

Other pricing methods are: Intuitive, experimental, incremental, multi-products, demand oriented.

Price discrimination is the sales of technically similar products at prices which are not proportional to their marginal costs. It could be practiced through negotiation, quality purchased, product type, location or area.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)
6.6 REVISION QUESTIONS

6.6.1 MULTIPLE CHOICE QUESTIONS

1. If there is excess capacity, the minimum acceptable price for a special order must cover:
   A Variable costs associated with the special order.
   B Variable and fixed manufacturing costs associated with the special order.
   C Variable and incremental fixed costs associated with the special order.
   D Variable costs and incremental fixed costs associated with the special order plus the contribution margin usually earned on regular units.
   E Both the variable and the general fixed overhead of the company.

2. If the firm is at full capacity, the minimum special order price must cover:
   A Variable costs associated with the special order.
   B Variable and fixed manufacturing costs associated with the special order.
   C Variable and incremental fixed costs associated with the special order.
   D Variable costs and incremental fixed costs associated with the special order plus foregone contribution margin on regular units not produced.
   E Only the total overhead cost of the organisation.

3. Which of the following is likely a kinked demand curve?
   A Perfect Competition
   B Imperfect Competition
   C Monopoly
   D Oligopoly
   E Duopoly

4. Which of the following cost would be used in cost plus pricing?
   (i) Marginal Cost only
   (ii) Full cost only
   (iii) ABC Cost only
   (iv) Direct Cost only
   A (i), (ii) and (iii) only
   B (i) and (ii) only
   C (ii) and (iii) only
   D (ii), (iii) and (iv) only
   E (i), (ii), (iii) and (iv)

5. A product estimate derived from subtracting a desired profit margin from a competitive market price is called a:
   A Shadow Cost
   B Target Cost
   C Marginal Cost
   D Joint Cost
   E Product Cost
6.6.2 SHORT ANSWER QUESTIONS

1. What is marginal pricing?

2. State two factors which may need to be considered in a pricing decision.

3. What are the shortcomings of using cost-plus-system pricing?

4. Explain full-Cost-Pricing.

5. Define price discrimination.

6. Explain demand oriented pricing.

7. A price which exactly covers incremental costs of making the items sold, the opportunity costs of the resources consumed in making the item is called ______

8. A product or service sold at lower than normal margins in order to attract customers who might then buy other items at normal prices is known as ______

(Refer to Suggested Solution in Appendix I, page 443)
7

DECISION MAKING UNDER RISK AND UNCERTAINTY

7.0 LEARNING OBJECTIVES

After studying this chapter, readers will be able to understand:

♦ The terms “risk and uncertainty”;
♦ Payback, risk premium and finite horizon methods;
♦ The application of probability in project appraisal;
♦ The calculation and explanation of expected value;
♦ The terms standard deviation and coefficient of variation as measures of risk and their limitations;
♦ The construction of a decision tree when there is a range of alternatives and possible outcomes;
♦ The description and calculation of the value of perfect and imperfect information;
♦ The maximin, maximax and regret rules;
♦ Sensitivity analysis and its application to project appraisal;
♦ Portfolio analysis and its implication for project appraisal; and
♦ Asset replacement decisions.

7.1 RISK AND UNCERTAINTY

In capital budgeting decisions, it is assumed that the variables and estimates used are known with certainty. However, under risk and uncertainty situations, the actual returns that will be realised from a project may differ from the expected return (usually NPV) on which decision was based. The risk is that, a project which should have been accepted might have been rejected and vice versa. Another problem that may be solved by incorporating risk and uncertainty is the estimation of errors needed in determining the risk factor.

In view of the above, the need becomes apparent to define the element of risks and uncertainty as well as the techniques used in adjusting for such
risk and uncertainty in long term decision making processes especially when projects are to be rejected or accepted.

7.1.1 Risk

A risk is a situation in which the occurrence of future uncertain events is known but the possibilities of such future events can be quantified. The quantification of occurrence of such events is usually called PROBABILITIES. However for long term decision making, such future events can be categorised into:
(a) Cash flows;
(b) Project life; and
(c) Cost of capital.

7.1.2 Uncertainty

An uncertainty is a situation in which the probability or possibility of occurrence of such future events cannot be quantified. Therefore, the inability to be able to quantify the possibility of occurrence may be as a result of lack of experience in that area of business or absence of research data.

The above distinctions between risk and uncertainty is purely theoretical and would not affect our methods for adjusting or incorporating risks and uncertainties in long term decisions. The reason is that most long term projects will have elements of both risks and uncertainties.

7.1.3 Adjusting for risks and uncertainties

Any of the following methods can be used to adjust for risk and uncertainty in long term projects:
(a) Accounting Rate of Return (ARR) Adjustment Method.
(b) Payback Adjustment Method.
(c) Finite Horizon Method.
(d) Risk Premium Method.
(e) Expected Value Approach or Probability Theory.
(f) Risk Analysis.
(g) Standard Deviation and Coefficient of Variation.
(h) Sensitivity Analysis.
(i) Simulation Analysis.
(j) Pay-Off Matrix.
(k) Decision Tree.
(l) Portfolio Theory.

(a) **ARR Adjustment Method**

Under this method, projects that are considered risky are evaluated by using a higher ARR than the normal ARR for the company, for example, if a company usually evaluates projects at an ARR of 30%, it may evaluate risky projects at 40%.

(b) **Payback Adjustment Method**

Like in the method above, risky projects would require a more stringent condition, that is, risky projects would meet a payback period that is shorter than the company's normal payback period e.g. if a company usually evaluates projects using a three year payback period, risky projects may be required to payback within two years.

(c) **Finite Horizon Method**

This method involves evaluating a project that is considered risky within a reduced number of years that the appraiser will be comfortable with. This reduced number of years is usually called the Finite Horizon or the foreseeable future. The assumptions for using this method are the following:

(i) Cash flows of future years for conventional projects would normally be the net cash in-flows;

(ii) Our inability to forecast cash flows of distant future years is unavoidable; and

(iii) The present values of such distant future cash flows will be insignificant or immaterial since they will tend to zero, for example, a project with a ten-year life-span may be evaluated with cash flows of the first five years only.
(d) **Risk Premium or Risk Adjusted Discount Rate Method**

In this case, the adjustment for risk is done on the cost of capital. Risky projects will then be evaluated at a cost of capital that will be higher than the company's normal cost of capital, for example, if the company's normal cost of capital is 10% per annum, then, a risky project may be evaluated at 15% per annum. The difference between the company's normal cost of capital and the risk adjusted cost of capital is known as the **Risk Premium** which in this case is 5%, that is, (15% - 10%). Refer to chapter 10 for a full understanding of the concept of cost of capital.

(e) **Expected Value Approach or Probability Theory Method**

Decision making under risk generally involves the use of probability. By probability we mean the likelihood of an event occurring. The values of probabilities range between 0 and 1 and the higher the probability, the more likely or certain the occurrence of that event. Basically, there are two major types of probability namely:

(i) **Objective probability**: By this we mean, the frequency of the occurrence of an event if repeated several times over, for example, the probability of having a "3", when a fair die is cast is 1/6.

(ii) **Subjective probability**: They are probabilities based on the decision makers' personal experience, guesses, judgment and initiatives. This is due to the fact that, most business problems are not repeatable in nature and, therefore, the rate of frequency of the occurrence of that event cannot be easily determined. In using this method, probabilities are already attached to a stratified form of the variable, that is, the variable would be broken down for each period into units or strata which a question can also refer to as states of the world or possibilities.

However, whenever probabilities are attached to variables, the weighted average of those variables must be used in the quantification of any decision to be arrived at under a given circumstance. In calculating the weighted average, the weights to be attached will be the respective probabilities of each unit. The weighted averages for the variables are known as
**Expected Values:** Thus, this expected value would be used in the normal discounting technique to arrive at an expected net present value (ENPV). The expected net present value is considered to be a risk adjusted net present value (NPV).

The advantages of probability theory in decision making are:

(i) A constructive effort is made to deal with uncertainty or forecasting of specific output or event;

(ii) It assists in achieving a better result in the preparation of realistic budget which would be of assistance to management;

(iii) Questioning of budget variables lays a better foundation for the control of actions and cost; and

(iv) The final figure may be more acceptable to management approving the budget or expenditure because management may see it as the outcome of a more constructive management process.

**ILLUSTRATION 7-1**

(a) Kosalabaro Plc introduces one new product with its range of products next year. The extra cost will be N750,000 for either product X and Y. The selling price of X would be N20 and for Y, N25. The variable costs would be N10 and N13, respectively.

From past experience with similar products, the demand probabilities have been estimated at:

<table>
<thead>
<tr>
<th>Demand in units</th>
<th>Probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
</tr>
<tr>
<td>50,000</td>
<td>0.2</td>
</tr>
<tr>
<td>75,000</td>
<td>0.4</td>
</tr>
<tr>
<td>100,000</td>
<td>0.3</td>
</tr>
<tr>
<td>125,000</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td><strong>1.0</strong></td>
</tr>
</tbody>
</table>

You are required to compute the breakeven point for each product and advise with reasons, which product should be chosen.
(b) Three choices are being considered for honouring a two year free service guarantee. Your company had an offer to obtain the sale of 2,000 communication sets to a hotel group. The choices are:

(i) Do the servicing with own staff based on past experience, the costs will be:

<table>
<thead>
<tr>
<th>Probability of Occurrence</th>
<th>Event of Servicing</th>
<th>Total Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.30</td>
<td>Very little trouble (500 calls/year)</td>
<td>7,000</td>
</tr>
<tr>
<td>0.50</td>
<td>Usual trouble (1,000 calls/year)</td>
<td>12,000</td>
</tr>
<tr>
<td>0.20</td>
<td>A lot of trouble (1,500 calls/year)</td>
<td>25,000</td>
</tr>
</tbody>
</table>

(ii) Sub-contract to firm K who has quoted a fixed cost of ₦14,000 plus ₦2 for each visit in excess of 750 visits over the two-year period.

(iii) Sub-contract to firm P who has quoted a fixed cost of ₦16,000 plus.

You are required to advise the management on the choice they should adopt. Justify your recommendations.

**SUGGESTED SOLUTION 7-1**

**Kosalabaro Plc**

(a) Calculation of BEP for products X and Y are as follows:

\[
\text{BEP in units} = \frac{\text{Fixed Cost}}{\text{Contribution}} \quad \text{or} \quad \frac{\text{FC}}{\text{C / U}}
\]

OR

\[
\text{BEP in ₦ sales} = \frac{\text{Fixed Cost}}{\text{Contribution Margin Ratio}} \quad \text{or} \quad \frac{\text{FC}}{\text{CMR}}
\]

<table>
<thead>
<tr>
<th>Products</th>
<th>BEP sales in units</th>
<th>X (=) 75,000 units</th>
<th>Y (=) 62,500 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMR</td>
<td>(=) 10/20</td>
<td>12/25</td>
<td></td>
</tr>
</tbody>
</table>
BEP in N sales \[ = \frac{750,000}{0.5} \frac{750,000}{0.48} \]
\[ = \, \text{₦1,500,000} \quad \text{₦1,562,500} \]

**EXPECTED DEMAND**

**PRODUCT X**

<table>
<thead>
<tr>
<th>Units</th>
<th>Probabilities</th>
<th>Expected Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000</td>
<td>0.2</td>
<td>10,000</td>
</tr>
<tr>
<td>75,000</td>
<td>0.4</td>
<td>30,000</td>
</tr>
<tr>
<td>100,000</td>
<td>0.3</td>
<td>30,000</td>
</tr>
<tr>
<td>125,000</td>
<td>0.1</td>
<td>12,500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>\text{82,500}</td>
</tr>
</tbody>
</table>

**PRODUCT Y**

<table>
<thead>
<tr>
<th>Units</th>
<th>Probabilities</th>
<th>Expected Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000</td>
<td>0.1</td>
<td>5,000</td>
</tr>
<tr>
<td>75,000</td>
<td>0.2</td>
<td>15,000</td>
</tr>
<tr>
<td>100,000</td>
<td>0.3</td>
<td>30,000</td>
</tr>
<tr>
<td>125,000</td>
<td>0.4</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>\text{100,000}</td>
</tr>
</tbody>
</table>

**ADVICE:**
Product Y should be chosen because of the following reasons:
(1) It reports a higher contribution margin.
(2) There is a higher margin of safety.
(3) There is a higher expected demand.
(4) There is lower break-even point.

(b) (i) Use own staff

<table>
<thead>
<tr>
<th>Total Cost</th>
<th>Probabilities</th>
<th>Expected Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>₦7,000</td>
<td>0.3</td>
<td>₦2,100</td>
</tr>
<tr>
<td>12,000</td>
<td>0.5</td>
<td>6,000</td>
</tr>
<tr>
<td>25,000</td>
<td>0.2</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>\text{13,100}</td>
</tr>
</tbody>
</table>

(ii) Sub-Contract to firm K
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Cost</td>
<td>14,000</td>
</tr>
<tr>
<td>Variable Cost</td>
<td>2,300</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16,300</strong></td>
</tr>
</tbody>
</table>

Note: variable costs are determined thus:

<table>
<thead>
<tr>
<th>No. of Visits</th>
<th>Probabilities</th>
<th>Expected Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>0.3</td>
<td>150</td>
</tr>
<tr>
<td>1000</td>
<td>0.5</td>
<td>500</td>
</tr>
<tr>
<td>1500</td>
<td>0.2</td>
<td>300</td>
</tr>
<tr>
<td><strong>Expected Visits</strong></td>
<td></td>
<td><strong>950</strong></td>
</tr>
</tbody>
</table>

For 2 years (950 x 2) = 1,900  
Less visits for 2 periods = 750  
**1,150**

Excess visits 1150 x 2 = 2,300  

(iii) Sub-contract to firm P - N16,000 plus

Decision - Management should use own staff as they would incur the lowest cost of N13,100 as against the other alternatives.

The following are the advantages and disadvantages of the Expected Value approach to decision making:

**Advantages of Expected Value Approach**

- It is simple to understand and easy to calculate;
- It takes account of expected variability of all outcomes;
- It represents the whole distribution by a single figure; and
- It leads directly to a simple optimising decision rule.

**Disadvantages of Expected Value Approach**

- It makes a general assumption that the decision maker is risk neutral.
- It is in itself meaningless, only by coincidence will it be an actual outcome. In fact, it is not an expected value, but
more of a weighted average;
- By asking for a series of forecasts, the forecasting procedure is complicated and in fact inaccurate forecasting is a major weakness in most business decisions; and
- By representing the whole distribution by a single figure, it ignores the other characteristics of the distribution.

(f) **Risk Analysis**

This method measures the risks in projects through an examination of the standard deviations. Harry Markowitz in his article "Portfolio Selection" equated risk to standard deviation. The argument being that decisions on long term projects where probabilities are attached are based on the expected values. The expected value is a central measure under a normal distribution. It follows, therefore, that deviations from the mean will capture the risks in projects which is the inaccuracy of our decisions.

Standard deviation (SD) can be measured as follows:

\[
\text{SD of cash flows} = \sqrt{\text{Variance}}
\]

where variance \(= \sqrt{p(x - \bar{x})^2}\)

Therefore, \(SD = \sqrt{\text{Variance}} = \sqrt{p(x - \bar{x})^2}\)

where \(x\) = each possible outcome
\(\bar{x}\) = expected or mean outcome
\(p\) = probability attached to each outcome

The rule is, the higher the standard deviation, the higher the risk

The major problem with using standard deviation as a measure of risk is that it does not recognise differences in sizes or scales of projects. The reason is that standard deviation is not a relative measure of dispersion.

A more perfect measure is the co-efficient of variation.

The co-efficient of variation \(= \frac{\text{SD}}{\text{Mean}} = \frac{\sqrt{(x - \bar{x})^2}}{x}\)

The rule remains, that the higher the co-efficient of
variation (COV) the higher the risk. It is clear that the correct way to measure risks among projects, if the expected value or scales are not the same, is the coefficient of variation (COV).

(g) Standard Deviation of Projects

The discussions on projects will normally be based on NPV rather than cash flows. For this reason, it is more relevant to calculate the risk on a project by calculating the standard deviation of NPV rather than standard deviation of cash flows. The standard deviation of NPV of a project can be calculated through the stream of cashflows in a project as follows:

(a) If the cash flows are dependent annually, the standard deviation of NPV of a project is:

\[
SD = \frac{S_1^2}{(1+r)} + \frac{S_1^2}{(1+r)^2} + \frac{S_1^2}{(1+r)^3} + \ldots + \frac{S_1^2}{(1+r)^n}
\]

\[
SD = \sum_{n=1}^{n} \frac{S_1^2}{(1+r)^n}
\]

Where \( S = \) standard deviation of cash flows

The cash flows are considered dependent, if each years' cash flow will occur on the basis of a particular level in previous years or will influence future level of cash flows.

(b) However, where cash flows are independent annually, the standard deviation of the project will be calculated as below:

\[
SD = \frac{S_1^2}{(1+r)} + \frac{S_1^2}{(1+r)^2} + \frac{S_1^2}{(1+r)^3} + \ldots + \frac{S_1^2}{(1+r)^n}
\]

Where \( S(x - \bar{x})^2P \) the variance of each year's cash flows.
ILLUSTRATION 7-2

Omoba Talodabire Enterprises Ltd. has two investment options, each of which involves an initial outlay of N 3,000 and an expected life of 3 years.

Annual net cash flows from each project being one year after the initial investment is made and have the following probability distributions:

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Probability</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(₦)</td>
<td>(₦)</td>
</tr>
<tr>
<td>Project A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.2</td>
<td>2,400</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.6</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>0.2</td>
<td>3,600</td>
<td></td>
</tr>
<tr>
<td>Project B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.2</td>
<td>2,400</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>0.6</td>
<td>3,000</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>0.2</td>
<td>3,600</td>
<td></td>
</tr>
</tbody>
</table>

(a) What is the expected value of the annual cash flow from each project?

(b) What is the risk-adjusted net present value of each project if the company has decided to evaluate the riskier project at 10% and the less riskier project at 8%?

SUGGESTED SOLUTION 7-2

OMOBA TALODABIRE ENTERPRISES LIMITED

(a) The expected value of the annual cash flow are determined as follows:

<table>
<thead>
<tr>
<th>State of the world</th>
<th>Prob.</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cash</td>
<td>Expected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>flows</td>
<td>Value</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(₦)</td>
<td>(₦)</td>
</tr>
<tr>
<td>i</td>
<td>0.2</td>
<td>2,400</td>
<td>480</td>
</tr>
<tr>
<td>ii</td>
<td>0.6</td>
<td>3,000</td>
<td>1,800</td>
</tr>
<tr>
<td>iii</td>
<td>0.2</td>
<td>3,600</td>
<td>720</td>
</tr>
</tbody>
</table>

Expected annual cash flow 3,000

Expected Annual cashflow 3,300
(b) **Project A**

SD of cash flows = \( S(x - \bar{x})^2 \)

<table>
<thead>
<tr>
<th>( x )</th>
<th>( p )</th>
<th>( xp )</th>
<th>( x - \bar{x} )</th>
<th>( (x - \bar{x})^2 )</th>
<th>( (x - \bar{x})^2p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2400</td>
<td>0.2</td>
<td>480</td>
<td>(600)</td>
<td>360,000</td>
<td>72,000</td>
</tr>
<tr>
<td>3000</td>
<td>0.6</td>
<td>1,800</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3600</td>
<td>0.2</td>
<td>720</td>
<td>600</td>
<td>360,000</td>
<td>72,000</td>
</tr>
</tbody>
</table>

\( \bar{x} = \frac{3,000}{3} = 144,000 \)

Therefore, standard deviation = \( \sqrt{144,000} = 379 \)

Therefore, co-efficient of variation = \( \frac{379}{3,000} = 0.126 = 12.60\% \)

**PROJECT B**

<table>
<thead>
<tr>
<th>( x )</th>
<th>( p )</th>
<th>( xp )</th>
<th>( x - \bar{x} )</th>
<th>( (x - \bar{x})^2 )</th>
<th>( (x - \bar{x})^2p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.2</td>
<td>0</td>
<td>(3300)</td>
<td>10,890,000</td>
<td>2,178,000</td>
</tr>
<tr>
<td>3000</td>
<td>0.6</td>
<td>1,800</td>
<td>(300)</td>
<td>90,000</td>
<td>54,000</td>
</tr>
<tr>
<td>7500</td>
<td>0.2</td>
<td>1,500</td>
<td>4200</td>
<td>17,640,000</td>
<td>3,528,000</td>
</tr>
</tbody>
</table>

\( \bar{x} = \frac{3,300}{3} = 5,760,000 \)

Therefore, standard deviation = \( \sqrt{5,760,000} = 2,400 \)

Therefore, coefficient of variation = \( \frac{2,400}{3,000} = 0.727 = 72.7\% \)

From the computations above, Project B is riskier than Project A. Therefore, the risk adjusted net present value can be determined thus:

**Project A**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>DCF @8%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(3,000)</td>
<td>1.000</td>
<td>(3,000)</td>
</tr>
<tr>
<td>1-3</td>
<td>3,000</td>
<td>2.577</td>
<td>7,731</td>
</tr>
</tbody>
</table>

**ENPV** 4,731

**Project B**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>DCF @10%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(3,000)</td>
<td>1.000</td>
<td>(3,000)</td>
</tr>
<tr>
<td>1-3</td>
<td>3,300</td>
<td>2.487</td>
<td>8,207</td>
</tr>
</tbody>
</table>

**ENPV** 5,207
(h) **Sensitivity Analysis**

Sensitivity Analysis is a term used to describe any technique whereby decision options are tested for their vulnerability to adverse changes in its constituent "variables" such as expected sales volume, sales per unit, material cost, labour cost, etc.

In practice, many companies try to resolve some of the risks in projects by applying sensitivity analysis to the major component of the project. The aim is to quantify the impact of changes in the variables of a project on the decision. Since decisions are always based on NPV, sensitivity analysis will attempt to quantify the percentage change in a variable that will change the NPV and ultimately change our decisions.

If the percentage change that will affect our decision is very small, then the project will be considered very sensitive to the particular variable being examined. A major advantage of sensitivity analysis is that it will identify the key variables of a project before a decision is taken and with this, management will take a more accurate decision. Secondly, it makes the management to be more conscious of the errors and dangers in incorrect estimations. Finally, it will enable the management to make contingency plan should the sensitive changes occur.

However, a major problem with the sensitivity analysis is the fact that the variables of a project are inter-related in many cases. Therefore, it does not make much sense to examine in isolation the effect of changes in a particular variable only. Nonetheless, many companies try to cope with this problem by examining a combination of related variables and in this way, they look at different scenarios. But where the number of variables and interrelationships are large or complicated, it may be better to use simulation analysis. There are two (2) popular ways of analysing the sensitivity in a project as follows:

(a) The first method involves changing the values of different project variables arbitrarily and checking the effect of those changes on our decisions (NPV).
(b) Alternatively, we may want to calculate the percentage change in a variable that would change our decision. As a guide, the following definitions may apply:

(i) Sensitivity of a project to cash flows is determined thus:

\[
\frac{\text{NPV of the Project}}{\text{PV of the Cash flow}} \times 100
\]

(ii) Sensitivity of a project to cost of capital can be thus:

\[
\frac{\text{IRR} - \text{Cost of Capital}}{\text{Cost of Capital}} \times 100
\]

(iii) Sensitivity of a project to the life of the project is thus:

\[
\frac{\text{Project Life} - \text{BEP of Project Life}}{\text{Project Life}} \times 100
\]

The example below is used to illustrate the application of the above method as that used in adjusting for risk in projects.

**ILLUSTRATION 7-3**

A project costing ₦20,000 is expected to last four years. Annual sales and related costs are shown below:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (50 units)</td>
<td>21,500</td>
</tr>
<tr>
<td>Direct Material</td>
<td>4,000</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>3,000</td>
</tr>
<tr>
<td>Direct Factory Overhead:</td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td>1,500</td>
</tr>
<tr>
<td>Contribution</td>
<td>8,500</td>
</tr>
<tr>
<td>Fixed cost (incremental)</td>
<td>13,000</td>
</tr>
<tr>
<td>Annual Profit</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td>8,000</td>
</tr>
</tbody>
</table>

**Required:**
(a) Calculate the project's NPV.
(b) Prepare a statement showing how sensitive the NPV is to errors...
of estimation in each component of your calculation in (a) above, namely:

(i) Annual sales volume
(ii) Unit selling price
(iii) Direct material cost
(iv) Direct labour cost
(v) Variable overhead
(vi) Annual fixed costs
(vii) Initial outlay
(viii) Product life
(ix) Cost of capital.

**SUGGESTED SOLUTION 7-3**

(a) The project’s NPV is determined thus:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>DCF 10%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>1.0000</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1-4</td>
<td>8,000</td>
<td>3.1699</td>
<td>25,359</td>
</tr>
<tr>
<td>Net Present Value</td>
<td></td>
<td></td>
<td><strong>₦ 5,359</strong></td>
</tr>
</tbody>
</table>

The project should be accepted since it has positive NPV of **₦ 5,359**.

(b) (i) **Sensitivity of annual sales volume:**

\[
\frac{\text{NPV}}{\text{DCF Contribution}} \times \frac{100}{1} = \frac{5,359}{13,000 \times 3.1699}
\]

The annual sales volume must not fall below 13%, otherwise the project will be unacceptable.

(ii) **Sensitivity of unit selling price:**

\[
\frac{\text{NPV}}{\text{DCF of Sales Value}} \times \frac{100}{1} = \frac{5,359}{21,500 \times 3.1699} \times \frac{100}{1}
\]

\[= 7.86\% = 8\%\]
The unit selling price must not decrease below 8%, otherwise the project becomes unacceptable.

(iii) **Sensitivity of direct material cost**

\[
\frac{\text{NPV}}{\text{DCF of Direct Material Cost}} \times \frac{100}{1} = \frac{5.359}{4,000 \times 3.1699} = \frac{100}{1} = 42\% 
\]

The direct cost must increase by more than 42%, otherwise, the project becomes unacceptable.

(iv) **Sensitivity of Direct Labour Cost**

\[
\frac{\text{NPV}}{\text{DCF of Direct Labour Cost}} \times \frac{100}{1} = \frac{5.359}{3,000 \times 3.1699} = \frac{100}{1} = 56\% 
\]

The direct labour cost must not increase by more than 56%.

(v) **Sensitivity of variable overhead cost**

\[
\frac{\text{NPV}}{\text{DCF of Variable Overhead}} \times \frac{100}{1} = \frac{5.359}{1,500 \times 3.1699} = \frac{100}{1} = 112\% 
\]

The variable overhead cost must not increase beyond 112%.

(vi) **Sensitivity of fixed overhead cost**

\[
\frac{\text{NPV}}{\text{DCF of Fixed Overhead}} \times \frac{100}{1} = \frac{5.359}{5,000 \times 3.1699} = \frac{100}{1} = 34\% 
\]

The fixed overhead cost must not increase above 34%.

(vii) **Sensitivity of Initial Outlay**

\[
\frac{\text{NPV}}{\text{DCF of initial outlay}} \times \frac{100}{1} = \frac{5.359}{20,000 \times 3.1699} = \frac{100}{1} = 27\% 
\]

The initial outlay must not increase more than 27% for the project to be acceptable.
(viii) **Sensitivity of product life**

NPV @ 3 years

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>DCF @ 10%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>1</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1-3</td>
<td>8,000</td>
<td>2.4869</td>
<td>19.895</td>
</tr>
</tbody>
</table>

\[ \text{NPV} = (105) \]

\[ = 3 + \left[ \frac{105}{5359 - (-105)} \times \frac{4 - 3}{1} \right] \text{ yrs} \]

\[ = 3 + \left[ \frac{105}{5464} \times 1 \right] \text{ yrs} \]

\[ = 3 + 0.0192 \text{ yrs} \]

\[ = 3.02 \text{ yrs} \]

Therefore, \( \frac{4 - 3.02}{4} \times 100 = 24.5\% \)

The product life should not fall by more than 24.5%, that is, 9 months of project life. Otherwise, the project becomes unacceptable.

(ix) **Sensitivity of Cost of Capital**

The IRR is calculated first thus:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>DCF @ 15%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>1</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1-4</td>
<td>8,000</td>
<td>2.855</td>
<td>22,840</td>
</tr>
</tbody>
</table>

\[ +\text{NPV} = 2,840 \]

Try DCF @ 20%

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>DCF @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>1</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1-4</td>
<td>8,000</td>
<td>2.5887</td>
<td>20,710</td>
</tr>
</tbody>
</table>

\[ +\text{NPV} = 710 \]

Try DCF @ 25%

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flow</th>
<th>DCF @ 25%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>1</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1-4</td>
<td>8,000</td>
<td>2.3616</td>
<td>18,893</td>
</tr>
</tbody>
</table>

\[ -\text{NPV} = 1,107 \]
The cost of capital must not increase by more than 12.43% or the cost of capital should not be more than 22.43% otherwise the project will become unacceptable.

(i) Simulation Analysis

Simulation analysis is fashioned after Monte-Carlo simulation which is based on the idea of taking random samples from mathematical models that represent a real life system. However, the use of this method involves establishing a probability distribution for each of the variables that make up the model. Basically, from the distribution of values, one particular value is selected at random whereby the individual values selected are combined and used to determine the appropriate decision.

Uses and Applications of Simulation Technique

The technique is applicable to decision making situations as follows:

(a) It can be used in determining stock requirements, for example, canteen, filling stations etc;

(b) It can be used to determine the optimal number of facilities in complex sequence situations for example production scheduling;

(c) It is very useful in evaluating alternative investment policies; and

(d) It can be used to determine optimum stock levels in situations involving a variation of supply and demand.
Advantages of Simulation Technique

(a) It enables various alternatives to be thoroughly examined;

(b) The degree of assumption is not so great as it is with analytical method; and

(c) It provides a means of solution for problems for which the application of analytical method is unsuitable.

Disadvantages of Simulation Technique

(a) It is non-optimising because random numbers used are subjectively determined; and

(b) It involves the use of computers.

(J) Pay-off Matrix

When a decision maker is under a complete uncertainty, that is, the probability of occurrence or non-occurrence of the event cannot be quantified, then any of the following decision criteria could be used:

(i) Maximax Decision Rule: The decision maker believes that the best out of the best possible outcomes will always occur. This is the decision rule of an optimist.

(ii) Maximin Decision Rule: Under this situation, the decision maker believes that the best out of the worst possible outcomes will always occur. This is the decision rule of a pessimist. The shortcoming of the maximax and maximin criteria is that they both fail to account for the uncertainty inherent in the decision making problem, that is, they ignore the likelihood or the probability of the various events occurring.

(iii) Minimax Regret Rule: Here, the decision maker believes in minimising the possible maximum opportunity cost to be suffered or incurred. Example is a military strategist who wants to win a war with minimal casualty.
Concept of Value of Perfect Information

It is a common fact that information has no value, unless it is used to change the course of events. Therefore, perfect information, is an information that will predict what will happen with 100% certainty. Imperfect information on the other hand, only adds to what the decision maker knows, but the information cannot be relied on for accuracy with 100% certainty.

The value of information can, therefore, be quantified only if it is going to change the course of event. The value, is the expected value of benefits that information might provide to the decision-maker. It serves as an assurance to choose a different alternative. Therefore, in order to determine the naira value of perfect information, the following need to be determined:

(a) Expected value based on perfect information;
(b) The optimal expected value under risk; and
(c) A comparison of the two, that is, (a) and (b) above.

**ILLUSTRATION 7.5**

Malaika Incorporation has been operating a stand at a University's football stadium on a concessory rate. The University has had successful football teams for many years as a result, the stadium is always full. The university is located in an area that suffers no rain during football season. From time to time, Malaika has found itself in short supply of meat pie and at other times it has unsold stock. A review of the records of sales of the past nine seasons revealed the following frequency of hot meat pie sold.

<table>
<thead>
<tr>
<th>No. Games</th>
<th>10,000 meat pie</th>
<th>20,000 meat pie</th>
<th>30,000 meat pie</th>
<th>40,000 meat pie</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>10</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Meat pie sells for 50k each and cost Malaika 30k each. Unsold meat pie are given to a local orphanage without charge.
Required:

(i) Assuming that only the four quantities listed were ever sold and that the occurrences were random events, prepare a pay-off table (ignore income tax) to represent the four possible strategies of ordering 10,000, 20,000, 30,000 or 40,000 meat pie.

(ii) Using the expected value decision rule, determine the best strategy.

(iii) What is the naira value of perfect information?

SUGGESTED SOLUTION 7-5

(i) MALAIKA INCORPORATION

Table 7.1: PAY-OFF TABLE

<table>
<thead>
<tr>
<th>UNITS STOCKED (A)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>B UNITS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10,000</td>
<td>2,000</td>
<td>-1,000</td>
<td>-4,000</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>2,000</td>
<td>4,000</td>
<td>1,000</td>
</tr>
<tr>
<td>3</td>
<td>30,000</td>
<td>2,000</td>
<td>4,000</td>
<td>6,000</td>
</tr>
<tr>
<td>4</td>
<td>40,000</td>
<td>2,000</td>
<td>4,000</td>
<td>6,000</td>
</tr>
</tbody>
</table>

Decision Rule:

Maximax Rule: Stock 40,000 units in order to realize the maximum profits of ₦8,000.

Maximin Rule: Stock 10,000 in order to realize the maximum of the minimum profit of ₦2,000.

Note:

The consideration for the operation here is not being able to sell more than stocked units. For example, units stocked is units demanded and if otherwise, it is a loss rather than profit. For the 10,000 units in stock and demanded (10,000 x 0.5 - 10000 x 0.3) = (5000 - 3000) = The profit is ₦2,000.

But for 20,000 units in stock and 10,000 units demanded, it is
(20,000 \times 0.3 - 10,000 \times 0.5) = (6,000 - 5,000) = (₦ 1,000) is profit or (loss).

Therefore, the calculation is a function of the following:

(a) Cost of units stocked for each level of storage.
(b) Revenue from units demanded.
(c) Comparison of the two to determine the profit or loss, for example, units demanded \( X \) selling price unit - units stocked \( X \) cost per unit.

### TABLE 7.2: REGRET PAY-OFF TABLE

<table>
<thead>
<tr>
<th>Units</th>
<th>Demands</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10,000</td>
<td>10,000</td>
<td>3,000*</td>
<td>6,000*</td>
<td>9,000*</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>2,000+</td>
<td>6,000*</td>
<td>1,000</td>
<td>6,000*</td>
</tr>
<tr>
<td>3</td>
<td>30,000</td>
<td>4,000+</td>
<td>2,000+</td>
<td>3,000*</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>40,000</td>
<td>6,000+</td>
<td>4,000+</td>
<td>2,000+</td>
<td></td>
</tr>
<tr>
<td>Minimal</td>
<td>6,000</td>
<td>4,000</td>
<td>6,000</td>
<td>9,000</td>
<td></td>
</tr>
</tbody>
</table>

**Decision Rule:**

Minimax Rule: Stock 20,000 units in order to minimise the regret of ₦ 4,000.

**Note:**

Two types of losses (or regrets) are involved here, namely:

(a) Loss of profit - Where he could not sell more than the units stocked.
(b) Loss of stock - Where he could not sell all units stocked.

*Denotes Loss of stock which is derived by multiplying stock loss by stock unit cost, that is, No.3, for example, \((C2 - R1 \times 0.3) = (3,000 - 10,000 \times 0.3) = ₦ 3,000\)

+ Denotes Loss of profit which is derived by multiplying stock loss by unit profit, that is, No.2, for example \((C1 - R2 \times 0.2) = (10,000 - 20,000 \times 0.2) = ₦ 2,000\)
(ii) **TABLE 7.3: EXPECTED PAY-OFF TABLE**

<table>
<thead>
<tr>
<th>Units Stocked (C)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Units Demanded</strong></td>
<td><strong>Demand</strong></td>
<td><strong>Prob.</strong></td>
<td><strong>10,000</strong></td>
<td><strong>20,000</strong></td>
</tr>
<tr>
<td>1</td>
<td>10,000</td>
<td>0.1</td>
<td>200</td>
<td>-100</td>
</tr>
<tr>
<td>2</td>
<td>20,000</td>
<td>0.2</td>
<td>400</td>
<td>800</td>
</tr>
<tr>
<td>3</td>
<td>30,000</td>
<td>0.4</td>
<td>800</td>
<td>1,600</td>
</tr>
<tr>
<td>4</td>
<td>40,000</td>
<td>0.3</td>
<td>600</td>
<td>200</td>
</tr>
<tr>
<td>Maximal</td>
<td></td>
<td></td>
<td>2,000</td>
<td>3,500</td>
</tr>
</tbody>
</table>

**Decision Rule:**

Under the maximax rule, stock 30,000 units order to realise the maximum expected profit of N4,000.

**Note:**

The expected profits in Column 1 above is arrived at thus with the assumption it is not possible to sell more than the units stocked at any point in time:

\[
(R_1 \times 0.5 - C_1 \times 0.3) \times 0.1 = (10,000 \times 0.5 - 10,000 \times 0.3) \times 0.1 = (5,000 - 3,000) \times 0.1 = \text{N}200.
\]

\[
(R_2 \times 0.5 - C_1 \times 0.3) \times 0.2 = (10,000 \times 0.5 - 10,000 \times 0.3) \times 0.2 = (5,000 - 3,000) \times 0.2 = \text{N}400.
\]

\[
(R_3 \times 0.5 - C_1 \times 0.3) \times 0.4 = (10,000 \times 0.5 - 10,000 \times 0.3) \times 0.4 = (5,000 - 3,000) \times 0.4 = \text{N}800.
\]

\[
(R_4 \times 0.5 - C_1 \times 0.3) \times 0.3 = (10,000 \times 0.5 - 10,000 \times 0.3) \times 0.3 = (5,000 - 3,000) \times 0.3 = \text{N}600.
\]

Those for columns 2, 3 and 4 are arrived at by just substituting \(R_2\) - \(C_2\), \(R_3\) - \(C_3\) and \(R_4\) - \(C_4\) respectively as well as applying the element of probability as above.

(iii) **VALUE OF PERFECT INFORMATION**

\[
\text{N}
\]

If demand is 10,000, supply is 10,000

\[
\text{N}(10,000 \times 0.5 - 10,000 \times 0.3) \times 0.1 = 200
\]

If demand is 20,000, supply is 20,000

\[
\text{N}(20,000 \times 0.5 - 20,000 \times 0.3) \times 0.2 = 800
\]

If demand is 30,000, supply is 30,000

\[
\text{N}(30,000 \times 0.5 - 30,000 \times 0.3) \times 0.4 = 2,400
\]

If demand is 40,000, supply is 40,000

\[
\text{N}(40,000 \times 0.5 - 40,000 \times 0.3) \times 0.3 = 2,400
\]

\[
\text{N}5,800
\]
Therefore, the value of perfect information is:

\[
\text{Expected value with perfect information (derived above)} \quad 5,800 \\
\text{Less optimal expected value under risk (derived as in (ii) above)} \quad 4,000 \\
\text{1,800}
\]

This is the maximum amount to be paid for the supply of the information.

(k) **Decision Tree**

This is a pictorial representation of the various alternatives and sequences involved in complex problems requiring inter-related decision-making.

There are two types of nodes used in drawing up decision trees, namely:

(a) **Decision nodes**

These are used where the decision maker can select a course of action from available alternatives.

(b) **Chance nodes**

These are used where probabilities can be attached to decision variables.

The procedures for drawing up a decision tree are follows:

(a) Draw the decision tree;
(b) Assign the probability;
(c) Assign the pay-off;
(d) Determine the terminal value of each root by adding together the relevant payoff;
(e) Find the values at each node by working backwards, applying the expected value criterion as chance nodes and selecting the highest terminal value at the decision nodes;
(f) The value at the starting decision node will dictate the course of action, that is, the best possible root to adopt; and
(g) Where the pay offs involve time value of money, 
the present value of the cash flows needs to be 
computed. This will now represent the terminal 
value of each root.

The above steps can be adopted in solving 
questions which involve complex problems in 
decision making.

ILLUSTRATION 7-6
A software company has just won a contract worth N80,000,000 if it 
delivers a successful product on time, but only N40,000,000 if this is 
late. It faces the problem on whether to produce the work in-house or 
to sub-contract it. To sub-contract the work would cost N50,000,000, 
but the local sub-contractor is so fast and reliable as to make it certain 
that successful software is produced on time.

If the work is produced in-house, the cost would be only N20,000,000 
but based on past experience, it would have a 90% chance of being 
successful. In the event of the software not being successful, there would 
be insufficient time to re-write the whole package internally, but there 
would still be the options of either a late rejection of the contract (at a 
further cost of N10,000,000) or sub-contracting the job on the same 
terms as before. With this late start, the local sub-contractor is estimated 
to have 50/50 chance of producing the work on time or producing it 
late. In this case, the sub-contractor still has to be paid N50,000,000 
regardless of whether he meets the deadline or not.

You are required to:

(a) Draw a decision tree for the software company, using squares 
    for decision points and circles for chance points including all 
    relevant data on the diagram.

(b) Calculate expected values as appropriate and to recommend 
    a course of action to the software company.

SUGGESTED SOLUTION 7-6

Decision: Produce the job in-house
WORKINGS

Chance Node 1
\[(\₦10m \times 0.5) + [\(\₦30m \times 0.5]\] \\
= \(\₦5m - \₦15m\) \\
= \(\₦10m\)

Decision Node 2
The higher of \(\₦39m\) and \(\₦10m\)
= \(\₦10m\)

Chance Node 3
\[(\₦60m \times 0.9) + (\-\₦10 \times 0.1)\] \\
= \(\₦54m - \₦1m\) \\
= \(\₦53m\)

Decision Node 4
Higher of \(\₦53m\) and \(\₦30m\)
= \(\₦53m\)

ILLUSTRATION 7-7

The government of the Republic of WAZOBIA has decided to sell the rights to drill for oil on a track of land in the Republic. They have offered the rights to Nuel Oil Plc., an oil exploration company for \(\₦1.5\) million payable one year before the start of the first year of drilling. The directors of the oil company have provided the following estimates relating to the relevant parcel of land at Ikire.

Annual Net Revenue Excluding Depreciation

<table>
<thead>
<tr>
<th>Qty. of Oil</th>
<th>Probability</th>
<th>Strong Demand</th>
<th>Weak Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>0.3</td>
<td>8M</td>
<td>2M</td>
</tr>
<tr>
<td>Low</td>
<td>0.3</td>
<td>4M</td>
<td>1M</td>
</tr>
<tr>
<td>Zero</td>
<td>0.4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The selling price of oil and hence the annual net revenue depends on whether the demand for oil is strong or weak. The directors estimate that there is a 40% probability that demand will be strong and a 60% probability that it will be weak. Exploratory drilling will be immediately after the drilling rights are acquired and will cost \(\₦0.5\) million payable at the time the drilling rights are paid for.

If the existence of oil is revealed by the exploratory drilling, it will be
extracted for 10 years and Nuel Oil Plc. will purchase special drilling and other equipments at a cost of ₦9 million payable at the start of the first year of drilling.

It will not be necessary to purchase the equipment if no oil is discovered. If the quantity of oil is high, the equipment will have no resale or scrap value after 10 years. If it is low, the equipment will have resale value of ₦2 million at the end of that period Nuel Oil Plc. has a cost of capital of 20% per annum. Annual net revenue are receivable in cash on the last day of the year.

Required:

(a) Represent the problem stated above in form of a decision tree.

(b) From the decision tree, determine the appropriate course of action.

**SUGGESTED SOLUTION 7-7**

![Decision Tree]

**Workings:**

**ROUTE A**

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>DCF @20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(1.5)</td>
<td>1.000</td>
<td>(1.5)</td>
</tr>
<tr>
<td>0</td>
<td>(0.5)</td>
<td>1.000</td>
<td>(0.5)</td>
</tr>
<tr>
<td>1</td>
<td>(9)</td>
<td>0.833</td>
<td>(7.49)</td>
</tr>
<tr>
<td>2-11</td>
<td>8</td>
<td>3.494</td>
<td>27.95</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+NPV</td>
<td>18.46</td>
</tr>
</tbody>
</table>
### ROUTE B

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash flows</th>
<th>DCF @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(2)</td>
<td>1.000</td>
<td>(2)</td>
</tr>
<tr>
<td>1</td>
<td>(9)</td>
<td>0.833</td>
<td>(7.49)</td>
</tr>
<tr>
<td>2-11</td>
<td>2</td>
<td>3.494</td>
<td>6.99</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+NPV</td>
<td>(2.50)</td>
</tr>
</tbody>
</table>

### ROUTE C

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash flows</th>
<th>DCF @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(2)</td>
<td>1.000</td>
<td>(2)</td>
</tr>
<tr>
<td>1</td>
<td>(9)</td>
<td>0.833</td>
<td>(7.49)</td>
</tr>
<tr>
<td>2-11</td>
<td>2</td>
<td>3.494</td>
<td>13.98</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>0.135</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+NPV</td>
<td>4.76</td>
</tr>
</tbody>
</table>

### ROUTE D

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash flows</th>
<th>DCF @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(2)</td>
<td>1.000</td>
<td>(2)</td>
</tr>
<tr>
<td>1</td>
<td>(9)</td>
<td>0.833</td>
<td>(7.49)</td>
</tr>
<tr>
<td>2-11</td>
<td>1</td>
<td>3.494</td>
<td>3.494</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>0.135</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+NPV</td>
<td>5.73</td>
</tr>
</tbody>
</table>

### ROUTE E

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Cash flows</th>
<th>DFC @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(2)</td>
<td>1.000</td>
<td>(2)</td>
</tr>
</tbody>
</table>

### ROUTE F

Same as Route E

---

The expected Value Criterion

**Node 1:** 
\[ [18.46 \times 0.4] + [(2.5) \times 0.6] \]
\[ 7.38 + (1.5) = 5.88 \]
Thus, 5.88 is selected.

**Node 2:** Select the highest terminal value which is 5.88 or '0'.

**Node 3:** 
\[ [4.76 \times 0.4] + [(5.73) \times 0.6] \]
\[ 1.904 + (3.44) = (1.54) \]

**Node 4:** Same as Node 3 for the same reason stated in Node 2.

**Node 5:** 
\[ [(2) \times 0.4] + [(2) \times 0.6] \]
\[ 0.8 + (1.2) = (2) \]

**Node 6:** 
\[ [(5.88 \times 0.3)] + [(1.54) \times 0.3] + [(2) \times 0.4] \]
\[ 1.76 - 0.46 - 0.8 = 0.50. \]

Nodes 7 and 8 is the same as Node 6.
Decision

Accept the offer as the project will generate a positive NPV of about ₦500,000.

(a) Portfolio Theory

The portfolio theory was developed by Harry Markowitz in relation to investments in securities. This theory is derived from the mean variance rate which states that if an investor has a pool of investments (a portfolio) he will be interested in the returns from the portfolio and the risks associated with the portfolio.

A portfolio is a collection of two or more securities or projects or investments.

Therefore, the portfolio theory is concerned with the selection of portfolio for which the managers and investors will consider the following:

(i) The returns expected from the portfolio or securities or investment; and
(ii) The risks associated with such returns.

(b) Portfolio Returns

The returns from a portfolio is the weighted average of all returns from the securities that make up the portfolio. The weights to be attached will be the proportion of the total portfolio constituted by the respective securities.

ILLUSTRATION 7.7

A portfolio comprising of two securities X and Y with an expected return of ₦150,000 from X and ₦100,000 from Y. If the security X constitutes 65% of the portfolio and security Y constitutes the remainder.

Required

Calculate the returns from the portfolio.
SUGGESTED SOLUTION 7-7

\[
\begin{align*}
X &= 65\% \text{ of } N150,000 = 97,500 \\
Y &= 35\% \text{ of } N100,000 = 35,000 \\
\text{Portfolio returns (weighted average)} &= \underline{132,500}
\end{align*}
\]

(c) Portfolio Risk

The risk of a portfolio is also measured by the standard deviation of the portfolio returns. In the case of a portfolio, the relationship between the fluctuation of the individual securities should be considered in addition to the relationship between the fluctuations of the securities. Thus, the relationship between the securities can materially affect the riskiness of the portfolio containing the securities.

The following are discussed in order to measure the riskiness of a portfolio thus:

(i) **Correlation**: The degree to which the returns of the securities in a portfolio fluctuate together or in opposite direction is called correlation. The statistical measure of this relationship is known as the co-efficient of correlation \((r)\). The co-efficient lies between \(-1\) for perfectly negative correlation and \(+1\) for perfectly positive correlation.

(ii) **Standard deviation**: The variance of a portfolio containing two securities A and B can be calculated as follows:

\[
\text{Variance} = A^2 + B^2 + 2ABr (A \cdot B)
\]

(Variance \(A \& B\)) = \(A^2 + B^2 + 2ABr\)

Where

- \(A\) = Standard deviation of A multiplied by weight of A in the portfolio
- \(B\) = Standard deviation of B multiplied by weight of B in the portfolio
- \(r\) = Co-efficient of correlation between A \& B
The standard deviation (SD) of a portfolio is, therefore, the square root of the variance, that is. SD of A & B = 
\[ \sqrt{A^2 + B^2 + 2ABr} \]

The above formulae show that the variance of a portfolio is not just a weighted average of the individual variance that make up the portfolio but also depend on the correlation between the returns of the securities that make up the portfolio.

Therefore, if the co-efficient of correlation is given, it will be possible to calculate the variance of the portfolio and thereafter its standard deviation of the portfolio. However, if it is not given, there will be a need to calculate the variance of the portfolio from first principles by constructing the probability distribution of the portfolio based on the entire possible combination of the securities.

(iii) **Co-variance:** This is the quantitative measure of the relationship between security fluctuations. Hence, the co-variance of a portfolio of A&B can be determined, thus:

\[
\text{Co-variance of A & B} = \frac{\text{Standard Deviation of AX}}{\text{Standard Deviation of BX}}
\]

r of A and B where \( r = \) co-efficient of correlation

OR

\[
R = \sqrt{\frac{\text{Co-variance A and B}}{\text{Standard deviation of A} \times \text{Standard deviation of B}}}
\]

OR

\[
R = \frac{\text{Cov. A B}}{\sigma A \times \sigma B}
\]

The portfolio theory states that there are two main types of risk inherent in a company and their securities. These are:

- Systematic risk; and
- Unsystematic risks.
(d) **Systematic Risks**

These are risks that affect every security or company in the system where the system is the entire capital market of the economy. Examples of these risks are declining economic condition, global inflation or recession, declining gross domestic product, declining foreign reserves, etc. The systematic risk can be measured by the beta factor (β).

(e) **Unsystematic Risks**

These are risks that are peculiar or unique to each security or company. Examples are the nature of the product or service the company is involved in, the industry in which the company operates, management inefficiency, etc. The unsystematic risks are measured by the alpha factor (α).

The theorists believe that systematic risks are uncontrollable and are, therefore, irrelevant to portfolio decision making or selection. They state that managers should concentrate on reducing unsystematic risk which can be reduced by diversification. Diversification, mean the introduction of new securities into the portfolio. However, they also believe that unsystematic risk can be substantially reduced or even eliminated through an adoption of efficient diversification policy. Efficient diversification means the introduction of new securities into the portfolio with returns that are negatively correlated to returns from the existing portfolio.

(f) **Efficient Portfolio**

The main element of portfolio theory as stated earlier concentrates on selecting projects on the basis of returns and risks. Returns would be maximized while risks should be minimized. Therefore, the manager should focus on holding a balanced portfolio. A balanced portfolio is that which strikes an ideal balance of returns and risks. It is also known as an efficient portfolio which is defined as the portfolio of which there is no other portfolio of either the same returns or lower risk or the same risks or higher returns.

Portfolio returns are to be maximised, since returns are in absolute terms, hence, no problem with choosing portfolios.
based on returns. This means that the focus of portfolio selection will be risk determination and risk minimisation.

The example below, is therefore, used to illustrate the operation of portfolio theory.

**ILLUSTRATION 7-8**

MOHAMMED LIMAN LIMITED has a two security portfolio namely Security A and Security B with each having the following returns and probability:

<table>
<thead>
<tr>
<th>Probability</th>
<th>Security A Returns</th>
<th>Security B Returns</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>0.8</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>0.1</td>
<td>35%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Required:** Determine the:

(a) Expected returns from each security.
(b) Standard deviation of the return from each security.
(c) The security with the highest risk.

**SUGGESTED SOLUTION 7-8**

**MOHAMMED LIMAN LIMITED**

(a) Calculation of Expected returns

<table>
<thead>
<tr>
<th>Probability</th>
<th>Security A Returns %</th>
<th>Security B Returns %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Expected Value %</td>
<td>Expected Value %</td>
</tr>
<tr>
<td>0.1</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>0.8</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>0.1</td>
<td>35</td>
<td>50</td>
</tr>
</tbody>
</table>

Expected Returns: 25.00  Expected Returns: 30.00

(b) Calculation of Standard Deviation

<table>
<thead>
<tr>
<th>Probability</th>
<th>Security A Returns %</th>
<th>Security B Returns %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(X - X̄)^2</td>
<td>(y - ȳ)^2</td>
</tr>
<tr>
<td>0.1</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>0.8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.1</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

Variance: 20  80
The standard deviation of each security is:

Security A \[ \sqrt{20} = 4.472\% \]
Security B \[ \sqrt{80} = 8.944\% \]

(c) Since security B has a higher standard deviation of 8.944\%, therefore, it is the security with the higher risk, even though it has a higher return of 30%.

ILLUSTRATION 7-9

You are considering investment in one or both of two securities X and Y, and you are given the following information:

<table>
<thead>
<tr>
<th>Security</th>
<th>Possible rates of return %</th>
<th>Probability of occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>30</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>0.3</td>
</tr>
<tr>
<td>Y</td>
<td>50</td>
<td>0.2</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>0.6</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>0.2</td>
</tr>
</tbody>
</table>

You are required to:

(a) Calculate the expected return for each security separately and for a portfolio comprising 60% X and 40% Y assuming neutral correlation between the possible rates of returns from the shares comprising the portfolio.

(b) Calculate the expected risk of each security separately and of the portfolio as defined above. (For this purpose, the measure of risk can be taken as the standard deviation of probable variances from the expected rate of return).

(c) Outline the objectives of portfolio diversification and explain in general terms why the risk on individual securities may differ from that of a portfolio as whole.
**SUGGESTED SOLUTION 7-9**

(a) (i) Calculation of expected returns from individual security

| Prob. | Rate of Returns | Expected Value | Security X | | Prob. | Rate of Returns | Expected Value | Security Y |
|-------|-----------------|----------------|------------| |-------|-----------------|----------------|------------|
| 0.3   | 30              | 9              |            | | 0.2  | 50              | 10             |            |
| 0.4   | 25              | 10             |            | | 0.6  | 30              | 18             |            |
| 0.3   | 20              | 6              |            | | 0.2  | 10              | 2              |            |

Expected Return for Security X = \( 0.3 \times 30 + 0.4 \times 25 + 0.3 \times 20 = 25 \)

Expected Return for Security Y = \( 0.2 \times 50 + 0.6 \times 30 + 0.2 \times 10 = 30 \)

(ii) Expected Return from combined portfolio = \( (60\% \times 25\%) + (40\% \times 30\%) = 15\% + 12\% = 27\% \)

(b) (i) Calculation of expected risk from each security

| Prob. | \( x \) | \( (x-\bar{x}) \) | \( p(x-\bar{x})^2 \) | Security X | | Prob. | \( y \) | \( (y-\bar{y}) \) | \( p(y-\bar{y})^2 \) | Security Y |
|-------|--------|-----------------|-----------------|------------| |-------|--------|-----------------|-----------------|------------|
| 0.3   | 30     | 5               | 7.5             |            | | 0.2  | 50     | 0               | 0               |            |
| 0.4   | 25     | 0               | 0               |            | | 0.6  | 30     | 0               | 0               |            |
| 0.3   | 20     | (5)             | \( 7.5 \)       |            | | 0.2  | 10     | (20)           | 80              |            |

Variance = \( \frac{15.0}{3} = 5.0 \)

Risk = Standard deviation

Risk is \( SD \) Security X: \( \sqrt{15} = 3.87\% \)

Risk = \( \sqrt{160} = 12.65\% \)

(ii) Calculation of combined risk from the portfolio. The combined expected returns from the portfolio can be alternatively confirmed as follows:

<table>
<thead>
<tr>
<th>Returns</th>
<th>Probability</th>
<th>Returns</th>
<th>Probability</th>
<th>Joint Return</th>
<th>Joint Prob.</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security x(%):</td>
<td>Security y(%)</td>
<td>P(X)</td>
<td>Y</td>
<td>Security</td>
<td>P(Y)</td>
<td>(60% + 40%)</td>
</tr>
<tr>
<td>30</td>
<td>0.3</td>
<td>30</td>
<td>0.2</td>
<td>18 + 20 = 38</td>
<td>0.06</td>
<td>2.28</td>
</tr>
<tr>
<td>30</td>
<td>0.3</td>
<td>30</td>
<td>0.6</td>
<td>18 + 12 = 30</td>
<td>0.18</td>
<td>5.40</td>
</tr>
<tr>
<td>25</td>
<td>0.4</td>
<td>30</td>
<td>0.2</td>
<td>15 + 20 = 35</td>
<td>0.08</td>
<td>2.80</td>
</tr>
<tr>
<td>25</td>
<td>0.4</td>
<td>30</td>
<td>0.6</td>
<td>15 + 12 = 27</td>
<td>0.24</td>
<td>6.48</td>
</tr>
<tr>
<td>25</td>
<td>0.4</td>
<td>10</td>
<td>0.2</td>
<td>15 + 4 = 19</td>
<td>0.08</td>
<td>1.52</td>
</tr>
<tr>
<td>20</td>
<td>0.3</td>
<td>30</td>
<td>0.2</td>
<td>12 + 20 = 32</td>
<td>0.06</td>
<td>1.92</td>
</tr>
<tr>
<td>20</td>
<td>0.3</td>
<td>30</td>
<td>0.6</td>
<td>12 + 12 = 24</td>
<td>0.18</td>
<td>4.32</td>
</tr>
<tr>
<td>20</td>
<td>0.3</td>
<td>10</td>
<td>0.2</td>
<td>12 + 4 = 16</td>
<td>0.06</td>
<td>0.96</td>
</tr>
</tbody>
</table>

Expected Return from Portfolio (x) = 27.00
<table>
<thead>
<tr>
<th>Portfolio Return</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>( x )</td>
<td>( x - \bar{x} )</td>
</tr>
<tr>
<td>38</td>
<td>11</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
</tr>
<tr>
<td>22</td>
<td>(5)</td>
</tr>
<tr>
<td>35</td>
<td>8</td>
</tr>
<tr>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>(8)</td>
</tr>
<tr>
<td>32</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td>(3)</td>
</tr>
<tr>
<td>16</td>
<td>(11)</td>
</tr>
</tbody>
</table>

**Variance**  
31.00

**Expected Returns from Portfolio \( \bar{x} \) (see page 152)**

Risk = Standard deviation = \( \sqrt{31} = 5.6\% \)

Alternatively, the combined risk can be calculated thus:

\[
p = [A^2 + B^2 + 2ABr]
\]

When the correlation co-efficient \( r \) is 0

\[
p = [(0.6)^2 + (3.87)^2 + (0.4)^2 (12.65)^2]
\]

\[
= [(0.36 \times 15 + 0.16 \times 160]
\]

\[
= \sqrt{5.4 + 25.6}
\]

\[
= \sqrt{31} = 5.6\% 
\]

Note: If the correlation co-efficient \( r \) had been 1

\[
p = [5.4 + 25.6 + 2(0.6)(0.4)(1)(3.87)(12.65)] = 7.38\%
\]

**Portfolio Diversification**

The objectives of portfolio diversification are to achieve a satisfactory rate of return at a minimum risk for that return. This return will be equal to risk free rate of return when the portfolio consists entirely of risk-free securities. Since most portfolios consist of some 'risky' securities, the expected return should exceed the risk free rate as a compensation for the risk in the investment.

According to Markowitz, there is an efficient frontier of portfolios which has either:

(i) A higher expected return, or

(ii) A lower risk.
Therefore, an investor should select a portfolio on this frontier. The actual portfolio preferences will depend on 'utility' values. A portfolio is preferable to holding individual securities, because it reduces risk whilst still offering a satisfactory rate of return, that is, it avoids the dangers of "putting all your eggs" in one basket". As the figures in (illustration 7-9b) show, if returns are positively correlated, the risk of the investment will be higher, and diversification will be less effective in reducing risk.

(h) **Reasons for not Using Portfolio Theory for Investment Appraisal**

The main shortcomings of the theory are as follows:

(i) It becomes a time consuming and expensive technique as the number of alternatives grow, that is, each alternative must be compared with every other alternative, individually. Thus, if n projects are to be considered, n variance and much more \( \frac{n^2 - n}{2} \) co-variances must be calculated.

(ii) The commercial sense of the results from the calculation of correlation has been questioned; particularly in the context of large diversified group, for example, if a project (to improve a mining process) is being compared with a project to open a new hotel, how can the correlation of returns of these projects be realistically estimated?

### 7.2 ASSET REPLACEMENT DECISIONS

This decision area is also referred to as **Optimum Replacement Theory**. In asset replacement decision, we concentrate on productive machines and expect that all other assets can have replacement decision model in a similar manner. We evaluate the relevant cash flows associated with the replacement cycles and period of the assets. This involves striking an ideal balance between the cost and advantage of early replacement against the cost and advantage of later replacement. However, the following concepts need to be properly explained:

(a) **Replacement cycle**: This covers the frequency of replacement of an asset with an implied assumption that the asset will be put to continuous usage over an indefinite period, for example, if an asset has a three-year life span. It can be replaced every year, every two
years or every three years. Therefore, these options are referred to as replacement cycle.

(b) **Replacement period:** This relates to a point in time for discontinuing usage of an existing asset. It relates mainly to old assets that are being replaced with new assets that are unidentical, for example, if an existing asset with a remaining life span of three years is to be replaced with a new non-identical type, it means that we can replace the old asset now, after one year, after two years or after three years. Therefore, these options are referred to as replacement period for the old asset.

Assets are considered to be identical if the streams of cash flows and the life span of the assets are the same, even though, the assets need not be physically identical. Whereas, non-identical assets are those that are not financially identical i.e. replacement of an old asset with a new asset that is not financially identical.

The above issues form the basis for taking decisions when assets are to be replaced or decision taken on them for replacement purposes.

7.2.1 **Identical Replacement**

This involves the replacement of existing assets with new assets that are financially identical. The decisions are normally based on replacement cycle (replace every year, every two years, every three years, etc.) that provides the least present value of cost or the highest present value of revenue.

However, for the purpose of making optimal decisions, the following methods can be adopted:

(a) Least Common Multiple method;
(b) Finite Horizon method; and
(c) Annual Equivalent Cost method.

(a) **Least Common Multiple Method (LCM)**

This method examines the cash flows of all possible cycles of the machine over an equal number of years. This period is usually the least common multiple (LCM) of all cycle, for example, for a machine that has a life span of four years, we can choose to replace it every year, every two years, every three years or every four years.
The LCM approach requires the examination of the relevant cash flows of these cycles over a period of twelve years. The cycle with the least present value, of cost or highest present value of revenue would be chosen.

A major drawback of this method is that an asset with a long life span will require computation over a very long period, for example, the LCM of a seven year period must be four hundred and twenty years.

(b) The Finite Horizon Method

This method examines cash flows of all cycles over a foreseeable period. This period is normally the length of time within which the company's financial management team can generate reliable estimates. As a result of availability of decision makers to accurately forecast the distant future cash flows and the fact that the present value of such future cash flows will tend to zero, a company will only evaluate replacement decisions over a specified period of time, for example, an asset that has a life span of eight years, may be evaluated on the cycle of the cash flows for the first ten years.

A major drawback of this method is that the choice of the foreseeable future or the finite horizon is subjective and varies among decision makers.

(c) Annual Equivalent Cost Method (AEC)

This is the most popular of all the asset replacement techniques and it consists of the following steps:

(i) Identify the relevant cash flows for the relevant cycle (every year, every two years etc.) of the asset.
(ii) Calculate the present value of each cycle
(iii) Calculate the annual equivalent cost or revenue for each cycle, thus:

\[
AEC = \frac{\text{Present value of each cycle}}{\text{Cumulative discount factors (annuity factors) for each year}}
\]

(iv) The optimal replacement cycle is the cycle with the least annual equivalent cost or the highest annual equivalent revenue.
Remember that the equivalent annuity method is recommended especially where there is no inflation, as it is quicker and less cumbersome than any of the two methods described above.

**ILLUSTRATION 7-10**

Igbiniigie MSE Limited, with a fleet of 20 motor vehicles, is considering its vehicle replacement policy. Under an existing policy, the fleet is exchanged every three years. In addition, to the trade-in-values, a discount of 5% is given from the list of the replacement vehicles.

The company is considering an offer from another motor dealer which gives allowance of 100% of the total cost price for companies exchanging their vehicles annually. A guarantee covering repairs and breakdown is also included in the offer. The company's cost of capital is 10%.

1. Cost Price of each vehicle is ₦2,200,000
2. Estimated trade-in value of each vehicle:
   - After 12 Months: ₦1,600
   - After 24 Months: ₦1,200
   - After 36 Months: ₦1,000
3. Estimated annual repairs and running costs:
   - Year 1: ₦50
   - Year 2: ₦100
   - Year 3: ₦200

**Required:**

As the Management Accountant of the company, determine:
(a) the vehicle trade-in values and repairs costs.
(b) whether the company should adopt the new policy of changing their fleet of vehicles each year.

Note: Ignore taxation.
SUGGESTED SOLUTION 7-10

IGBINIGIE MSE LIMITED

Replace every three years  
<table>
<thead>
<tr>
<th>Year</th>
<th>Cost N'000</th>
<th>DCF @ 10%</th>
<th>PV N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(41,800)</td>
<td>1.0000</td>
<td>(41,800)</td>
</tr>
<tr>
<td>1</td>
<td>(1,000)</td>
<td>0.9091</td>
<td>(909.1)</td>
</tr>
<tr>
<td>2</td>
<td>(2,000)</td>
<td>0.8264</td>
<td>(1,653)</td>
</tr>
<tr>
<td>3</td>
<td>(4,000)</td>
<td>0.7513</td>
<td>(3,005)</td>
</tr>
<tr>
<td>3</td>
<td>20,000</td>
<td>0.7513</td>
<td>15,026</td>
</tr>
</tbody>
</table>

+ NPV 32,341.1

Replace every two years  
<table>
<thead>
<tr>
<th>Year</th>
<th>Cost N'000</th>
<th>DCF @ 10%</th>
<th>PV N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(36,600)</td>
<td>1.0000</td>
<td>(39,600)</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>32,000</td>
<td>0.9091</td>
<td>29,091</td>
</tr>
</tbody>
</table>

+ NPV 10,341.1

Annual Equivalent Cost (AEC) = \( \frac{NPV}{AF} = \frac{\text{Net Present Value}}{\text{Annuity Factor}} \)

Note: All figures are in N'000

AEC  
Every 3 years: \( NPV = (32,341) \)  
Annuity Factor (AF) for 3 years \( 2.4868 \)  
Therefore, AEC \( \frac{32,341}{2.4868} = N(13,005) \)

Every 1 year:  
NPV = N10,509  
AF for 1 year = 0.9091  
Therefore, AEC \( \frac{10,509}{0.9091} = N(11,560) \)

The company should change policy and replace annually since it results in a saving in cost of N2,496, that is, (13,005-10,509).

Workings:  
All figures are in N'000

(i) For replacement every 3 years.  
Year 0 Cost flow = 2,200 x 20 x 95% (100-5) = 41,800  
Year 1 repairs and running costs = N 50 x 20 = N 1,000
7.2.2 Non-Identical Replacements

In this case, we are examining the replacement of existing assets (machines) with new assets that are not financially identical. The relevant question will no longer be how often do we replace the machine but when. For instance, if the old machine can still be used for two more years, we need to identify the optimal replacement period for these old machines. The possible replacement period will be to replace the old machine now, after one year or after two years.

The basic assumption in this case derivable from the going concern is that the new machine would be replaced indefinitely with identical machine. Therefore, we must always determine first the optimal replacement cycle for the new machine. Because of this assumption of indefinite replacement for the new machine, the relevant cash flows for the machine will be a perpetuity of the optimal replacement cycle that is equal to AEC/r where 'r' is the cost of capital.

Steps for Non-Identical Replacements

(a) Identify the optimal replacement cycle for the new machine.

(b) Calculate the NPV of the relevant cash flows of each replacement period of the old machine (replace now or after one year etc.)

(c) To arrive at the NPV in (b) above, you must incorporate at the end of each replacement period, the cost of the new machine (assets). This cost is equal to the perpetuity (Annual Equivalent Cost)/r.

(d) The optimal replacement period for the old machine is that period that produces the lowest NPV of cost or highest NPV of revenue.
ILLUSTRATION 7-11

Isiaq Ismail Nigeria Limited currently operates an outdated machine which has the following cost and residual value data:

<table>
<thead>
<tr>
<th>Year</th>
<th>Operating Expenditure N'000</th>
<th>Maintenance N'000</th>
<th>Residual Value N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>2500</td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
<td>2</td>
<td>3000</td>
<td>1000</td>
<td>600</td>
</tr>
<tr>
<td>3</td>
<td>3500</td>
<td>1500</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>4000</td>
<td>1700</td>
<td>0</td>
</tr>
</tbody>
</table>

This machine is to be replaced by one of the new types for which financial data are:

<table>
<thead>
<tr>
<th>Time</th>
<th>Outlay N'000</th>
<th>Operating (o) N'000</th>
<th>Maintenance (m) N'000</th>
<th>Residual Value N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td>1800</td>
<td>2200</td>
<td>2600</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>200</td>
<td>500</td>
<td>900</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>4000</td>
<td>3000</td>
<td>2000</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>1000</td>
</tr>
</tbody>
</table>

The appropriate interest rate is 8%. At what time should the old and new types of machines be replaced?

SUGGESTED SOLUTION 7-11

ISIAQ ISMAIL NIGERIA LIMITED

New Machine

<table>
<thead>
<tr>
<th>Year</th>
<th>DF @ 8%</th>
<th>After 1 year N</th>
<th>After 2 years N</th>
<th>After 3 years N</th>
<th>After 4 years N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
<td>(7000) (o&amp;m) (1852)</td>
<td>(7000) (1852)</td>
<td>(7000) (1852)</td>
<td>(7000) (1852)</td>
</tr>
<tr>
<td>1</td>
<td>0.9259</td>
<td>Scrap 3704</td>
<td>(o&amp;m) (2315)</td>
<td>(2315)</td>
<td>(2315)</td>
</tr>
<tr>
<td>2</td>
<td>0.8573</td>
<td>Scrap 2572</td>
<td>(2315)</td>
<td>Scrap 1588</td>
<td>Scrap 735</td>
</tr>
<tr>
<td>3</td>
<td>0.7938</td>
<td>(2778)</td>
<td>(o&amp;m) (2778)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>0.7350</td>
<td>(2940)</td>
<td>Scrap 1588</td>
<td>Scrap 735</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(5148) (12357)</td>
<td>(5560)</td>
<td>(16150)</td>
<td></td>
</tr>
</tbody>
</table>

NPV

Annuity Factor

AEC

Note: All figures are in N'000
### Old Machine

#### PRESENT VALUES

<table>
<thead>
<tr>
<th>Year</th>
<th>DF @ 8%</th>
<th>New</th>
<th>After 1 year</th>
<th>After 2 years</th>
<th>After 3 years</th>
<th>After 4 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>0.9259</td>
<td></td>
<td>(o &amp; m) (2778)</td>
<td>2778</td>
<td>2778</td>
<td>2778</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scrap 926 Cost of New Machine (55,497)</td>
<td>(2778)</td>
<td>(2778)</td>
<td>(2778)</td>
</tr>
<tr>
<td>2</td>
<td>0.8573</td>
<td></td>
<td>(o&amp;m) (3429)</td>
<td>3429</td>
<td>3429</td>
<td>3429</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scrap 544 Cost of New Machine (51,385)</td>
<td>(3429)</td>
<td>(3429)</td>
<td>(3429)</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>(o&amp;m) (3969)</td>
<td>3969</td>
<td>47579</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scrap 79 Cost of New Machine</td>
<td>(3969)</td>
<td></td>
<td>(47579)</td>
</tr>
<tr>
<td>4</td>
<td>0.7350</td>
<td></td>
<td>(o&amp;m) (4190)</td>
<td>4190</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Scrap - Cost of New Machine</td>
<td>(4190)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NPV</td>
<td>(44,056)</td>
<td>(57,349)</td>
<td>(57,078)</td>
<td>(57,676)</td>
<td>(58,420)</td>
<td>(58,420)</td>
</tr>
</tbody>
</table>

#### Decision:

Replace the old machine after 2 years since it is the point of least cost with the new machine which will be replaced after 3 years at the least annual equivalent cost (AEC) of N99,938.

### 7.2.3 Where no Cost of Capital is Given

Where no cost of capital is given, it should not be assumed. It means that time value of money has been ignored or that there is a zero\% of cost of capital. In this case, our decision will be based on the average cash flow concept, therefore, the following steps would be involved:

- **(a)** Identify the relevant cash flow for each cycle or period.
- **(b)** Add the relevant cash flows for each cycle or period.
- **(c)** Calculate the average cost or average revenue for each cycle or period. The average cost is equal to:
  \[
  \text{Total Cash Flows for each cycle} \div \text{Number of years in each cycle}
  \]
(d) Optimal replacement cycle or period is that cycle which produces the least average cost or highest average revenue.

**ILLUSTRATION 7-12**

Baguda Rentals Limited estimated the following cost possible for "Workaholic", one of its equipment costing N57,200.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Annual Running Cost</td>
<td>8,800</td>
<td>9,900</td>
<td>11,000</td>
<td>13,200</td>
<td>15,000</td>
<td>19,250</td>
</tr>
<tr>
<td>Resale Price</td>
<td>44,000</td>
<td>34,100</td>
<td>27,500</td>
<td>24,200</td>
<td>20,900</td>
<td>18,150</td>
</tr>
</tbody>
</table>

(a) At what point in time should Baguda Rentals Limited replace "workaholic"?
(b) Assuming the "Workaholic" will be on hire for 120 days per annum and that Baguda wants a minimum annual return of 25% on the initial cost of the equipment, what will be the minimum daily hire rate?

**SUGGESTED SOLUTION 7-12**

<table>
<thead>
<tr>
<th>(a) Year</th>
<th>(b) Net Cash Flow NCF</th>
<th>(c) Cumulative NCF</th>
<th>(d) = (c)/(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>22,000</td>
<td>22,000</td>
<td>22,000</td>
</tr>
<tr>
<td>2</td>
<td>19,800</td>
<td>41,800</td>
<td>20,900</td>
</tr>
<tr>
<td>3</td>
<td>17,600</td>
<td>59,400</td>
<td>19,800</td>
</tr>
<tr>
<td>4</td>
<td>16,500</td>
<td>75,900</td>
<td>18,975</td>
</tr>
<tr>
<td>5</td>
<td>18,700</td>
<td>94,600</td>
<td>18,920</td>
</tr>
<tr>
<td>6</td>
<td>22,000</td>
<td>116,600</td>
<td>19,433</td>
</tr>
</tbody>
</table>

**Decision:**

(a) Baguda Rentals Limited should replace workaholic at the end of year 5, when the average annual NCF is least.

(b) In order to achieve the minimum return of 25% throughout the life of "Workaholic" we have to select the highest daily rental which is N 302.50. This incidentally occurs at years 1 and 6.

**Workings:**

(a) Since the company's cost of capital is not given, it is assumed that the replacement of the equipment will be at the point in time when the average annual net costs now is minimum.
(b) The net cash outflow (NCF) = depreciation + running costs where the depreciation in this case is the difference in cost price between what the asset can be sold for at the beginning of the year and what it can be sold for at the end of the same year, for example, for year 1, depreciation is \( \text{₦57,200} - \text{₦44,000} = \text{₦13,200} \) etc.

(c) The calculation of the NCF for each year is as follows:

<table>
<thead>
<tr>
<th>Age(years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value @ begin. of age</td>
<td>57,200</td>
<td>44,000</td>
<td>34,100</td>
<td>27,500</td>
<td>24,200</td>
<td>20,900</td>
</tr>
<tr>
<td>Value @ end of age</td>
<td>44,000</td>
<td>34,100</td>
<td>27,500</td>
<td>24,200</td>
<td>20,900</td>
<td>18,150</td>
</tr>
<tr>
<td>Depreciation (a)</td>
<td>13,200</td>
<td>9,900</td>
<td>6,000</td>
<td>3,300</td>
<td>3,300</td>
<td>2,750</td>
</tr>
<tr>
<td>Annual Running cost(b)</td>
<td>8,800</td>
<td>9,900</td>
<td>11,000</td>
<td>13,200</td>
<td>15,400</td>
<td>19,250</td>
</tr>
<tr>
<td>Total Cost (a + b)</td>
<td>22,000</td>
<td>19,800</td>
<td>17,600</td>
<td>16,500</td>
<td>18,700</td>
<td>22,000</td>
</tr>
</tbody>
</table>

(d) It is assumed that all costs accrue at the end of the year.

(e) The minimum return of 25% on the initial cost of \( \text{₦57,200} \) is \( 0.25 \times \text{₦57,200} = \text{₦14,300} \).

The sum is added to NCF for each year to arrive at minimum annual revenue for the respective years. These minimum annual revenues are divided by 120 days to arrive at the minimum daily hire rate as follows:

<table>
<thead>
<tr>
<th>Age(years)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCF</td>
<td>22,000</td>
<td>19,800</td>
<td>17,600</td>
<td>16,500</td>
<td>18,700</td>
<td>22,000</td>
</tr>
<tr>
<td>Minimum return</td>
<td>14,300</td>
<td>14,300</td>
<td>14,300</td>
<td>14,300</td>
<td>14,300</td>
<td>14,300</td>
</tr>
<tr>
<td>Minimum revenue</td>
<td>36,300</td>
<td>34,100</td>
<td>31,900</td>
<td>33,000</td>
<td>36,300</td>
<td>36,300</td>
</tr>
<tr>
<td>Min. Daily Rental</td>
<td>302.50</td>
<td>284.17</td>
<td>265.83</td>
<td>256.67</td>
<td>275.00</td>
<td>302.50</td>
</tr>
</tbody>
</table>

7.3 SUMMARY AND CONCLUSIONS

Risk and uncertainty are relevant issues to be considered in investment appraisal with reference to individual project uncertainty, the decision makers' attitude to risk and the diversification effect.

Various methods are available for taking care of risk and uncertainty and they include: sensitivity analysis, simulation, finite horizon, expected value, decision tree, risk analysis, pay-off matrix, risk premium, adjusted ARR, adjusted payback, asset replacement decisions and portfolio theory.

*(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)*
7.4 REVISION QUESTIONS

7.4.1 MULTIPLE CHOICE QUESTIONS

1. Risk adjusted discount rates for a firm can be calculated using:
   (a) Net present value
   (b) Internal rate of return
   (c) Capital rationing
   (d) Capital asset pricing model
   (e) Accounting rate of return

2. In calculating equivalent annual cash flow the formula is:
   \[ \frac{\text{Present Value of Revenue}}{\text{Annuity factor for N years at R\%}} \]
   (a)
   \[ \frac{\text{Present Value of total Cost}}{\text{Present factor for N years at R\%}} \]
   (b)
   \[ \frac{\text{Present Value of Cost}}{\text{Present factor for N years at R\%}} \]
   (c)
   \[ \frac{\text{Present Value}}{\text{Present factor}} \]
   (d)
   \[ \frac{\text{Present Value of Cost}}{\text{Present factor}} \]
   (e)

3. A division within the Wazobia Plc is considering whether to undertake a project that will cost N1 million and will have the following cash inflows:

<table>
<thead>
<tr>
<th>Year</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>600,000</td>
</tr>
<tr>
<td>II</td>
<td>400,000</td>
</tr>
<tr>
<td>III</td>
<td>1,000,000</td>
</tr>
</tbody>
</table>

   The cost of capital is 10%. The net present value is:
   (a) +£617,500
   (b) +£637,500
   (c) +£637,320
   (d) +£627,320
   (e) +£647,320.

Use data below to answer questions 4 and 5.

Expected value of a product is 7,800 units. The net positive present value is £10,470. The break-even point is 7,200 units and the cost of capital is 10%, while the capital outlay is £40,000.

4. Sensitivity to sales volume is:
   (a) 7.7%
   (b) 10.7%
   (c) 7.5%
   (d) 8.5%
   (e) 8.4%.
5. Sensitivity of cost of capital is:
   (a) 25.5%
   (b) 26.2%
   (c) 25.9%
   (d) 26.5%
   (e) 26.8%.

7.4.2 SHORT ANSWER QUESTIONS

1. What is the formula for standard deviation?

2. A term used to describe any technique whereby decision are tested by their vulnerability to changes in any variable is known as __________.

3. The standard deviation of project A is N3,500 and its expected value is N6,000 while standard deviation of project B is N4,500 and its expected value is N12,500, which project should be accepted using coefficient of variation as decision model.

4. Distinguish between risk and uncertainty?

5. The sales demand of a product are as follows:
   
<table>
<thead>
<tr>
<th>Units</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>0.3</td>
</tr>
<tr>
<td>20,000</td>
<td>0.4</td>
</tr>
<tr>
<td>50,000</td>
<td>0.2</td>
</tr>
<tr>
<td>100,000</td>
<td>0.1</td>
</tr>
</tbody>
</table>

   Selling price per unit is N20 and variable cost is N6. What is the total contribution of the product?

(Refer to Suggested Solution in Appendix 1, page 443)
8.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

- The opportunity cost of an investment;
- The concepts of payback period, accounting rate of return, net present value and the internal rate of return;
- The limitations of the various concepts;
- How to calculate PBP, ARR, NPV and IRR;
- Superiority of NPV over the IRR;
- Exclusive projects with unequal lives;
- Capital rationing and select the optimum combination of investments when capital is rationed for a single period;
- The concept of profitability index; and
- Treatment of inflation in capital investment appraisal.

8.1 INTRODUCTION

Capital budgeting can be explained in the context of a firm's decision to invest its current funds in long term activities in anticipation of an expected flow of future benefits over a number of years. However, the investment decisions could be in form of acquisition of additional fixed assets, replacements and modifications of activities or expansion of a plant. Therefore, the financial manager should give due consideration to the following factors when capital budgeting decisions are involved:

(a) Availability of investment capital and its alternative uses;

(b) The huge expenditures cash outlay;

(c) The gestation period between initial expenditure and returns; and
(d) The expectation of higher returns because of factors (a) and (b) above.

Based on the factors above, the manager must not fail to make appropriate investment decision on selection of good projects because, the volume of fixed assets far exceeds current assets of the owners of the company. That is, shareholders are long term investors, whose high expected returns can only be met with the higher returns from long term assets. These assertions, call for the need to examine the different methods of selecting investments in long term assets.

8.2 CAPITAL BUDGETING TECHNIQUES

There are two major methods of appraising capital projects. These are:

(a) The Non-discounted Cash Flow (Traditional) method:
   (i) Payback Period (PBP) Method
   (ii) Accounting Rate of Return (ARR) Method

(b) The Discounted Cash Flow (DCF) method:
   (i) Net Present Value (NPV)
   (ii) Internal Rate of Return (IRR)

8.2.1 Payback Period Method (PBP)

This technique measures projects on the basis of the period over which the investment pays back itself or the period of recovery of the initial investment. This means the full recovery of projects’ cash outflow through project cash inflows. Payback is defined as the period usually expressed in years, in which the cash outflows will equate the cash inflows from a project (CIMA). It is evident that this method pays attention to the shortness of the project that is, the shorter the period of recovery of initial outlay, the more acceptable the project becomes and this constitutes the decision rule.
ILLUSTRATION 8-1

Aminu Isah Limited is a manufacturing outfit, having a project which involves an immediate cash outlay of ₦200,000. The company estimates that the net cash inflows from the project will be as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>40,000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>220,000</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>80,000</td>
<td></td>
</tr>
</tbody>
</table>

Calculate the payback period for the above project.

SUGGESTED SOLUTION 8-1

AMINU ISAH LIMITED

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>₦</th>
<th>Cumulative Cash Flows</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>₦</td>
<td>₦</td>
</tr>
<tr>
<td>0</td>
<td>(200,000)</td>
<td>(200,000)</td>
<td>(200,000)</td>
</tr>
<tr>
<td>1</td>
<td>20,000</td>
<td></td>
<td>(180,000)</td>
</tr>
<tr>
<td>2</td>
<td>40,000</td>
<td></td>
<td>(140,000)</td>
</tr>
<tr>
<td>3</td>
<td>220,000</td>
<td></td>
<td>80,000</td>
</tr>
<tr>
<td>4</td>
<td>80,000</td>
<td></td>
<td>-</td>
</tr>
</tbody>
</table>

Payback Period = 2 years + \( \left( \frac{140,000}{220,000} \times \frac{12}{1} \right) \) months

Payback Period = 2 years + 7.6 months or 2 years 8 months

Decision Rules:

(a) Using the payback method, accept all projects whose payback period are shorter than the company's predetermined minimum acceptable payback period.

(b) If mutually exclusive projects are involved, whereby only one of the projects can be undertaken and others rejected, the rule is to accept the project with the shortest payback period.
Advantages of Payback Period

(a) It is simple to calculate and understand.

(b) Of all the methods of capital budgeting, it least exposes the firm to problems of uncertainty, since it focuses on shortness of project to pay back the initial outlay.

(c) It is a fast screening technique, especially for the firms that have liquidity problems.

Disadvantages of Payback Period

(a) It does not incorporate time value of money, that is, it does not recognise the fact that the value of £1 today will be far more than the value of £1 in two or three years time. This constitutes the alternative forgone due to passage of time.

(b) It ignores cash flows after the payback period.

(c) It does not take into account the risks associated with each project and the attitude of the company to risk.

8.2.2 Accounting Rate of Return Method (ARR)

This method is derived from the concept of return on capital employed (ROCE) or return on investment (ROI), in that it measures the ratio of accounting profits to the accounting investments and evaluates projects based on this ratio. The following two ways of determining the ratio are acceptable for examination purposes:

(a) \[
ARR = \frac{\text{Average annual accounting profits after depreciation, interest but before taxation}}{\text{Initial Investments}} \times \frac{100}{1}
\]

where the initial capital invested is equal to the original cost of a new project or the written down value or net book value of an existing project. The reason for this assertion is that since companies are going concerns, there must be replacement of assets, thus, the need for depreciation.
(b) \[ \text{ARR} = \frac{\text{Average annual accounting profits}}{\text{Average Capital invested}} \times \frac{100}{1} \]

where the average capital invested is equal to initial capital invested plus scrap value (if any) divided by 2.

It should be noted that if a particular question specifically defines the accounting rate of return, such definition as stipulated in the question must be adopted in solving the problem.

**ILLUSTRATION 8-2**

Aminu Hassan recently convinced his friends and relations to grant him a loan of N200,000, which he intends to invest in a farming project. He estimates that the project will yield the following returns annually for the next five years.

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60,000</td>
</tr>
<tr>
<td>2</td>
<td>60,000</td>
</tr>
<tr>
<td>3</td>
<td>80,000</td>
</tr>
<tr>
<td>4</td>
<td>60,000</td>
</tr>
<tr>
<td>5</td>
<td>40,000</td>
</tr>
</tbody>
</table>

There was no scrap value at the end of the fifth year and the company desires to evaluate the project on the basis of accounting rate of return.

**Required:**

Provide the accounting rate of return of this project on the assumption that the annual returns are profits after depreciation but before taxation.

**SUGGESTED SOLUTION 8-2**

If option (a) ARR method is adopted, then the ARR will be:

\[ \text{ARR} = \frac{\text{Average Profits}}{\text{Initial Investment}} \]

Average Profits
\[ = \frac{N60,000 + 60,000 + 80,000 + 60,000 + 40,000}{5} = N60,000 \]
Initial Investment = ₦200,000

Therefore, \( \text{ARR} = \frac{\text{₦60,000}}{\text{₦200,000}} \times \frac{100}{1} = 30\% \)

If option (b) of the ARR method is adopted, then the ARR will be:

\[
\text{ARR} = \frac{\text{Average Profits}}{\text{Average Capital Employed}} \times \frac{100}{1}
\]

Average Capital = \( \frac{\text{₦200,000}}{2} = \text{₦100,000} \)

Therefore, \( \text{ARR} = \frac{\text{₦60,000}}{\text{₦100,000}} \times 100 = 60\% \)

**Decision Rules**

(a) The rule is to invest in all projects whose accounting rate of return are higher than the company's predetermined minimum acceptable ARR.

(b) Where mutually exclusive projects are concerned, the rule is to accept the project with the highest ARR.

**Advantages of ARR**

(a) It is easy to calculate.

(b) Unlike the payback period, it makes use of all the profits for the project's life.

(c) For divisionalised companies, managers would find the technique easier to understand because it is similar to their normal annual performance evaluation technique.

**Disadvantages of ARR**

(a) It does not recognize the time value of money.

(b) It is an average concept and as such will hide the sizes and timing of the individual cash flows.

(c) It is based on accounting profits which may differ as a result of differences in accounting methods and does not necessarily represent relevant cash flows.
(d) It recognizes depreciation instead of the more relevant capital allowances.

(e) It does not take into consideration the risk associated with each project as well as the attitude of the management of the company to risk.

(f) There is no unique definition for ARR. For instance, "average profits" may be profits after depreciation, interest and before tax or profit after depreciation, interest and tax. Initial investment could be initial investment plus scrap value or just initial investment.

8.3 CONCEPTS IN CAPITAL BUDGETING DECISIONS

To understand the relevance of the other two methods, that is, NPV and IRR, some basic concepts which apply to capital budgeting decisions need to be explained. The concepts are:

(a) Time value of money;

(b) Annuity;

(c) Perpetuity; and

(d) Relevant cash flows.

8.3.1 Concept of Time Value of Money

This concept recognises the opportunity cost of receiving the same amount of money sometime in the future instead of now. This alternative forgone is as a result of lost returns or interest on the money, due to passage of time. This concept is based on the compound interest formula.

The compound interest formula states that the future value(FV) of money receivable in a period at a specified interest rate shall be equal to:

\[ FV = P(1 + r)^n \]

where:
- \( FV \) = future value of money receivable in a period
- \( P \) = Principal
- \( r \) = the rate of interest or cost of capital
- \( n \) = number of years
Therefore, by deduction, the present value (PV) can be determined as follows:

\[ PV = \frac{F}{(1 + r)^n} = PV = \frac{FV}{(1 + r)^n} \]

where,

\[ PV = \frac{1}{(1 + r)^n} = (1 + r)^{-n} \] is the discount factor

**ILLUSTRATION 8-3**

Calculate the present value of ₦10,000 receivable in 5 years time if the interest rate is 10%.

**SUGGESTED SOLUTION 8-3**

\[ PV = FV \times \frac{1}{(1 + r)^n} = \frac{10,000}{(1 + 0.1)^5} = \frac{10,000}{1.6105} = ₦6209 \]

*8.3.2 Concept of Annuity*

An annuity is a constant sum of money receivable or payable over a specified period of time.

The present value of annuity can be calculated using the annuity formula as follows:

\[ PV = \frac{1 - (1 + r)^{-n}}{r} \]

Where  
A = the constant or equal annual sum  
n = number of years  
r = rate of interest or cost of capital

**ILLUSTRATION 8-4**

Calculate the present value of ₦10,000 receivable every year for 5 years at the interest rate of 10% per annum.

A = ₦10,000  
n = 5yrs  
r = 10% = 0.1
8.3.3 Relevant Cash Flows

Where the present value is used, in which case, time value of money has been incorporated, the cash flows used are said to be Discounted Cash Flows (DCF). The DCF techniques, namely: the NPV and IRR for evaluation of capital projects recognise only the relevant cash flows of a project. During examination, a list of cash flows both relevant and irrelevant may be provided. Therefore, in order to properly evaluate projects, there is need to determine the relevant cash flows and this is done by taking the following steps:

(a) Determine the decision to be taken, for example, accept or reject a project, scrap a product line, make or buy an item, etc.;

(b) Any cash flow that will influence or affect (a) above is relevant;

(c) Look beyond the decision or project being evaluated and examine its effects on the other operations of the company.

This is referred to as the opportunity cost concept which can be a function of cost or revenue, thus:

(i) If the decision will result in additional expenses or increased running costs in other operations of the company, then this cost must be included as relevant cash outflows in the original decision in (a) above.
(ii) Similarly, if the decision or project being evaluated will result in additional contributions or savings from other operations of the company, those savings must be treated as relevant cash inflows in the evaluation of decisions in (a) above.

(d) The following are not relevant for decision making on projects being evaluated, namely:

(i) All appropriations, reserves and other non-cash items.

(ii) All fixed costs except incremental or attributable fixed costs.

(iii) All historical or past or sunk costs.

8.3.4 Further Assumptions

The following additional assumptions may be required in capital budgeting situations:

(a) Year zero is the initial period of investments or the point at which the investment decision is to be made. It is always the beginning of investments of year one or the first year and it is to be taken as a year on its own.

(b) Apart from year zero, there is no other beginning of a year in the stream of cash flows, that is, all cash flows after year zero are assumed to arise at the end of the year to which they relate.

(c) For working capital, in case of practical situations or problems, assumption (b) above may not hold. In this case, it is assumed that working capital required in year ‘n’ will be provided in year n - 1.

(d) It may also be assumed that working capital utilised in a project will be recovered in full at the end of the project, that is, the total sum of all working capital used for the life of the project will be treated as relevant cash flows at the end of the project.

There is the need to realise that where a project becomes profitable only on the full recovery of working capital, then the attention of management must be drawn to the control of working capital in recommending acceptance of the project.
8.4 DISCOUNTED PAYBACK PERIOD METHOD

The principles and decision rules are the same as in the normal payback period method. The only difference is that, the cash flows to be used are discounted at the given or appropriate cost of capital. Therefore, this version of payback technique, does not suffer from the disadvantage of ignoring time value of money.

ILLUSTRATION 8-5

Using the information in illustration 8-2, calculate the discounted payback of the project, if the cost of capital is 10% per annum.

SUGGESTED SOLUTION 8-5

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DCF @ 10%</th>
<th>PV</th>
<th>Cumm. Cashflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(200,000)</td>
<td>1.0000</td>
<td>(200,000)</td>
<td>(200,000)</td>
</tr>
<tr>
<td>1</td>
<td>60,000</td>
<td>0.9091</td>
<td>54,546</td>
<td>(145,454)</td>
</tr>
<tr>
<td>2</td>
<td>60,000</td>
<td>0.8264</td>
<td>49,584</td>
<td>(95,870)</td>
</tr>
<tr>
<td>3</td>
<td>80,000</td>
<td>0.7513</td>
<td>60,104</td>
<td>(35,766)</td>
</tr>
<tr>
<td>4</td>
<td>60,000</td>
<td>0.6830</td>
<td>40,980</td>
<td>5,214</td>
</tr>
<tr>
<td>5</td>
<td>40,000</td>
<td>0.6209</td>
<td>24,836</td>
<td></td>
</tr>
</tbody>
</table>

\[
PBP = 3\text{yrs} + \left[ \frac{35766}{40980} \times \frac{12}{1} \right] \text{mths} \\
= 3\text{yrs} + 10.47\text{mths} \\
= 3 \text{ years } 10 \text{ months.}
\]

8.5 NET PRESENT VALUE METHOD (NPV)

The net present value (NPV) is a summation of all discounted cash flows (DCF) associated with a project, that is, the difference between the PV of cash outlay or outflow and the positive PV of the cash inflows.

Decision Rules

(a) Accept all projects that produce positive net present value (NPV).

(b) If mutually exclusive projects are involved, the rule is to accept the project that produces the highest positive net present value.
ILLUSTRATION 8-6

Using the information in illustration 8-2 at 10% cost of capital, calculate the NPV of the project.

SUGGESTED SOLUTION 8-6

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>DF @ 10%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(200,000)</td>
<td>1.0000</td>
<td>(200,000)</td>
</tr>
<tr>
<td>1</td>
<td>60,000</td>
<td>0.9091</td>
<td>54,546</td>
</tr>
<tr>
<td>2</td>
<td>60,000</td>
<td>0.8264</td>
<td>49,584</td>
</tr>
<tr>
<td>3</td>
<td>80,000</td>
<td>0.7513</td>
<td>60,104</td>
</tr>
<tr>
<td>4</td>
<td>60,000</td>
<td>0.6830</td>
<td>40,980</td>
</tr>
<tr>
<td>5</td>
<td>40,000</td>
<td>0.6209</td>
<td>24,836</td>
</tr>
<tr>
<td></td>
<td>+NPV</td>
<td></td>
<td>30,050</td>
</tr>
</tbody>
</table>

Advantages of NPV

(a) The time value of money is recognised.

(b) It measures in absolute terms (Naira Value), the increase in the wealth of the shareholders.

(c) It is additive, in that decisions can be reached on a combination of projects, through the addition of their respective NPVs.

(d) Unlike the payback period, it measures projects by the utilisation of all cash flows of the project.

(e) It is more preferable to IRR in decisions under capital rationing, that is, shortage of investments funds.

Disadvantages of NPV

(a) It is more difficult to calculate than PBP and ARR.

(b) It relies heavily on the correct estimation of the cost of capital, that is, where errors occur in the cost of capital used for discounting the decision, using the NPV would be misleading.

(c) Unlike the IRR, non-accounting managers may not be conversant with the decision rule of NPV, especially in large decentralised organisations.
Like all the other methods, it does not take risk into account.

It ignores inflation.

8.6 INTERNAL RATE OF RETURN METHOD (IRR)

The IRR is that cost of capital or return that will produce an NPV of zero if applied to a project. It is a break-even point cost of capital. It is also the cost of capital or discount rate that will equate the cash inflows of a project with the cash outflows of that project. In order to generate the cost of capital that will produce exactly zero NPV, the following procedures may be followed:

(a) Generate two (2) opposite values of NPV (+ and - values) using two different discount rates earlier calculated.

(b) Interpolate between the two discount rates generated in (a) above in order to estimate the cost of capital that will produce an NPV of zero. The assumption here is that there is a linear relationship between the cost of capital and the NPV. Moreover, it is implied that the higher the cost of capital, the lower the NPV and vice-versa.

(c) The interpolation formulae can be defined as:

Let \( R_1 \) be the lower cost of capital that will generate positive \( NPV_1 \), and \( R_2 \) be the highest cost of capital that will generate negative \( NPV_2 \).

\[
IRR = R_1 + \frac{NPV_1}{NPV_1 + NPV_2} \times [R_2 - R_1]
\]

Note: The absolute value of the negative NPV is used in the computation.

\[
\begin{array}{ccc}
\text{A} & \text{B} & \text{C} \\
\text{NPV} & 200 & 0 & -80 \\
\end{array}
\]

Therefore, \( IRR = 4\% + \left( \frac{200}{200 + 80} \right) \times (10\% - 4\%) \)

\[
= 4\% + \frac{200}{280} \times 6\%
\]

\[
= 4\% + 4.286\%
\]

\[
= 8.29\%
\]

195
ILLUSTRATION 8-7

Using the information in illustration 8-2, calculate the IRR for the project.

SUGGESTED SOLUTION 8-7

<table>
<thead>
<tr>
<th>Year</th>
<th>Cash flows</th>
<th>DF @10%</th>
<th>PV</th>
<th>DF @20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(200,000)</td>
<td>1.00</td>
<td>(200,000)</td>
<td>1.0000</td>
<td>(200,000)</td>
</tr>
<tr>
<td>1</td>
<td>60,000</td>
<td>0.9091</td>
<td>54,546</td>
<td>0.8333</td>
<td>49,998</td>
</tr>
<tr>
<td>2</td>
<td>60,000</td>
<td>0.8264</td>
<td>49,584</td>
<td>0.6944</td>
<td>41,664</td>
</tr>
<tr>
<td>3</td>
<td>80,000</td>
<td>0.7513</td>
<td>60,104</td>
<td>0.5787</td>
<td>46,296</td>
</tr>
<tr>
<td>4</td>
<td>60,000</td>
<td>0.6830</td>
<td>40,980</td>
<td>0.4822</td>
<td>28,932</td>
</tr>
<tr>
<td>5</td>
<td>40,000</td>
<td>0.6209</td>
<td>24,836</td>
<td>0.4109</td>
<td>16,436</td>
</tr>
<tr>
<td></td>
<td>+ NPV</td>
<td>30,050</td>
<td>- NPV</td>
<td></td>
<td>(16,674)</td>
</tr>
</tbody>
</table>

\[ R_1 = 10\%, \ NPV_1 = \text{₦}30,050 \]

\[ R_2 = 20\%, \ NPV_2 = (\text{₦}16,674) \]

\[ IRR = R_1 + \left( \frac{\text{NPV}_1}{\text{NPV}_1 + \text{NPV}_2} \right) \times (R_2 - R_1) \]

\[ IRR = 10\% + \left( \frac{30,050}{16,674 + 30,050} \right) \times \left( \frac{20 - 10}{1} \right)\%

= 10\% + 6.43\%

= 16.43\%

Decision Rules

(a) Using the IRR technique, the rule is to accept all projects whose IRR are greater than the company's cost of capital.

(b) If mutually exclusive projects are being considered, the rule is to accept the project that produces the highest IRR.

Advantages of IRR

(a) It recognises the time value of money.

(b) It is more attractive to divisional managers in large organisations since they are used to the return approach in evaluations.
(c) It provides a margin of safety in the calculation of a company's cost of capital, that is, it measures all allowable margin of errors.

Disadvantages of IRR

(a) It is more difficult to calculate than the other methods.

(b) Where the cash flows of a project are unconventional, in which case, cash inflows occur in between cash outflows and vice-versa, the IRR technique will produce more than one IRR for a project. It can lead to a situation of sub-optimal decision.

(c) Where mutually exclusive projects are being considered, the IRR may produce a decision that will conflict with the NPV decision in that the IRR, being a rate of return, does not recognize the size or scale of project.

(d) A project may produce more than one IRR. This also occurs when a project has unconventional cash flows.

8.6.1 Modification of IRR

The IRR can be modified under the following circumstances:

♦ Where the cash flows are unconventional; and

♦ Where projects are mutually exclusive.

The above can be taken care of by the following two methods:

♦ Extended yield method, and

♦ Incremental yield approach.

(a) Extended Yield Method

By this method, we modify the IRR technique in order to produce a unique IRR rather than multiple IRR. The following steps may be adopted:

(i) Convert the unconventional cash flows into conventional cash flows by discounting all future cash flows backwards at the given cost of capital until they are fully absorbed by the positive cash flows (cash inflows) or they become year zero cash flow.
(ii) Calculate the IRR of the revised (conventional) cash flows in the normal way. This is the required IRR.

(b) Incremental Yield Method

Where projects are mutually exclusive, it means that all the projects cannot be undertaken at the same time. This means that the acceptance of one project is equivalent to the rejection of all other mutually exclusive projects.

IRR will produce conflicting results with NPV where mutually exclusive projects are involved because IRR does not recognise the scale or size of investments. For this reason, the cash flow of mutually exclusive projects must be modified if IRR is to be used for evaluation. This modification is called “Incremental Yield Approach”. Under this method, the cash flows to generate differential or incremental cash flows is revised. Thereafter, the IRR of these incremental cash flow is calculated and the decision for project selection based on the projects incremental cash flows, that is, the project that was kept constant).

8.6.2 Steps for Calculating Incremental IRR

The following steps are to be followed in calculating the incremental IRR:

(a) Calculate the incremental cash flows by keeping one project constant that is, subtracting the cash flows of the other project from the cash flows of the project that was kept constant e.g. project Y minus Z - if incremental cash flows are generated from Y minus Z, then Y must be kept constant.

(b) Calculate the IRR of these incremental cash flows in the normal way.

(c) If the IRR of these incremental cash flows is greater than the company's cost of capital, then the project that was kept constant must be better than the other project and must be accepted. On the other hand, if the IRR of the incremental cash flows is lower than the cost of capital, then the project that was kept constant must be rejected.
ILLUSTRATION 8-8

Two accountants of Adepoju Bamide Plc are in disagreement as to which of two mutually exclusive projects to undertake. One has based his conclusions on an IRR computation, and the other, using NPV. Dike Ltd required rate of return is 10%. The first project requires an investment of \( \text{₦}1,410,400 \) and will generate net cash savings of \( \text{₦}300,000 \) per annum for 10 years. The second project requires \( \text{₦}867,800 \) to be invested to generate \( \text{₦}200,000 \) per annum for 10 years.

**Required**

(a) Produce the calculation of the two accountants.

(b) Produce an unambiguous result by considering the internal rate of return of the investment.

(c) If the alternative investment rate was 14%, which of the two projects should be accepted.

(d) Compare your conclusions in (c) with calculation of the NPV of both projects at the alternative rate of 14%.

**SUGGESTED SOLUTION 8-8**

(a)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DF @10%</th>
<th>PV @10%</th>
<th>Cashflow</th>
<th>DF @10%</th>
<th>PV @10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(1,410,400)</td>
<td>1.0000</td>
<td>(1,410,400)</td>
<td>0</td>
<td>(867,800)</td>
<td>1.0000</td>
</tr>
<tr>
<td>1-10</td>
<td>300,000</td>
<td>6.1446</td>
<td>1,843,380</td>
<td>1-10</td>
<td>200,000</td>
<td>6.1446</td>
</tr>
<tr>
<td>NPV</td>
<td>432,980</td>
<td></td>
<td></td>
<td>NPV</td>
<td>361,120</td>
<td></td>
</tr>
</tbody>
</table>

@ 20%

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DF @20%</th>
<th>PV @20%</th>
<th>Cashflow</th>
<th>DF @20%</th>
<th>PV @20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(1,410,400)</td>
<td>1.0000</td>
<td>(1,410,400)</td>
<td>0</td>
<td>(867,800)</td>
<td>1.0000</td>
</tr>
<tr>
<td>1-10</td>
<td>300,000</td>
<td>4.1925</td>
<td>1,257,750</td>
<td>1-10</td>
<td>200,000</td>
<td>4.1925</td>
</tr>
<tr>
<td>NPV</td>
<td>152,650</td>
<td></td>
<td></td>
<td>NPV</td>
<td>29,300</td>
<td></td>
</tr>
</tbody>
</table>

**Project 1**

\[
\text{IRR} = R_1 + \frac{\text{NPV}_1}{(\text{NPV}_1 + \text{NPV}_2)} \times [R_2 - R_1] \%
\]

\[
\begin{align*}
\text{IRR} &= 10\% + \frac{\text{NPV}_1}{585,630} \times 10\% \\
\text{IRR} &= 10\% + \frac{432,980}{585,630} \times 10\% \\
\text{IRR} &= 10\% + 7.39 \\
\text{IRR} &= 17.39\%
\end{align*}
\]

**Project 2**

\[
\text{IRR} = 10\% + \frac{\text{NPV}_2}{(\text{NPV}_1 + \text{NPV}_2)} \times [R_2 - R_1] \%
\]

\[
\begin{align*}
\text{IRR} &= 10\% + \frac{\text{NPV}_2}{390,420} \times 10\% \\
\text{IRR} &= 10\% + 9.25 \\
\text{IRR} &= 19.25\%
\end{align*}
\]
Using NPV, Project 1 should be accepted, because project 1 has the higher NPV.

Using IRR, Project 2 should be accepted, because project 2 has the higher IRR.

(b)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>Year</th>
<th>Cashflow</th>
<th>Incremental Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$1,410,400</td>
<td>0</td>
<td>$867,800</td>
<td>$542,600</td>
</tr>
<tr>
<td>1-10</td>
<td>300,000</td>
<td>1-10</td>
<td>200,000</td>
<td>100,000</td>
</tr>
</tbody>
</table>

Incremental Cash Flows

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DCF @ 10%</th>
<th>PV</th>
<th>DCF @ 20%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$542,600</td>
<td>1.00</td>
<td>($542,600)</td>
<td>($542,600)</td>
<td>($542,600)</td>
</tr>
<tr>
<td>1-10</td>
<td>100,000</td>
<td>6.1446</td>
<td>614,460</td>
<td>100,000</td>
<td>419,250</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+NPV 71,860</td>
<td>-NPV 123,350</td>
<td></td>
</tr>
</tbody>
</table>

Since the IRR of the incremental cash flows is greater than the company's cost of capital, it means project 1, which was held constant, should be accepted. This agrees with the result of the NPV.

(c) If the investment rate is now 14%, it means the decision to accept project 1 will no more hold as the incremental IRR is lesser than the cost of capital of 14%. Therefore, project 2, now looks more attractive and should be accepted.

(d)  

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DCF at 14%</th>
<th>PV</th>
<th>Year</th>
<th>Cashflow</th>
<th>DCF at 14%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$1,410,400</td>
<td>1.0000</td>
<td>$1,410,400</td>
<td>0</td>
<td>$867,800</td>
<td>1.0000</td>
<td>$867,800</td>
</tr>
<tr>
<td>1-10</td>
<td>300,000</td>
<td>5.2161</td>
<td>1,564,830</td>
<td>1-10</td>
<td>200,000</td>
<td>5.2161</td>
<td>1,043,220</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>+NPV 154,430</td>
<td></td>
<td></td>
<td></td>
<td>+NPV 175,420</td>
</tr>
</tbody>
</table>

From the calculations of this NPV based on 14% cost of capital, Project 2 shows higher NPV, and therefore should be accepted. This confirms the decision in (c) above.
NPV Vs IRR

Since the two methods belong to the same class of appraisal technique, one will expect that their decisions will tally at all times.

However, on few occasions, (like when the cash flows are unconventional and where there is difference in the initial cash flow), the decision will not tally. For instance, NPV may say accept project A and reject project B, whereas IRR will say accept B and reject A. This shows that there is a conflict in the decisions of NPV and IRR.

For example, as a management accountant, if you are faced with this situation, which of the two appraisal techniques would you recommend for acceptance?

The solution to the above problem is that whenever there is a conflict in the decisions of NPV and IRR, NPV decision is superior. This is because NPV has many technical advantages over IRR.

(a) NPV is technically superior to IRR and is simpler to calculate.

(b) Where cash-flow patterns are non-conventional, there may be nil or several internal rates of return making the IRR impossible to apply.

(c) NPV is superior for ranking investments in order of attractiveness because shareholders prefer absolute figures than percentages.

(d) With conventional cash flow patterns, both methods give the same accept or reject decision.

(e) Where discount rates are expected to differ over the life of the project such variations can be readily incorporated into NPV calculations, but not in those for the IRR.

(f) The NPV calculations assume that funds generated by the project, are reinvested at the firm's cost of capital where IRR assumes reinvestment at the calculated IRR which could be unrealistic if the IRR is significantly higher than the firm's cost of capital. A modified IRR can be calculated based on the assumption that funds generated are reinvested at the firm's cost of capital. However, this introduces a further layer of assumption and calculation merely in order to overcome one of the inherent characteristics of the IRR approach.
Notwithstanding the technical advantages of NPV over IRR, IRR is widely used in practice so, it is essential that students are aware of its inherent limitations.

8.7 CAPITAL RATIONING

A capital rationing situation is one in which a company does not have sufficient fund to execute worthwhile investment projects. Under this situation, a company has projects with positive NPV whose combined outlays exceed all available finance to the company for the same period.

Capital rationing is the technique for selecting projects during a period of funds restriction which normally requires the ranking of projects in a descending order of desirability and accepting them in that order until all available funds have been exhausted.

8.7.1 Single Period Capital Rationing

Where restriction is for only one period, profitability index is used.

8.7.2 Profitability Index (PI)

This concept is based on the contribution per limiting factor approach. It is actually a benefit/cost analysis of projects, that is, the Naira receivable per Naira of expenditure. It can be measured as the ratio of NPV or in some cases, Gross Present Value (GPV) of a project to the outlay required for the project during the year of restriction. The PVs are the contributions while the expenditure or the outlays are the limiting factors. However, two definitions of PI are allowable as follows:

(a) \[ PI = \frac{\text{NPV of a project}}{\text{Outlay required during the year of restriction}} \]

(b) \[ PI = \frac{\text{Gross Present Value (GPV) of a project}}{\text{Outlay required during the year of restriction}} \]

Where GPV will normally equal to NPV + Initial Outlay

8.7.2.1 Steps to be taken in a Single Period Capital Rationing Situation

The following steps are recommended when questions are being attempted concerning a single period capital rationing situation:
(a) Identify the year of restriction.
(b) Calculate the NPV of projects (if not given).
(c) Rank all projects using the PI.
(d) Allocate available finance or funds to all projects in a descending order of the PI.
(e) If a project does not require outlay during the year of restriction, its PI would be an infinite sum, (that is, NPV +0) and such projects must be ranked first and must be selected.

**ILLUSTRATION 8-9**

Mercy Aina Buk Limited has a capital budget of N 500,000 for the year to 30th June, 2009. The available projects have been identified and quantified by the Technical Director and the Works Manager as listed below. The individual project’s related profitability index has been computed by a financial management team and stated hereunder.

<table>
<thead>
<tr>
<th>Projects</th>
<th>Initial Outlay</th>
<th>Profitability Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250,000</td>
<td>1.10</td>
</tr>
<tr>
<td>B</td>
<td>100,000</td>
<td>0.95</td>
</tr>
<tr>
<td>C</td>
<td>200,000</td>
<td>1.25</td>
</tr>
<tr>
<td>D</td>
<td>200,000</td>
<td>1.23</td>
</tr>
<tr>
<td>E</td>
<td>250,000</td>
<td>1.05</td>
</tr>
<tr>
<td>F</td>
<td>100,000</td>
<td>1.20</td>
</tr>
<tr>
<td>G</td>
<td>50,000</td>
<td>0.99</td>
</tr>
</tbody>
</table>

**Required:**

(a) Which projects should the company invest in?
(b) What difference would the absence of capital rationing make to your selection in (a) above?

**SUGGESTED SOLUTION 8-9**

<table>
<thead>
<tr>
<th>Projects</th>
<th>Initial Outlay</th>
<th>Profitability Index</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>250,000</td>
<td>1.10</td>
<td>4th</td>
</tr>
<tr>
<td>B</td>
<td>100,000</td>
<td>0.95</td>
<td>7th</td>
</tr>
<tr>
<td>C</td>
<td>200,000</td>
<td>1.25</td>
<td>1st</td>
</tr>
</tbody>
</table>
8.7.2.2 Different Situations of Capital Rationing

The different situations of capital rationing are as follows:

(a) Where projects are divisible.

(b) Where projects are not divisible.

(c) Where projects are mutually dependent.

(d) Where projects are mutually exclusive.

Divisible Projects

In this case, there is an implicit linearity assumption between the initial outlays and the NPVs of projects. This follows from the basic assumption that fractions of a project can be undertaken. Therefore, a fractional investment in the outlay would yield a proportionate fractional return in NPV e.g. investment of 20% in outlay, would yield 20% of NPV.
Indivisible Projects

These are projects that cannot be undertaken in fractions. In this case, there may be surplus funds which represents the balance of available funds after allocation that cannot meet the requirement in full for the remaining projects. In this situation, there is a need to invest such surplus funds. This is one of such situations where a company can invest at a rate below its cost of capital.

ILLUSTRATION 8-10

ALHASSAN HALADU Ltd. is experiencing a shortage of funds for investment in the current year, when only N100,000 is available for investment. No fund shortages are foreseen thereafter. The cost of investment funds is 20%. The following projects are available:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Initial Outlay</th>
<th>Annual Receipts from projects to perpetuity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N50,000</td>
<td>15,000</td>
</tr>
<tr>
<td>2</td>
<td>N80,000</td>
<td>20,000</td>
</tr>
<tr>
<td>3</td>
<td>N60,000</td>
<td>18,000</td>
</tr>
<tr>
<td>4</td>
<td>N30,000</td>
<td>10,000</td>
</tr>
<tr>
<td>5</td>
<td>N25,000</td>
<td>8,000</td>
</tr>
<tr>
<td>6</td>
<td>N40,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

You are required to advise management on the projects which you would recommend for acceptance if they were:

(a) Divisible, and
(b) Indivisible,
(c) Would your answer to (b) change if surplus funds could be invested at 12%? Ignore Taxation.

SUGGESTED SOLUTION 8-10

Workings

<table>
<thead>
<tr>
<th>Projects</th>
<th>Outlay</th>
<th>Annual Receipts</th>
<th>NPV N</th>
<th>PI</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>50,000</td>
<td>15,000</td>
<td>25,000</td>
<td>0.50</td>
<td>3rd</td>
</tr>
<tr>
<td>2</td>
<td>80,000</td>
<td>20,000</td>
<td>20,000</td>
<td>0.25</td>
<td>6th</td>
</tr>
<tr>
<td>3</td>
<td>60,000</td>
<td>18,000</td>
<td>30,000</td>
<td>0.50</td>
<td>4th</td>
</tr>
<tr>
<td>4</td>
<td>30,000</td>
<td>10,000</td>
<td>20,000</td>
<td>0.67</td>
<td>1st</td>
</tr>
<tr>
<td>5</td>
<td>25,000</td>
<td>8,000</td>
<td>15,000</td>
<td>0.60</td>
<td>2nd</td>
</tr>
<tr>
<td>6</td>
<td>40,000</td>
<td>10,000</td>
<td>10,000</td>
<td>0.25</td>
<td>5th</td>
</tr>
</tbody>
</table>
If the projects are divisible:

<table>
<thead>
<tr>
<th>Allocations</th>
<th>₦'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available funds</td>
<td>100</td>
</tr>
<tr>
<td>Select Project 4</td>
<td>(30)</td>
</tr>
<tr>
<td></td>
<td>70</td>
</tr>
<tr>
<td>Select Project 5</td>
<td>(25)</td>
</tr>
<tr>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Select 90% of Project 1</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>NIL</td>
</tr>
</tbody>
</table>

Management should accept Project 4, 5 and 90% of Project 1

If the Projects are indivisible

<table>
<thead>
<tr>
<th>Allocations</th>
<th>₦'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available funds</td>
<td>100</td>
</tr>
<tr>
<td>Select Project 4</td>
<td>(30)</td>
</tr>
<tr>
<td></td>
<td>70</td>
</tr>
<tr>
<td>Select Project 5</td>
<td>(25)</td>
</tr>
<tr>
<td></td>
<td>45</td>
</tr>
<tr>
<td>Select Project 6</td>
<td>(40)</td>
</tr>
<tr>
<td>Surplus Fund</td>
<td>5</td>
</tr>
</tbody>
</table>

Since projects are indivisible, management should accept projects 4, 5 and 6.

(c) The answer would not change, except that management will be advised to invest the surplus funds at the 12% rate rather than not having any returns though 12% is still less than the company’s cost of investments. This will make the management to earn some interest, rather than losing it.

Working Note

(i) NPV is derived by the perpetuity formula of, for example, Year 1 is

$$\frac{A}{r} = \frac{15,000}{0.20} = \text{₦75,000} - 50,000 = \text{₦25,000 etc}$$

(ii) Profitability index is:

$$\text{Year 1} = \frac{\text{NPV of a Project}}{\text{Initial Outlay}} = \frac{25,000}{50,000} = 0.5 \text{ etc}$$
**Where projects are mutually dependent**

In this case, an acceptance of one of the mutually dependent projects automatically implies an acceptance of the remaining mutually dependent projects, for example, if projects A and B are mutually dependent, it means that one can only accept or reject both projects and not undertake only one of them. However, any of the two methods may be adopted as follows:

(i) In ranking all the projects, one can decide to rank all the mutually dependent projects as soon as or immediately after any of the mutually dependent projects is ranked irrespective of the sizes of their respective profitability index. For instance, if projects A and B are mutually dependent in a group of the under listed projects, the ranking can be done as follows:

<table>
<thead>
<tr>
<th>Projects</th>
<th>PI</th>
<th>Initial Outlay</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.1</td>
<td>200</td>
<td>3rd</td>
</tr>
<tr>
<td>B</td>
<td>1.6</td>
<td>100</td>
<td>2nd</td>
</tr>
<tr>
<td>C</td>
<td>1.7</td>
<td>200</td>
<td>1st</td>
</tr>
<tr>
<td>D</td>
<td>1.2</td>
<td>300</td>
<td>5th</td>
</tr>
<tr>
<td>E</td>
<td>1.3</td>
<td>400</td>
<td>4th</td>
</tr>
</tbody>
</table>

Therefore, one can select and allocate funds in that order as above.

(ii) If one wants to arrive at a more accurate solution, he has to combine all mutually dependent projects into a unique single project. Where the latter would have as its initial outlay, a combined total of all initial outlays of the mutually dependent projects. The PI would be a weighted average PI, where the weight to be attached to the PI will be the initial outlays of the respective projects. Using the same group of projects as above, the projects can be ranked after a combination of projects A and B as follows:

\[
\text{PI} = \frac{\text{PI} \times \text{Initial Outlay}}{300} = \frac{(1.1 \times 200) + (1.6 \times 100)}{300} = 1.27
\]
A and B = 1.27

The new ranking/project is 1st 2nd 3rd 4th
C=1.7 E=1.3 AB=1.27 D=1.2

Where Projects are Mutually Exclusive

In this case, an acceptance of one project group implies the rejection of all the other project groups. To resolve this issue, there is a need to modify the ranking procedures and it is done as follows:

(i) create as many groups of projects as long as they are mutually exclusive i.e. each group must contain only one of the mutually exclusive projects and would of course exclude the others.

(ii) rank and select projects in each group.

(iii) calculate the total NPVs of the selected projects in each group.

(iv) the decision would be to accept projects from the groups that produce maximum total NPVs.

ILLUSTRATION 8-11

Abubakar, Dele and Edwin have just received their gratuities which amounted to N250,000 and they are prepared to invest in a new venture XYZ Ltd. The Bank of Nigeria Ltd has expressed the desire to grant them long-term loan of up to N950,000. They have presented the following investment proposals to you for financial advice:

<table>
<thead>
<tr>
<th>PROJECTS</th>
<th>PROFITABILITY INDEX</th>
<th>OUTLAY (N'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.19</td>
<td>150</td>
</tr>
<tr>
<td>2</td>
<td>1.20</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>1.17</td>
<td>200</td>
</tr>
<tr>
<td>4</td>
<td>1.20</td>
<td>300</td>
</tr>
<tr>
<td>5</td>
<td>1.22</td>
<td>400</td>
</tr>
<tr>
<td>6</td>
<td>1.15</td>
<td>400</td>
</tr>
<tr>
<td>7</td>
<td>1.10</td>
<td>300</td>
</tr>
<tr>
<td>8</td>
<td>1.15</td>
<td>200</td>
</tr>
<tr>
<td>9</td>
<td>1.22</td>
<td>100</td>
</tr>
<tr>
<td>10</td>
<td>1.16</td>
<td>100</td>
</tr>
</tbody>
</table>

Their expected cost of capital is 15%. Projects 3 and 6 are mutually exclusive while Projects 1 and 4 are mutually dependent.

Required:
(a) As a financial adviser, what projects would you recommend that the new venture should embark upon?
(b) What is the opportunity cost of the accepted project?
SUGGESTED SOLUTION 8-11

ABUBAKAR MUSA, DELE OJOYEWUKE & EDWIN IGBINIGIE

(a) Group A (includes Project 3)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Projects</th>
<th>Profitability Index</th>
<th>Initial Outlay</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N’000</td>
<td>N’000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1.22</td>
<td>100</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.22</td>
<td>400</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.20</td>
<td>150</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>1 and 4</td>
<td>1.197</td>
<td>450</td>
<td>88.5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.17</td>
<td>200</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.16</td>
<td>100</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.15</td>
<td>200</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.10</td>
<td>300</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

Allocation

<table>
<thead>
<tr>
<th>Available funds</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,200</td>
<td></td>
</tr>
</tbody>
</table>

Select Project 9

<table>
<thead>
<tr>
<th>(100)</th>
<th>22.00</th>
</tr>
</thead>
</table>

Select Project 5

<table>
<thead>
<tr>
<th>(400)</th>
<th>88.00</th>
</tr>
</thead>
</table>

Select Project 2

<table>
<thead>
<tr>
<th>(150)</th>
<th>30.00</th>
</tr>
</thead>
</table>

Select 1 and 4

<table>
<thead>
<tr>
<th>(450)</th>
<th>88.50</th>
</tr>
</thead>
</table>

Select 50% of Project 3

<table>
<thead>
<tr>
<th>100</th>
<th>17.00</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>NIL</th>
<th>245.50</th>
</tr>
</thead>
</table>

Group B (includes Project 6)

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Projects</th>
<th>Profitability Index</th>
<th>Initial Outlay</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N’000</td>
<td>N’000</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>1.22</td>
<td>100</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.22</td>
<td>400</td>
<td>88</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1.20</td>
<td>150</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1.197</td>
<td>450</td>
<td>88.65</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1.17</td>
<td>200</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>1.16</td>
<td>100</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1.15</td>
<td>200</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>1.10</td>
<td>300</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

The total NPV here is 22 + 88 + 30 + 88.50 + 16 = 244.50. Since they constitute projects for which the total allocation of funds is made.
However, the company is advised to select projects 9, 5, 2, "1 of 4" and 50% of 3 because they produced the higher NPV of ₦245.50 compared to that of Group B of ₦244.50.

Note: The P1 for "1 of 4" is derived thus:

\[
P1 = \frac{1.19 \times 150 + (1.20 \times 300)}{150 + 300} = 1.197
\]

The projects are assumed to be divisible.

(b) The opportunity cost of accepted projects is the lost NPV from projects not accepted. These actions were the result of capital rationing and the nature of the relationship between the projects. This is equal to NPVs of 50% of Project 3, 6, 7, 8 and 10 which sum up to ₦153. The position of project 6 in this regard may be debated and the argument is that with or without capital rationing we would not undertake project 6, if Project 3 is undertaken; therefore, the opportunity cost of accepted projects should not include the NPV of Project 6. However, the acceptance of Project 3, is the opportunity cost of project 6 and vice-versa.

8.7.3 Multi-Period Capital Rationing

Where capital is restricted in more than one period, the requirement is likely in the least, a formulation of the Linear Programming required, to select projects which will maximize the NPVs for the company. For this reason, the following steps will be required:

(a) Identify the relevant variables (e.g. available funds, required fund for each project, years of restriction of respective projects and the resultant NPVs etc.)

(b) Specify these variables in a form adaptable to mathematical manipulation by representing the variables in (a) above with symbols Let “x” represent the LAGOS project, etc. or let “y” represent the fraction of SHOGUNLE project accepted.

(c) State the objective function, which normally is the maximisation of the NPVs of all the projects.

(d) Specify the constraints as follows:

(i) **Financial constraint**: this ensures that total required funds for all the projects and other operations of the company do not exceed the available funds for each corresponding period.
(ii) **Non-negativity constraint:** this ensures that projects are either accepted or rejected and in no situation would a negative portion of a project be accepted.

(iii) **Logical constraint:** this ensures that fractions of projects can be undertaken whereas no project will be repeated.

**Note:** Steps (b), (c) and (d) will constitute the Linear Programming formula or plan for multi-period capital rationing.

### 8.7.4 Limitations of Capital Rationing

The following constitute the limitations of capital rationing:

(a) The assumption of divisibility of projects may not be possible in practice for all projects.

(b) In addition to (a), we also assume linearity between outlays and NPVs of projects, for example, a fractional investment in outlay will yield the same fraction of NPV. In practice, because of economies and diseconomies of scale, this may not hold.

(c) On many occasions, capital rationing treats projects in isolation. It does not recognize the interdependence of projects, for example, an investment in a project may result in substantial savings only if another project is undertaken, which capital rationing ignores.

(d) Where more than two projects are involved and capital is restricted in more than one period, the profitability index approach will no longer be sufficient for resolving project acceptance under capital rationing. In such cases, linear programming technique may be applied.

### 8.8 INFLATION IN CAPITAL BUDGETING

Inflation in capital budgeting refers to increases in estimates as a result of changes in price levels. This means that, if we ignore inflation we may end up overstating or understating our net cash flows in which case the NPVs used for decision making would be wrong.

A school of thought believes that inflation can be ignored, because it affects both variables that make up NPV on which the decision whereby the variables are the cash flows and cost of capital based. They argue that, since inflation
will generate increases in cash flows and cost of capital, the provider will increase its required returns to meet changes in price level. Therefore, the effect of inflation will be cancelled out in arriving at the NPV.

The above assertions may be contested because of the following reasons:

(a) Inflation does not affect the cash flows and cost of capital in the same way. Cash flow may increase, whereas providers of funds especially shareholders may not ask for the proportionate increase in their required return (i.e. cost of capital).

(b) Even among the cash flows, inflation will not affect them in the same way. A company may translate expected inflation rate into estimates of materials and overhead costs. It will be wrong if estimates for sales related cash flows also incorporate the same expected inflation rate. This inability of the company to adjust for inflation in its selling price is dependent on the nature of the demand for its product or service.

(c) Labour cost and labour related cash flows may not move in line with the general inflation rate because of the actions of labour and industrial unions.

(d) For the manager, making estimates for inflation rate will be compounded by the fact that there must be full provision for variable cost of production with full effects of inflation if the company intends to remain in operation.

From the above reasons, inflation will be ignored in order to arrive at sub-optimal decision as the presence of inflation will complicate planning and forecasting problems of the manager. Predicting the estimates of future cash flows is difficult on its own and would be worsened if inflation is recognised.

8.8.1 Relevant Concepts

Inflation can be incorporated in capital budgeting by the usage of any of the following two concepts:

(a) Money cost of capital; and

(b) Real cost of capital.

Concept of Money Cost of Capital

The money cost of capital is the normal cost of capital of a company
which would have been calculated by reference to money market rate of interest of the providers of capital or funds. It is the cost of capital that has not been adjusted for inflation (i.e. it does not incorporate inflation). Where cash flows are inflated or incorporate inflation, or are given in money terms, we should discount such cash flows using the money cost of capital.

**Concept of Real Cost of Capital**

The real cost of capital is, the cost of capital that has been adjusted for inflation and the adjustment formula is as follows:

\[
1 + r = \frac{1 + m}{1 + i} - 1
\]

Where

- \( i \) = inflation rate
- \( m \) = money cost of capital
- \( r \) = real rate or real cost of capital

In order to use the real cost of capital, there is need to ensure that the cash flows to be discounted are the real cash flows. The real cash flows are cash flows given in today's prices, also known as current values or year zero cash flows. To use the real cost of capital, there is need to bring this cash flows to year zero values. The result is the same whether real or money cost is applied, that is, it is not material which concept is applied as long as the concepts are properly applied.

**ILLUSTRATION 8-12**

The Directors of Newsline Nigeria Ltd. are considering the manufacture of a new product. The company's current cost of capital is 20% in money terms. Construction of the plant required to produce the new product would take one year; that is, production would commence on 1 January 2010. The plant would cost ₦500,000 of which ₦300,000 is payable immediately and ₦200,000 on 31 December 2009. The construction cost is fixed by contract. One hundred thousand units of the new product would be produced and sold each year from 1 January 2010 until 31 December 2013. Expected revenues and anticipated costs expressed in terms of 1 January 2008 price level are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Per Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>₦5.00</td>
</tr>
<tr>
<td>Variable cost (excluding labour)</td>
<td>₦1.50</td>
</tr>
<tr>
<td>Labour</td>
<td>₦1.00</td>
</tr>
</tbody>
</table>

Additional overhead costs ₦60,000 per annum, selling price, variable
costs (excluding labour) and additional overhead costs are expected to increase in line with general price index. For a number of years, this index has increased at an annual compound rate of 10% and it is generally expected to continue increasing in line with the wage rate index which has been increasing at an annual compound rate of 20%. The same rate of increase is expected in the future. All revenues and costs occur at the end of the year in which they arise.

**Required:** Advise the directors of Newsline Nigeria Ltd. whether the manufacture of the new products is worthwhile.

Ignore taxation.

**SUGGESTED SOLUTION 8-12**

<table>
<thead>
<tr>
<th>Year</th>
<th>Items</th>
<th>Cash Flows</th>
<th>DF/AF at the</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Plant</td>
<td>(300,000)</td>
<td>20% 1.00</td>
<td>(300,000)</td>
</tr>
<tr>
<td>1</td>
<td>Plant</td>
<td>(200,000)</td>
<td>20% 0.8333</td>
<td>(166,660)</td>
</tr>
<tr>
<td>2-5</td>
<td>Sales less Overhead and Labour</td>
<td>(319,000)</td>
<td>9.09% 2.964</td>
<td>945,516</td>
</tr>
<tr>
<td>2-5</td>
<td>(120,000)</td>
<td></td>
<td>10% 4</td>
<td>(480,000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>NPV (1,144)</strong></td>
</tr>
</tbody>
</table>

**Decision Rule:**

Management should not manufacture the product since it results in negative NPV of N1,144.

**Note:**

(a) Year 0: 1 January 2009
   1: 31 December 2009
   2: 31 December 2010
   3: 31 December 2011
   4: 31 December 2012
   5: 31 December 2013

(b) **Real Cost of Capital**

   (i) For selling price, additional overhead, variable cost (excluding labour) Inflation rate: 10%
\[
\frac{1 + m}{1 + i} - 1 = \frac{1.20}{1.10} - 1 = 9.09\%
\]

Inflation : 10%

\[
\frac{1 + m}{1 + i} - 1 = \frac{1.20}{1.20} - 1 = 0\%
\]

(c) Revenues and costs are given in 1 January, 2008 index:

(i) Year 1 January, 2009
Selling Price = 5.0
Variable Costs = 1.50
Contribution = 3.50 x 100,000 = 350,000 x 110%
= ₦385,000

(ii) Additional Overhead = 60,000 x 110% = Year 0
= ₦66,000

(iii) Labour costs 1 x 100,000 = 100,000 x 120%
= Year 0 = ₦120,000

(iv) Contribution = ₦385,000
Less Additional Overhead = ₦66,000
Profit or Cash inflows = ₦319,000

8.8.2 Other Considerations

(a) The real cost of capital should be used under the following conditions:

(i) Where the inflation rate for the same cash flow will differ annually e.g. sales will increase by 10% in first year; 20% in second year, etc.

(ii) If in addition to inflation, relevant cash flows concept, any other capital budgeting concept or decision is being tested, usage of real cost of capital approach may become cumbersome.

(iii) Where the inflation rate is greater than the real cost of capital, the real cost of capital is a negative cost.

(b) The differential inflation rate is a situation where different rates of inflation apply to different cash flows of a project. We can still apply the real cost of capital approach as follows:

(i) Calculate the real cost of capital for a collection of cash flows that have the same inflation rate.
Calculate the present values of each cash flows that have the same inflation rate.

A summation of all the relevant PVs of the project will be equal to the NPV.

8.9 TAXATION IN CAPITAL BUDGETING

In this area, and in other areas whenever cash flows are to be used, it must reflect all available information in the solution. These include:

(a) All capital allowances claimable including balancing allowances. This should be reflected as tax savings in the cash flows. These tax savings will result in cash inflows which should be calculated thus: Tax Rate x Capital Allowances = Tax Savings.

(b) All balancing charges will give rise to additional tax payments known as tax cost - This tax cost should be recognised as relevant cash outflows and calculated as; Tax Cost = Tax Rate x Balancing Charges.

(c) Additional tax cost or tax savings from allowable income and expenditure. Additional Income = Tax Costs which is relevant cash outflows and determined thus: Tax Rate x Additional Income. Additional expenditure = Tax Saving which is relevant cash inflows and is determined thus: Tax Rate x Additional Expenditure.

(d) Timing of tax related cash flows. The inflows and outflows above arising from tax costs and savings should be incorporated in the cash flow during the period for the payment of tax in relation to the allowable timing period for tax. It is usual to assume, where there is silence on the issue of tax, that it is payable one year after the end of the period to which the tax cash flow relates. If no tax rate is given or you are asked to ignore taxation, you need not adjust for taxation in the cash flow.

8.10 LEASE OR BUY DECISIONS

These decisions are usually mutually exclusive, hence the usage of the incremental approach will hasten the rate of attempting problems in this area. Capital allowances would substantially affect our lease or buy decision, therefore the earlier explained adjustment for capital allowances are expected under lease or buy decision with particular reference to the buy option. However, in financial management, it is assumed that the lessee whether in operating or finance lease arrangement would not enjoy capital allowance, that is, implicit assumption of leases as operating lease for capital budgeting.
8.10.1 Qualitative Factors Affecting Lease or Buy Decisions

The following qualitative factors need to be considered when lease or buy decisions are involved:

(a) **Liquidity**

(i) Is there enough funds now to buy the asset instead of leasing it?

(ii) Will there be sufficient funds in future to meet lease obligations?

(b) **Off balance sheet financing:** Leasing will be more attractive than borrowing or buying if a company is already highly geared.

(c) **Availability of spare parts and ease of maintenance:** Most lease contracts contain maintenance clauses. In many cases it will be more economical for the lessor who has more exposure units to import spare parts and run maintenance centre.

(d) **Changes in technology or obsolescence:** Leasing may become attractive, if the asset is exposed to frequent changes in technology for example, leasing is a regular feature in the Hi-tech industries like aircraft and computers.

(e) **Inflation:** This may affect lease or buy decisions in terms of changes in prices vis-a-vis replacement cost, scrap value and maintenance charges.

(f) **Beneficial ownership**

(i) It is advisable not to lease specialised equipment or accommodation.

(ii) Purchase increases the asset base of companies, thereby improving the company’s ability to raise further finance.

(g) **Description in production:** This will lead to Losses if the lessor repossesses the asset for any reason.

(h) **Changes in taxation rate:** This factor can also affect either the lease or buy decision.
8.10.2 Assumptions

Logical assumptions are allowed to be made in this area of decision making and the major issue of choice centres around the cost of capital to be used in discounting the relevant cash flows. Therefore, as a guide, the following may be adopted:

8.10.2.1 Choice of Cost of Capital

(i) **Nature of cost of capital:** If the company is in a taxable position, use the after tax cost of capital. The after tax cost of capital is that cost of capital that has been directly or indirectly adjusted for taxation. Tax adjustments are considered as direct if the specific calculation of the cost of capital has recognised taxation. It is indirect if the figure for the cost of capital is adjusted using the following formula:

\[
\text{After Tax Cost} = \text{Cost of Capital} \times (1 - \text{Tax Rate})
\]

* e.g. if Cost of Capital = 10% and Tax Rate = 40%  
  After Tax Cost of Capital = 10\% \times (1 - 0.4) = 6\%

However, if the company is not in a taxable position, the pre-tax cost of capital should be used. A company is in a taxable position if it is required to pay tax during its normal course of business. If a company is currently making losses and therefore not paying taxes, it does not mean that the company is not in a taxable position. The loss position of the company will only mean a deferral of tax payment.

(ii) **Specific cost of capital:** The choice of a particular cost of capital to use for either the lease or buy decision can be by reference to source of finance or by reference to nature of cash flow. If the source of finance for the decision is specified or known, the specific cost or cost of borrowing should be used. However, if the source is from the company's pool of funds, we should use the company's weighted average cost of funds (WACC) should apply.

8.10.3 Nature of Cash Flows

Cash flows are considered certain if they do not fluctuate over time and they are not linked to sales or production, for example, lease rentals, hire purchases, etc. On the other hand, cash flows are uncertain if they are dependent on the level of activity of the company or if they can be linked with the demand or sales of the company's production or services, for example, variable costs including sales price, labour, etc.
The example below is used to illustrate the effect of taxation in capital budgeting decisions as well as the element of lease or buy decision by a firm.

**ILLUSTRATION 8-13**

Tukur Nasarawa Nigeria Limited intends to obtain the use of an asset, but is uncertain of the best financing method to be employed. The financing methods under consideration are:

(a) To borrow and purchase the asset: borrowing would cost 12% before tax which is the current competitive market rate for debt. The asset would cost ₦90,000 to purchase and will have a guaranteed salvage value of ₦10,000 in five years. Expenditure on the asset qualifies for capital allowance at 25% per annum on the reducing balance.

(b) To lease the asset, two financial leases are being considered, the details are:

<table>
<thead>
<tr>
<th>Year</th>
<th>Lease A (₦'000)</th>
<th>Lease B (₦'000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>50</td>
</tr>
</tbody>
</table>

If the asset is leased, the entire salvage value will accrue to the lessor. The firm's weighted average cost of capital is 15%. Advise on the best method of financing the use of the asset if the firm is:

(a) Subject to company tax at 35% with a one year delay and has large taxable profits,

(b) Permanently in a non-taxable position.
### Suggested Solution 8-13

**Tukur Nasarawa Nigeria Limited**

#### Buy Decision

<table>
<thead>
<tr>
<th>Year</th>
<th>(a) Cash Flow</th>
<th>(b) Tax Savings</th>
<th>(a+b) NCF Cost</th>
<th>DCF @ 7.8%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>90000</td>
<td>-</td>
<td>90,000</td>
<td>1.0000</td>
<td>(90000)</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>7875</td>
<td>7875</td>
<td>0.9276</td>
<td>7305</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>5906</td>
<td>5906</td>
<td>0.8605</td>
<td>5082</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>4430</td>
<td>4430</td>
<td>0.7983</td>
<td>3536</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>3322</td>
<td>3322</td>
<td>0.7405</td>
<td>2460</td>
</tr>
<tr>
<td>5</td>
<td>10000</td>
<td>2492</td>
<td>12492</td>
<td>0.6869</td>
<td>8581</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>3975</td>
<td>3975</td>
<td>0.6372</td>
<td>2533</td>
</tr>
</tbody>
</table>

**NPV (60,503)**

#### Lease A

<table>
<thead>
<tr>
<th>Year</th>
<th>(a) Cash Flow</th>
<th>(b) Tax Savings/Cost</th>
<th>(a+b) New Cash Flow</th>
<th>DCF @ 7.8%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(20,000)</td>
<td>-</td>
<td>(20,000)</td>
<td>1.0000</td>
<td>(20,000)</td>
</tr>
<tr>
<td>1</td>
<td>(20,000)</td>
<td>7000</td>
<td>(13,000)</td>
<td>0.9276</td>
<td>(12,059)</td>
</tr>
<tr>
<td>2</td>
<td>(20,000)</td>
<td>7000</td>
<td>(13,000)</td>
<td>0.8605</td>
<td>(11,187)</td>
</tr>
<tr>
<td>3</td>
<td>(20,000)</td>
<td>7000</td>
<td>(13,000)</td>
<td>0.7983</td>
<td>(10,378)</td>
</tr>
<tr>
<td>4</td>
<td>(20,000)</td>
<td>7000</td>
<td>(13,000)</td>
<td>0.7405</td>
<td>(9,627)</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>7000</td>
<td>7,000</td>
<td>0.6869</td>
<td>4,808</td>
</tr>
</tbody>
</table>

**NPV (58,443)**

#### Lease B

<table>
<thead>
<tr>
<th>Year</th>
<th>(a) Cash Flow</th>
<th>(b) Tax Savings/Cost</th>
<th>(a+b) New Cash Flow</th>
<th>DCF @ 7.8%</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(4,000)</td>
<td>-</td>
<td>(4,000)</td>
<td>1.0000</td>
<td>(4,000)</td>
</tr>
<tr>
<td>1</td>
<td>(8,000)</td>
<td>1,400</td>
<td>(6,000)</td>
<td>0.9276</td>
<td>(6,122)</td>
</tr>
<tr>
<td>2</td>
<td>(16,000)</td>
<td>2,800</td>
<td>(13,200)</td>
<td>0.8605</td>
<td>(11,359)</td>
</tr>
<tr>
<td>3</td>
<td>(30,000)</td>
<td>5,600</td>
<td>(24,400)</td>
<td>0.7983</td>
<td>(19,479)</td>
</tr>
<tr>
<td>4</td>
<td>(50,000)</td>
<td>10,500</td>
<td>(39,500)</td>
<td>0.7405</td>
<td>(29,250)</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>17,500</td>
<td>17,500</td>
<td>0.6869</td>
<td>12,025</td>
</tr>
</tbody>
</table>

**NPV (58,185)**

#### Decision Rule:

Lease from B since it has the lowest figure in terms of the investment cost or present value of cost.
**Working Notes**

(a) Cost of borrowing is 12%
    after tax cost of borrowing = 12% x (1 - 0.35) = 7.8%

(b) Capital allowance calculation

<table>
<thead>
<tr>
<th>Year</th>
<th>Calculation</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90,000 x 25% = 22,500 x 35%</td>
<td>7,875</td>
</tr>
<tr>
<td>2</td>
<td>67,500 x 25% = 16,875 x 35%</td>
<td>5,906</td>
</tr>
<tr>
<td>3</td>
<td>50,625 x 25% = 12,656 x 35%</td>
<td>4,430</td>
</tr>
<tr>
<td>4</td>
<td>37,969 x 25% = 9,492 x 35%</td>
<td>3,322</td>
</tr>
<tr>
<td>5</td>
<td>28,477 x 25% = 7,119 x 35%</td>
<td>2,492</td>
</tr>
</tbody>
</table>

Written Down Value (WDV) = 28,477 - 7,119 = 21,358

Balancing Allowance = WDV less scrap value
                      = 21,358 - 10,000
                      = 11,358 x 35% = 3,975

**8.11 SUMMARY AND CONCLUSIONS**

Investment decisions are long-run decisions where consumption and investment opportunities are balanced over time after taking into consideration investor's beliefs in the future, the alternatives available and attitude to risk.

The appraisal techniques are of two main types, namely: traditional and discounted cash flow (DCF). The traditional elements are payback period and accounting rate of return while the DCF that uses cash flows rather than profits and take account of the time value of money are net present value and internal rate of return. With the conventional projects, IRR and NPV give the same ‘accept’ or ‘reject’ decision. NPV is an absolute measure whereas IRR is a relative one, hence the superiority of the NPV over IRR when making decision.

Capital rationing is where all apparently profitable projects cannot be initiated because of shortage of capital and decision rule under this instance is to maximise the return from project(s) selected rather than simply accept/reject decision on projects in isolation.

The probability index is used in ranking single period projects in terms of the expected value having regards to mutually exclusive projects.

Multi-period capital rationing with divisible projects is usually solved by linear programming technique which produces the optimal solution.

Taxation affects the cash flows of a project, hence, it is a factor to be considered because it affects profits, investment incentives and cost of capital.
8.12 REVISION QUESTIONS

8.12.1 MULTIPLE CHOICE

1. Dotun is currently considering an investment that gives a positive net present value of ₦3,664 at 15%. At a discount rate of 20%, it has a negative net present value of ₦21,451 What is the internal rate of return of this investment?

   A  15.75%
   B  16.0%
   C  19.30%
   D  19.90%
   E  18.40%.

2. Ayo Limited is planning on paying ₦300 into a fund on a monthly basis starting 3 months from now for 12 months. The interest earned will be at a rate of 3% per month. What is the present value of these payment?

   A  ₦2816
   B  ₦2733
   C  ₦2541
   D  ₦2986
   E  ₦2886.

The following data relates to question 3 and 4.

Yemi Limited is considering investing in a manufacturing project that would have a three-year life span. The investment would involve an immediate cash outflow of ₦50,000 and have a zero residual value. In each of the three years, 4000 units would be produced and sold. The contribution per unit based on current price is ₦5. The company has an annual cost of capital of 8%. It is expected that the inflation rate will be 3% in each of the next three years.

3. The net present value of the project to the (nearest ₦500) is

   A  ₦4500
   B  ₦5000
   C  ₦5500
   D  ₦6000
   E  ₦6500.

4. If the annual inflation rate is projected to be 4%, the maximum necessary cost of capital for this project to remain viable is (to the nearest 0.5%)

   A  13.0%
   B  13.5%
   C  14.0%
   D  14.5%
   E  15.0%.
5 If N400 is invested today and generate N500 in one year's time. What is the internal rate of returns?
A  30%
B  32%
C  31%
D  25%
E  27%.

8.12.2. SHORT ANSWER QUESTIONS

1 Explain the concept of Capital Rationing.
2 What is Profitability Index?
3 State any four main factors to be considered in a lease or buy decision.
4 What is Internal Rate of Return?
5 The discount rate used in DCF calculation is known as -------

(Refer to Suggested Solution in Appendix I, page 443)
9

PLANNING AND MANAGEMENT
CONTROL SYSTEM

9.0 LEARNING OBJECTIVES

After studying this chapter, readers will be able to understand:

♦ Short-term and long-term Planning;

♦ The differences between strategic, tactical and operational planning; Control systems and the basic knowledge of closed loop and open loop system; and

♦ The decision process.

9.1 INTRODUCTION

Planning is one of the functions of management and is concerned with the future. Planning relies upon information from many sources, both external and internal to the company for it to be successful. Information for planning includes cost and financial data and also information relating to personnel, markets, competitors, production capacities, constraints and material supplies.

Definition of Planning

“...The establishment of objectives and the formulation, evaluation and selection of the policies, strategies, tactics and actions required to achieve these objectives. Planning comprises long term (strategic planning) and short-term operational planning. The latter usually refers to a period of one year” (CIMA).

The overall planning process covers both the long and short terms. Planning is thinking before doing.

9.2 LONG-TERM STRATEGIC PLANNING (CORPORATE PLANNING)

This is defined as ‘the formulation, evaluation and selection of strategies for the purpose of preparing a long-term plan of action to attain objectives. Also known as planning and long range planning’ (CIMA).

Long-term strategic planning denotes planning with a long-term span in
economic and business affairs. It can further be explained as the total resources of a company for the achievement of quantifiable objectives within a specified period of time. It signifies a comprehensive and organized but flexible approach to planning. There is a need for a routine monitoring of the organisation's internal and external environment to keep the plan relevant.

9.2.1 Importance of Corporate Planning (CP)

Corporate Planning is essential for the following reasons:

(a) It is a means by which a company expresses the desire to determine its own future;

(b) Capital formation needs to be planned as a unit, because the implication of investment decisions is more widespread nowadays;

(c) Business diversification is spreading presently resulting in complexity of operations; and

(f) The increased sophistication of products and production processes make decision-making difficult for top executives. Hence, long-term planning will assist in solving the problem.

9.2.2 Stages in Corporate Planning (CP)

Corporate planning involves six stages. These are:

Stage 1: Determine the objective

This is the first stage in corporate planning process and it is the key stage. It seeks to answer the question: what is the business attempting to achieve? A set of objectives needs to be established, which express in quantitative terms, what the organisation is trying to accomplish. There are difficulties in establishing corporate objectives because of the sophisticated nature of the modern businesses. We have the following areas in which objectives of performance and results have to be set, namely:

(a) Productivity
(b) Innovation
(c) Market standing
(d) Physical and financial resources
(e) Manager performance and development
(f) Employee performance and attitude
(g) Public responsibility.

Stage 2: Establish the Current Position (Assessment Stage)

This is called a "position audit" which seeks to provide detailed answers to the following questions:

How is the business at the present time and the environment in which it operates? In what environment will the company operate in future?

The four aspects of the current position stage are:

(a) The external environment includes an assessment of economic, political, social and technological factors, detailed analysis of competitive activity for established product affecting the organisation.

The external investigation exposes the threats and opportunities that exist by identifying changes within the environment.

(b) The organisation: This is a process of looking from the outside into the company to assess its present strengths and weaknesses. It also involves the appraisal of each part of the company's objective and identifying the key profit-making factors. The following should be established: "How much can present profits be increased from present resources?", "What serious weaknesses are apparent? and so on.

(c) The future: The future is very difficult to predict. That notwithstanding, the following factors have to be considered to be able to predict properly: economic forecast, inflation, taxation, political, and social trend in taste and trend in government policy thrust.

(d) The expectation: The expectations of the stakeholders are to influence the corporate
objectives: stakeholders are employees, customers, shareholders, government, the general public, and so on.

Stage 3: Develop a strategy (also known as Appraisal Stage)

In this stage, SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats) needs to be carried out in order to be able to determine the next line of action. The question to be asked is: "How can the gap between objectives and current position be closed?" Primary considerations are:

(a) Product development expenditure;
(b) Improved cash flow;
(c) Greater share of the existing markets;
(d) New market expansion;
(e) Alternative product lines;
(f) Production capacity;
(g) Manpower planning; and
(h) Control systems.

All the above represent the strengths, weaknesses, opportunity and threats which the planning team must take into consideration when embarking on long-term planning.

A policy document showing the major decision to be taken, the time span for the change and the supporting evidence necessary will be produced.

Stage 4: Preparation of the Plan

The chosen strategy is being worked out. The critical problem that would have to be resolved is getting a commitment from the management team and an undertaking to make the strategy a success. Each aspect of the plan will be produced by the department concerned while the whole exercise is being co-ordinated by the corporate planning team.
Stage 5: Implementation of the Plan

The strategy is translated into action. The preparation stage leads on to implementation stage. The plans will contain targets and will be sufficient in details so that tactical level management know the task they have to plan and execute. The strategic plan will be used by tactical management to prepare operational plans, budgets etc. Each member of management must be informed about the details of the plan together with the contribution each will make towards its realization.

Stage 6: Continuous Re-appraisal

This is the monitoring and control stage. Re-appraisal of the plan will occur in the following ways: There will be an on going system by the corporate planning department to improve the information on which the plan is based. This should be helpful to the long-term forecast in closing the forecast gap. Specific re-appraisal or monitoring will be required:

(a) At the end of each year, when current performance is measured against trends; and

(b) When any significant event occurs that would materially affect the plan, for example, a merger of competitors.

9.2.3 Advantages of Corporate Planning

The benefits that can accrue from corporate planning include the following:

(a) Clarifying policies and strategies and providing the essential framework for realistic operational budgeting and planning.

(b) Providing strategies to avoid sub-optimality as operational planning helps to co-ordinate the different aspects of the organization.

(c) Assisting to achieve in greater job security.

(d) Improving management team because executives are forced to think ahead of time.
(e) Exposing weaknesses in the company's information flow and assisting to improve the system.

(f) Improving the goal-congruence of the organisation and assisting in the motivational programme of the company.

9.2.4 Disadvantages of Corporate Planning

(a) The process may absorb a considerable amount of management time and involve a lot of bureaucracy.

(b) It may lead to the formulation of unrealistic objectives, which may act as a disincentive to the employees.

(c) It may make the organisation inflexible and less capable of responding to changes.

9.3 CONTROL CONCEPTS

Control is the process of compelling events to conform to plan.

Control is concerned with the efficient use of resources to achieve determined objective, or a set of objectives, contained within a plan. In an organisation, control is exercised by the feedback of information on performance compared with plan. Control regulates performance so that results conform to plans. Control is dependent upon planning and cannot exist in isolation. In practice, planning and control overlap so much that it is sometimes extremely difficult to separate them. Planning is a pre-requisite for control. Control does not end when deviations from plans occur neither is it merely the correction of past mistakes. Control information is produced so that decisions can be made in order to ensure that objectives are achieved.

9.3.1 Types of Control Systems

The quantitative control systems include budgetary control, standard costing, production control and inventory control. We also have quantitative systems for monitoring product quality and scheme of staff appraisal. In addition to the quantitative systems. There are also control systems that are concerned with qualitative factors.

9.3.2 The Process of Control

The control process or the elements of control cycle are:

(a) The setting of standard of performance: Targets and plans
are established and standards of performance are determined in order to achieve those targets. The standards must be carefully set in order to ensure that they are realistic and can be achieved.

(b) **The operation of the system**: The information of the standard of performance and operation results are communicated to those operating the system. There is need for good communication and motivation in order to ensure that output is achieved in accordance with plans. It is important that managers must know their objectives and the limits of their responsibility and authority.

(c) **Feedback**: Deviation is determined after the actual performance has been compared with the standard expected. The decisions are reported to the appropriate authority in a clear and useful way to ensure that corrective action is taken. It may involve the adjustment of the original plans or current operation to ensure the realisation of objectives.

9.3.3 Open and closed loop systems

(a) **The closed loop system**: In a closed loop system, the feedback remains within the control system itself and passes to a control unit or correcting unit. This unit will automatically correct the operating performance in response to any deviation from standard. It is referred to as a closed loop system because it operates without outside control, for example, problems are solved internally and automatic machines such as numerically controlled machines, which are capable of self adjustment, are examples of closed loop systems.

(b) **The open loop system**: In an open loop system, feedback is directed to a higher level for action. The system is capable of adjustment for external factors, and control, usually human, is external to the system. It is usually recognised that the original plans and standards of performance may have to be changed in the light of actual results. Most business systems are open systems because control is exercised by managers using skill and judgment to evaluate information and initiate appropriate action.
9.4 THE DECISION PROCESS

9.4.1 Stages in decision making process

Decision making is one of the major functions of management. A decision is a commitment to action. Decision making is an important aspect of management because the quality of decisions made can affect the long-term planning success of a whole business as well as the day to day effectiveness of its operations. The following stages form part of the decision making process:

(a) Identify that there is a problem;
(b) Collect all necessary information on all aspects of the problem;
(c) Evaluate the relevance of the information obtained;
(d) Define the objective;
(e) Find out the alternative courses of action;
(f) Evaluate these alternatives;
(g) Make decision with regard to the course of action to be adopted;
(h) Mobilise the resources required;
(i) Implement the objective; and
(j) Find out if the problem has been solved.

It must be emphasised that many other factors may be of critical importance in a decision situation. Examples include; markets, the environment, legal factors, personal and psychological characteristics, production or service quality, reliability and so on. Therefore, decision making is not just a consideration of financial factors alone.

9.4.2 Types of Decisions

Decisions can be classified into programmed and non-programmed categories.

(a) Programmed decisions: These are decisions that can be clearly defined and tailored through computer based management information system e.g. re-order level decision and inventory control techniques incorporated into computer based management information systems. A typical example is a reorder decision based on usage and reorder levels in an inventory control system.
(b) **Non-programmed decisions:** These are decisions with decision, rules and procedures that cannot be defined. These decisions will therefore involve many external and internal factors frequently with high levels of risk that require information from various sources.

### 9.5 SUMMARY AND CONCLUSIONS

Planning is an important part of business activity and can be defined as the act of setting objectives and deciding upon the manner by which these will be achieved.

Planning could be strategic - covering periods longer than one year but within 10 years. It is made up of several stages such as assessment, objective, approval and evaluation.

The corporate plan gives birth to the detailed short term or operational plan spanning a period of one year.

The advantages of corporate planning include: the classification of policies and strategies, the avoidance of sub-optimality, taking a long-term view, the exposure of weaknesses and motivational effects.

The shortcomings are: time costing, inflexibility and possible bureaucratic procedures.

Part of the planning process include consideration of an appropriate control system which is concerned with the efficient use of resources to achieve a plan.

The major quantitative control systems are budgetary control, standard costing, inventory control and production control.

Control in organisations is carried out using information feedback loops. Control action must be correctly phased otherwise the action may become the opposite of that intended.

Open systems interact with the environment whereas close systems are self-contained.

*(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)*
9.6 REVISION QUESTIONS

9.6.1 SHORT ANSWER QUESTIONS

1. Define Planning.

2. List two short-comings of Corporate Planning.

3. Define tactical planning.

4. Distinguish between Programmed decision and Non-Programmed decision.

5. What is "SWOT ANALYSIS"?

6. A depiction of the interrelationship among recognized factors in real situation is called------

7. What is the difference between an open and closed loop systems?

8. The formulation, evaluation, and selection of strategies for the purpose of preparing a long term plan of action to attain objectives is known as ----

9. List two advantages of Corporate Planning?

(Refer to Suggested Solution in Appendix I, page 443)
10 BUDGETING AND BUDGETARY CONTROL

10.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

♦ The objectives of budgeting.
♦ The stages in developing budgets and their inter-relationships.
♦ Cash budget and its importance in an organisation.
♦ Functional budgets and master budget.
♦ Control limits, activity and efficiency ratios.
♦ The major techniques used in budgeting such as Flexible budgets, Zero-based budgeting, Activity-based budgeting, Continuous budgeting, and Programme Planning and Budgeting systems.
♦ The need for budgetary control.
♦ The importance of the human aspects of budgeting.

10.1 DEFINITION OF BUDGET

A budget is defined as "a quantitative statement for a defined time which may include, planned revenues, expenses, assets, liabilities and cash flow. A budget provides a focus for the organisation, aids the coordination of activities and facilitates control. Planning is achieved by means of a fixed master budget whereas control is generally exercised through the comparison of actual costs with a flexible budget" (CIMA).

Budget is a financial and/or quantitative plan of operations for a forthcoming accounting period.

Many functional budgets (a budget of income or expenditure for individual functions of a business such as the sales budget, production budget, direct labour budgets, etc) are incorporated into a master budget.

"Budgets are designed to carry out various functions such as planning, evaluating performance, co-ordinating activities, implementing plans, communicating, motivating and authorising actions. The last-named role
seems to predominate in government budgeting and not-for-profit budgeting, where budget appropriations serve as an authorisation and ceiling for management actions. Horngren (2004).

**The purpose of a budget is to:**

(i) Communicate ideas and plans to everyone affected by them. A formal system is necessary to ensure that each person is aware of what he or she is supposed to be doing. Communication might be one-way, that is, with managers giving order to subordinates or there might be a two-way dialogue and exchange of ideas, between managers and subordinates.

(ii) Coordinate the activities of different departments or sub-units of the organisation. This concept of coordination implies, for example, that the purchasing department should base its budget on production requirements, and that the production budget [that is, direct labour budget and machinery utilisation budgets, etc] should in turn be based on sales expectations. Although, straightforward in concept, coordination, in practice, is remarkably difficult to achieve, and this often leads to 'sub-optimality' and conflict among departmental managers.

(iii) Establish a system of control by having a plan against which actual results can be progressively compared and variances analysed for prompt attention and action.

(iv) Motivate employees to improve their performances. The level of attainment usually incorporated in the budget is a realistic figure for the budget period. Thornton: (1978).

Thornton, (1978) suggests that two levels of attainment could be fixed:

(i) a “minimum expectations” budget, and

(ii) a “desired standards” budget.

A budget is a means to an end, and not an end in itself. It is a short term plan that depicts the focus of a long term objective of the organisation. It covers area of responsibility of one specified person, so that his performance can be measured at the end of a budget period. It follows that the budget should be prepared in conjunction with those who are to be responsible for achieving the budgeted performance. In this way, a head of department translates his goal in the budgets. This approach offers motivation to the managers. This technique, with its stress on personality, differs from standard costing, for the latter is concerned with standards for products or services.
10.2 TYPES OF BUDGET

(a) Functional budgets

Functional budgets are prepared by the departmental heads. The order of importance in preparation of the budget depends on the budget limiting factor of the organisation. Where sales are considered critical to the success of the objectives, the sales budget is prepared first. Similarly, where source of raw material is restricted and in limited supply, the raw material budget is prepared first.

The order of presentation suggests that the sales are critical and so sales budget is prepared before other budgets:

(i) Sales budget. This will incorporate decisions about selling prices and expected sales volume for each item of product (or service) for all segments of the company's product or service;

(ii) The departmental budgets for marketing, sales and distribution would also be made at an early stage, because estimates of spending on sales promotion, advertising and salesmen, etc will be necessary to gauge the expected volume of sales;

(iii) Having prepared the sales budget, it should be possible to estimate production requirements in terms of quantity of raw materials, labour hours, machine hours, etc. However, decision must first be taken about stocks of finished goods. A decision to increase stocks would mean that production for the period must exceed sales volume. On the other hand, a decision to reduce stock levels (so as to improve the organisation's cash position) would mean that production volume would be less than sales volume by the amount of the run-down in stocks. The level of stock to hold would depend on the variability in demand, lead-time for raw materials, etc.;

(iv) The production budget is then prepared, specifying the expected quantities of each product to be made, in each factory or manufacturing department, followed by the budgets of resources for production, that is,

- Materials usage budget for all types of materials, direct and indirect;
- Machine utilisation budget for the operating hours required on each machine or group of machines;
Management Accounting

- Labour budget (all grades of labour, direct and indirect in hours and cost);
- Overhead cost centre’s budgets for production, administration, and research and development cost centres.

(v) A material’s purchasing budget is also required, specifying the expected quantities and price of each stores item for raw materials bought-in components, stationery, etc. In order to prepare the purchases budget, a decision must first be taken about stock level. Purchase requirements (in quantity) are the usage requirements, plus any increase in raw material stocks, or less any decrease in stocks;

(vi) A capital expenditure budget, updated each year, covering a period of the next three to five years;

(vii) A working capital budget, specifying the changes in debtors and creditors during the year. Turnover periods would be estimated and the effect of any proposed decision on discounts or credit period allowances considered; and

(viii) The cash budget cannot be prepared until the functional budgets in (i) to (vi) have been decided, prepared and agreed.

(b) Master budget

The master budget consolidates the position of all the functional budgets in the form of a budgeted trading and profit and loss account and a budgeted balance sheet.

Budgetary control relates expenditure to the person responsible for each function, thus affording an effective method of control. It is an important principle of the system that an executive is held responsible only for expenditure within his control.

10.3 BUDGET PREPARATION AND APPROVAL PROCEDURES

10.3.1 Budget Preparation Procedures

The business of any organisation must be conducted in an organised and orderly manner to achieve the desired results. Budget preparation is a serious activity of management and some time should be expended on it. In practice, top management may constitute a budget committee which could comprise:
BUDGETING AND BUDGETARY CONTROL

(a) The Managing Director / Chief Executive Officer as the Chairman

(b) Chief Accountant (or Director of finance) as the budget officer. He coordinates the preparation and readiness of other budgets and prepares the cash budget as well as the master budget. His knowledge of the interrelationship of these other functional budgets puts him in an advantageous position to be the budget officer.

(c) The head of department or the line and service managers who prepares the functional budgets of the department.

It is good management policy to have a pre-budgeting meeting where the guidelines for the new budget period are drafted, discussed and approved. This would include the requirements that the new budgets must meet the standard parameters.

10.3.2 Approval of the master budget

The budget committee will submit the master budget to the top management (usually the Board of Directors) for approval. If it is approved, the master budget will then become the blueprint for the activities of the budgeted period. If approval is not received, sections of the budget will have to be amended to incorporate any change or review in emphasis so as to meet the requirements of top management. However, these requirements should be realistic. There are limits to the success which can be achieved. Some improvements may be possible for the following reasons:

(a) Managers may have been too pessimistic in their estimates.

(b) Padding or slack variables may have been built into the budget that is, estimates of costs may be overstated and activity understated so that the budget can be easily achieved.

(c) Improvements in efficiency may be possible.

(d) Additional sales promotion may yield positive results.

(e) It may be possible to increase productive capacity although in many industries, this could take considerable time.
10.4 PREPARATION OF BUDGETS

10.4.1 Cash Budget

A cash budget is a summary of the company's expected cash inflows and outflows over a given period of time.

Cash is required in order to facilitate the achievement of a company's plans and intentions. Inadequate flow of liquidity will hamper efficiency and level of profitability of the firm. A company may be profitable but, still faces liquidity problems. Cash is a resource which should be effectively utilised in order to generate benefits for the company. Cash budget shows the timing of expected cash flows.

The benefits to be derived from the preparation of detailed cash budget are as follow:

(a) It provides early signals of potential deficit or surplus in order to take appropriate action.

(b) It enables financial feasibility of plans to be ascertained.

(c) It indicates the financial effects of policies within a firm.

(d) It provides a base for monitoring actual activity. The frequent comparison of actual cash flow with budgeted cash flow will enable up-to-date information to be incorporated into budget revisions.

ILLUSTRATION 10-1

Adenola Plc accounting year normally ends on 30th September of every year. The company has instructed its Chief Accountant to prepare the cash budget for the first four months of the year beginning from October 2010. The following data are given:

(i) Total Sales

<table>
<thead>
<tr>
<th>Month</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2010</td>
<td>₦150,000</td>
</tr>
<tr>
<td>September 2010</td>
<td>₦200,000</td>
</tr>
<tr>
<td>October 2010</td>
<td>₦180,000</td>
</tr>
<tr>
<td>November 2010</td>
<td>₦250,000</td>
</tr>
<tr>
<td>December 2010</td>
<td>₦300,000</td>
</tr>
<tr>
<td>January 2011</td>
<td>₦400,000</td>
</tr>
</tbody>
</table>

40% of the total sales is for cash while the remaining are credit sales to be collected as follows:
(ii) Total Purchases  
- September 2010  ₦100,000  
- October 2010  ₦80,000  
- November 2010  ₦120,000  
- December 2010  ₦50,000  
- January 2011  ₦150,000  

50% of the total purchase is for cash. 50% of credit purchases must be settled within one month and the remaining within two months after purchase.

(iii) The company pays the following expenses during the budget period:
- Company Income Tax of ₦25,000 in October 2010  
- Salaries and wages of ₦50,000 every month  
- Dividends of ₦50,000 in February 2011  
- Plant costing ₦150,000 in May 2011  

(iv) The company will receive the following additional income:
- Sales of motor vehicle costing ₦10,000 for ₦12,000 in November 2010.  
- Dividends received of ₦5,000 and ₦9,000 in October and December 2010 respectively.  

(v) The cash balance brought forward as at 1st October 2010 was an overdraft of ₦10,000.

Required:
Prepare the cash budget of the company for each of the first four months of 2010 and 2011 financial year.

SUGGESTED SOLUTION 10-1

ADENOLA PLC  
CASH BUDGET FOR THE FIRST FOUR MONTH OF 2010/2011  
FINANCIAL YEAR STARTING FROM OCTOBER 2010  

<table>
<thead>
<tr>
<th></th>
<th>October 2010</th>
<th>November 2010</th>
<th>December 2010</th>
<th>January 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflows (A)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Sales (w.1)</td>
<td>72,000</td>
<td>100,000</td>
<td>120,000</td>
<td>160,000</td>
</tr>
<tr>
<td>Cash from Debtors (w.2)</td>
<td>50,400</td>
<td>159,000</td>
<td>174,600</td>
<td>192,000</td>
</tr>
<tr>
<td>Sales of motor vehicle</td>
<td>-</td>
<td>12,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dividends received</td>
<td>5,000</td>
<td>-</td>
<td>7,000</td>
<td>-</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>127,400</strong></td>
<td><strong>271,000</strong></td>
<td><strong>301,600</strong></td>
<td><strong>352,000</strong></td>
</tr>
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</table>
### Outflows (B)

<table>
<thead>
<tr>
<th>Description</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Purchases (w3)</td>
<td>40,000</td>
<td>60,000</td>
<td>75,000</td>
<td>75,000</td>
</tr>
<tr>
<td>Payment to creditor (w4)</td>
<td>25,000</td>
<td>45,000</td>
<td>50,000</td>
<td>67,500</td>
</tr>
<tr>
<td>Company’s income tax</td>
<td>25,000</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Salaries and wages</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td><strong>Total Outflows</strong></td>
<td>140,000</td>
<td>155,000</td>
<td>175,000</td>
<td>192,500</td>
</tr>
</tbody>
</table>

### Net Inflows (A-B)

<table>
<thead>
<tr>
<th>Description</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>(12,600)</td>
<td>116,000</td>
<td>126,600</td>
<td>159,500</td>
<td></td>
</tr>
<tr>
<td>Balance brought forward</td>
<td>(10,000)</td>
<td>(22,600)</td>
<td>93,400</td>
<td>220,000</td>
</tr>
<tr>
<td>Balance carried forward</td>
<td>(22,600)</td>
<td>93,400</td>
<td>220,000</td>
<td>379,500</td>
</tr>
</tbody>
</table>

### Workings Sales:

<table>
<thead>
<tr>
<th>Months</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sales</td>
<td>180,000</td>
<td>250,000</td>
<td>300,000</td>
<td>400,000</td>
</tr>
<tr>
<td>(i) Cash Sales at 40%</td>
<td>72,000</td>
<td>100,000</td>
<td>120,000</td>
<td>160,000</td>
</tr>
<tr>
<td>(ii) Credit Sales at 60%</td>
<td>108,000</td>
<td>150,000</td>
<td>180,000</td>
<td>240,000</td>
</tr>
<tr>
<td>Cash from Debtors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 2010</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>(30% x 60% x N150,000)</td>
<td>18,000</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>September 2010</td>
<td>--</td>
<td>60,000</td>
<td>24,000</td>
<td>--</td>
</tr>
<tr>
<td>October 2010</td>
<td>32,400</td>
<td>54,000</td>
<td>21,600</td>
<td>--</td>
</tr>
<tr>
<td>November 2010</td>
<td>--</td>
<td>45,000</td>
<td>75,000</td>
<td>30,000</td>
</tr>
<tr>
<td>December 2010</td>
<td>--</td>
<td>--</td>
<td>54,000</td>
<td>90,000</td>
</tr>
<tr>
<td>January 2011</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>72,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>50,400</td>
<td>159,000</td>
<td>174,600</td>
<td>192,000</td>
</tr>
</tbody>
</table>

### Purchases:

<table>
<thead>
<tr>
<th>Description</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Purchases</td>
<td>80,000</td>
<td>120,000</td>
<td>150,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Cash purchases at 50%</td>
<td>40,000</td>
<td>60,000</td>
<td>75,000</td>
<td>75,000</td>
</tr>
</tbody>
</table>

### Credit Purchase 50%

<table>
<thead>
<tr>
<th>Description</th>
<th>October</th>
<th>November</th>
<th>December</th>
<th>January</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash paid to creditors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 2010</td>
<td>25,000</td>
<td>25,000</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>October 2010</td>
<td>--</td>
<td>20,000</td>
<td>20,000</td>
<td>--</td>
</tr>
<tr>
<td>November 2010</td>
<td>--</td>
<td>--</td>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>December 2010</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>37,500</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>25,000</td>
<td>45,000</td>
<td>50,000</td>
<td>67,500</td>
</tr>
</tbody>
</table>

### ILLUSTRATION 10-2

Ogunjuboun Plc expects sales of its airtime to amount to ₦800 million in January, ₦850 million in February and ₦950 million in March, 2010.
Prepare an estimate of cash budget from this information for the three (3) months ending 31 March 2010, assuming the following:

(i) 10% of sales are cash sales with 5% discount.

(ii) 3% discount is also given for credit sales when payment is received within 10 days. 25% of credit sales are paid within 10 days.

(iii) Half of the remaining debtors paid in the month following sales.

(iv) The remainder paid two months following sale with the exception of bad debtors, who amount to 1% of total sales.

(v) The following expenses were incurred during the period:

<table>
<thead>
<tr>
<th></th>
<th>JAN '000</th>
<th>FEB '000</th>
<th>MAR '000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salaries and wages</td>
<td>14,500</td>
<td>15,200</td>
<td>16,000</td>
</tr>
<tr>
<td>Printing of cards</td>
<td>2,300</td>
<td>4,200</td>
<td>4,500</td>
</tr>
<tr>
<td>Loan (Principal due)</td>
<td>80,000</td>
<td>185,000</td>
<td>220,000</td>
</tr>
<tr>
<td>Interest on loan</td>
<td>8,500</td>
<td>9,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

The following notes relate to these expenses:

- 10% of salaries are paid one month in arrears. 10% salaries and wages due as at the end of December 2009 not yet paid amounted to ₦1,200,000.

- Loan is paid as at when due while interest on loan is paid one month in arrears. Loan interest for the month of December 2009 is ₦7,900,000.

- Royalties are also paid one month in arrears. Royalties are 5% of total cash receipts and total receipts for December 2009 is ₦210,500,000.

- Administrative expenses are 5% of total sales and are paid in the month of sales.
## Suggested Solution 10-2

### Ogunjuboun Plc

#### Workings

<table>
<thead>
<tr>
<th></th>
<th>Jan N'000</th>
<th>Feb N'000</th>
<th>Mar N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sales</td>
<td>800,000</td>
<td>850,000</td>
<td>950,000</td>
</tr>
<tr>
<td>10% Cash Sales</td>
<td>(80,000)</td>
<td>(85,000)</td>
<td>(95,000)</td>
</tr>
<tr>
<td>Credit Sales</td>
<td>720,000</td>
<td>765,000</td>
<td>855,000</td>
</tr>
<tr>
<td>Payment within 10 days (25%)</td>
<td>(180,000)</td>
<td>(191,250)</td>
<td>(213,750)</td>
</tr>
<tr>
<td>50% month following 10 days</td>
<td>540,000</td>
<td>573,750</td>
<td>641,250</td>
</tr>
<tr>
<td>50% month following 10 days</td>
<td>270,000</td>
<td>286,875</td>
<td>320,625</td>
</tr>
<tr>
<td>Bad debt-1% of sales</td>
<td>8,000</td>
<td>8,500</td>
<td>9,500</td>
</tr>
<tr>
<td>Payment 2 month after sales</td>
<td>262,000</td>
<td>278,375</td>
<td>311,125</td>
</tr>
<tr>
<td>10% Cash Sales without discount</td>
<td>80,000</td>
<td>85,000</td>
<td>95,000</td>
</tr>
<tr>
<td>Less 5% discount</td>
<td>4,000</td>
<td>4,250</td>
<td>4,750</td>
</tr>
<tr>
<td>Credit sales within 10 days</td>
<td>180,000</td>
<td>191,250</td>
<td>213,750</td>
</tr>
<tr>
<td>Less 3% discount</td>
<td>5,400</td>
<td>5,738</td>
<td>6,413</td>
</tr>
<tr>
<td>Admin expenses – 5% of sales</td>
<td>40,000</td>
<td>42,500</td>
<td>47,400</td>
</tr>
<tr>
<td>Salaries &amp; Wages 90%</td>
<td>13,050</td>
<td>13,680</td>
<td>14,400</td>
</tr>
<tr>
<td>10% Arrears</td>
<td>1,200</td>
<td>1,450</td>
<td>1,520</td>
</tr>
<tr>
<td>Salaries &amp; Wages paid</td>
<td>14,250</td>
<td>15,130</td>
<td>15,920</td>
</tr>
</tbody>
</table>

### Ogunjuboun Plc

#### Cash Budget for the Period Ended 31 March 2010

<table>
<thead>
<tr>
<th></th>
<th>Jan N'000</th>
<th>Feb N'000</th>
<th>Mar N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inflows</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Sales Less discount</td>
<td>76,000</td>
<td>80,750</td>
<td>90,250</td>
</tr>
<tr>
<td>Credit sales less discount</td>
<td>174,600</td>
<td>185,512</td>
<td>207,337</td>
</tr>
<tr>
<td>Payment in the following month</td>
<td>-</td>
<td>270,000</td>
<td>286,875</td>
</tr>
<tr>
<td>Payment-2 months after sale</td>
<td>-</td>
<td>-</td>
<td>262,000</td>
</tr>
<tr>
<td>Total cash receipts</td>
<td>250,600</td>
<td>536,262</td>
<td>846,462</td>
</tr>
<tr>
<td><strong>Outflows</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries and wages</td>
<td>14,250</td>
<td>15,130</td>
<td>15,920</td>
</tr>
<tr>
<td>Printing of cards</td>
<td>2,300</td>
<td>4,200</td>
<td>4,500</td>
</tr>
<tr>
<td>Loan repayment</td>
<td>80,000</td>
<td>185,000</td>
<td>220,000</td>
</tr>
<tr>
<td>Interest repayment</td>
<td>7,900</td>
<td>8,500</td>
<td>9,000</td>
</tr>
<tr>
<td>Admin expenses</td>
<td>40,000</td>
<td>42,500</td>
<td>47,500</td>
</tr>
<tr>
<td>Royalties</td>
<td>10,525</td>
<td>12,530</td>
<td>26,813</td>
</tr>
<tr>
<td>Total payment</td>
<td>154,975</td>
<td>267,860</td>
<td>323,733</td>
</tr>
<tr>
<td>Net Cash Flows</td>
<td>95,625</td>
<td>268,402</td>
<td>522,729</td>
</tr>
<tr>
<td>Opening Balance</td>
<td>-</td>
<td>95,625</td>
<td>364,027</td>
</tr>
<tr>
<td>Closing Balance</td>
<td>95,625</td>
<td>364,027</td>
<td>886,756</td>
</tr>
</tbody>
</table>
ILLUSTRATION 10-3

SAB BAMMEKE Manufacturing Limited manufactures three products X, Y and Z. Relevant cost data relating to the products are as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit Cost (Kobo)</th>
<th>Unit in Final Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>55</td>
<td>5  4  -</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>3  2  6</td>
</tr>
<tr>
<td>C</td>
<td>35</td>
<td>-  3  5</td>
</tr>
<tr>
<td>D</td>
<td>60</td>
<td>-  1  4</td>
</tr>
<tr>
<td>E</td>
<td>80</td>
<td>1  1  -</td>
</tr>
</tbody>
</table>

No losses occurred in the use of materials A, B, C, and D. The standard yield of material E is 90%. This is an ideal standard. The expected yield is 80%.

During the four-week period budgeted sales are:

<table>
<thead>
<tr>
<th>Product</th>
<th>Sales Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>12,000</td>
</tr>
<tr>
<td>Y</td>
<td>15,000</td>
</tr>
<tr>
<td>Z</td>
<td>10,000</td>
</tr>
</tbody>
</table>

It is anticipated that 5% of the production of product Y will not pass inspection and will be disposed off immediately.

The stocks on hand at the beginning of the period are expected to be:

<table>
<thead>
<tr>
<th>Finished Goods</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1,800</td>
</tr>
<tr>
<td>Y</td>
<td>2,000</td>
</tr>
<tr>
<td>Z</td>
<td>1,600</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Materials</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20,000</td>
</tr>
<tr>
<td>B</td>
<td>30,000</td>
</tr>
<tr>
<td>C</td>
<td>15,000</td>
</tr>
<tr>
<td>D</td>
<td>5,000</td>
</tr>
<tr>
<td>E</td>
<td>9,000</td>
</tr>
</tbody>
</table>

It is planned to increase finished goods stocks in order to satisfy orders more quickly. Production in period 1 will be sufficient to increase stocks by 10% by the end of the period. Material stocks however, are considered to be too high and a reduction of 10% is planned by the end of period 1.
You are required to prepare budgets for:

(i) Production (in quantity).

(ii) Materials usage (in quantity).

(iii) Materials purchased (in quantity and value).

**SUGGESTED SOLUTION 10-3**

**SAB BAMMEKE MANUFACTURING LIMITED**

**Production Budget (Quantity)**

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>12,000</td>
<td>15,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Add:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Closing stock</td>
<td>1,980</td>
<td>2,200</td>
<td>1,760</td>
</tr>
<tr>
<td>Less: Opening stock</td>
<td>1,800</td>
<td>2,000</td>
<td>1,600</td>
</tr>
<tr>
<td>Add: Normal Loss</td>
<td></td>
<td>800</td>
<td></td>
</tr>
<tr>
<td>Good Production</td>
<td>12,180</td>
<td>16,000</td>
<td>10,160</td>
</tr>
</tbody>
</table>

(ii) **Materials Usage Budget (Quantity)**

<table>
<thead>
<tr>
<th>Materials</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product X</td>
<td>60,900</td>
<td>36,540</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Y</td>
<td>64,000</td>
<td>32,000</td>
<td>48,000</td>
<td>16,000</td>
</tr>
<tr>
<td>Z (10,160)</td>
<td>-</td>
<td>60,060</td>
<td>50,800</td>
<td>40,640</td>
</tr>
<tr>
<td>Add: Loss in production</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Qty. Required</td>
<td>124,900</td>
<td>129,500</td>
<td>98,800</td>
<td>56,640</td>
</tr>
</tbody>
</table>

Note = Loss in production = 28,180 ÷ 80% = 35,225

(iii) **Material Purchase Budget**

<table>
<thead>
<tr>
<th>Usage</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add: Closing Stock</td>
<td>18,000</td>
<td>27,000</td>
<td>13,500</td>
<td>4,500</td>
</tr>
<tr>
<td>Less: Opening Stock</td>
<td>142,900</td>
<td>156,500</td>
<td>112,300</td>
<td>61,140</td>
</tr>
<tr>
<td>Purchase Quantity</td>
<td>122,900</td>
<td>126,500</td>
<td>97,300</td>
<td>56,140</td>
</tr>
<tr>
<td>Price (%)</td>
<td>0.55</td>
<td>0.50</td>
<td>0.35</td>
<td>0.60</td>
</tr>
<tr>
<td>Total Qty. Required</td>
<td>67,595</td>
<td>63,250</td>
<td>34,055</td>
<td>33,684</td>
</tr>
</tbody>
</table>
ILLUSTRATION 10-4

Musa Saliu Plc manufactures three products: A, B and C. You are required:
(a) Using the information given below, to prepare budgets for the month of January for:
   (i) sales in quantity and value, including total value;
   (ii) production quantities;
   (iii) material purchases in quantity and value, including total value.
   Particular attention should be paid to your layout of the budgets.

(b) To explain the term 'principal budget factor' and state what it was assumed to be in (a) of this question.
Data for preparation of January Budgets

<table>
<thead>
<tr>
<th>Sales</th>
<th>Product</th>
<th>Quantity</th>
<th>Unit Price</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>1,000</td>
<td>₦100</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>2,000</td>
<td>₦120</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1,500</td>
<td>₦140</td>
</tr>
</tbody>
</table>

Materials used in the company's products are:

<table>
<thead>
<tr>
<th>Material</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit Cost</td>
<td>₦4</td>
<td>₦6</td>
<td>₦9</td>
</tr>
</tbody>
</table>

Quantities used in:

<table>
<thead>
<tr>
<th>Product</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity: units</td>
<td>4</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Product A</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Product B</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Product C</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Finished stocks:

<table>
<thead>
<tr>
<th>Product</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantities: 1 January</td>
<td>1,000</td>
<td>1,500</td>
<td>500</td>
</tr>
<tr>
<td>31 January</td>
<td>1,100</td>
<td>1,650</td>
<td>550</td>
</tr>
</tbody>
</table>

Material stocks:

<table>
<thead>
<tr>
<th>Material</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>26,000</td>
<td>20,000</td>
<td>12,000</td>
</tr>
<tr>
<td>Units</td>
<td>31,200</td>
<td>24,000</td>
<td>14,400</td>
</tr>
</tbody>
</table>
### Suggested Solution 10-4

**Musa Salih Plc**

**Sales Budget**

<table>
<thead>
<tr>
<th></th>
<th>Sales Qty</th>
<th>Price</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1,000</td>
<td>100</td>
<td>100,000</td>
</tr>
<tr>
<td>B</td>
<td>2,000</td>
<td>120</td>
<td>240,000</td>
</tr>
<tr>
<td>C</td>
<td>1,500</td>
<td>140</td>
<td>210,000</td>
</tr>
<tr>
<td><strong>Total sales budget</strong></td>
<td><strong>550,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Production Quantity Budget**

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales unit from sales budget</td>
<td>1,000</td>
<td>2,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Add: Closing stock (units)</td>
<td>1,100</td>
<td>1,650</td>
<td>550</td>
</tr>
<tr>
<td>Less: Opening stock (units)</td>
<td>1,000</td>
<td>1,500</td>
<td>500</td>
</tr>
<tr>
<td><strong>Required production</strong></td>
<td>1,100</td>
<td>2,150</td>
<td>1,550</td>
</tr>
</tbody>
</table>

**Material Usage Budget (Quantity)**

<table>
<thead>
<tr>
<th>Product</th>
<th>Production Units</th>
<th>M1 Unit per Product</th>
<th>Total</th>
<th>M2 Unit per Product</th>
<th>Total</th>
<th>M3 Unit per Product</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.100</td>
<td>4</td>
<td>4,400</td>
<td>2</td>
<td>2,200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B</td>
<td>2.150</td>
<td>3</td>
<td>6,450</td>
<td>3</td>
<td>6,450</td>
<td>2</td>
<td>4,300</td>
</tr>
<tr>
<td>C</td>
<td>1.550</td>
<td>2</td>
<td>3,100</td>
<td>1</td>
<td>3,100</td>
<td>1</td>
<td>1,550</td>
</tr>
<tr>
<td></td>
<td><strong>13,950</strong></td>
<td></td>
<td><strong>10,200</strong></td>
<td></td>
<td><strong>5,850</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Material Purchases Budget (Quantity & Value)**

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage from budget</td>
<td>13,950</td>
<td>10,200</td>
<td>5,850</td>
</tr>
<tr>
<td>Add: Closing stock (units)</td>
<td>31,200</td>
<td>24,000</td>
<td>14,400</td>
</tr>
<tr>
<td>Less: Opening Stock</td>
<td>19,150</td>
<td>14,200</td>
<td>8,250</td>
</tr>
<tr>
<td>Unit Cost</td>
<td>(\times$4)</td>
<td>(\times$6)</td>
<td>(\times$9)</td>
</tr>
<tr>
<td></td>
<td><strong>₦76,600</strong></td>
<td><strong>₦85,200</strong></td>
<td><strong>₦74,250</strong></td>
</tr>
<tr>
<td></td>
<td><strong>₦236,050</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The limiting factor in this question is sales.
10.5 TECHNIQUES USED IN BUDGETING

10.5.1 Flexible budget

CIMA defines a flexible budget as "a budget which is designed to change in accordance with the level of activity attained".

A flexible budget recognizes the existence of fixed, variable and semi-variable costs and it is designed to change in relation to the actual volume or output or level of activity in a period. The principles underlying the flexible budget are:

(i) **To prepare “contingency plans” in advance:** Flexible budgets are prepared for a range of activity rather than for a single level of activity (although the most probable activity level becomes unavoidable/desirable during the course of the year, management automatically adapts itself to the change by switching to a more appropriate flexible budget as the new budget master plan;

(ii) **Budgetary control:** Flexible budgeting is fundamental to budgetary control. Control is not achievable with a fixed budget. In fixed budgets control, the budgets prepared are based on one level of output, a level which has been carefully planned to equate sales and production at the most profitable rate. If the level of output actually achieved differs considerably from that budgeted, large variances will arise. Basically the idea of a flexible budget is that there shall be some standard of expenditure from varying levels of output.

The concept of flexible budget was to focus on how control could be achieved over operations. In a flexible budget, overheads are analysed into three, namely:

(a) Fixed;

(b) Variable; and

(c) Semi variable.
ILLUSTRATION 10-5
Binta Kabiru is operating a system of Flexible Budgetary Control.

Her budget for the year is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Levels of Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>70%</td>
</tr>
<tr>
<td></td>
<td>700 units</td>
</tr>
<tr>
<td>Prime cost</td>
<td>14,000</td>
</tr>
<tr>
<td>Variable Selling Overhead</td>
<td>2,100</td>
</tr>
<tr>
<td>Semi Variable Selling Overhead Distribution</td>
<td>3,400</td>
</tr>
<tr>
<td>Other Fixed Overhead</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24,500</strong></td>
</tr>
</tbody>
</table>

You are required to present the above to the management, separating the semi variable overhead to variable and fixed and also include the cost of "attaining 120% level of activity". Fixed costs remain unchanged.

SUGGESTED SOLUTION 10-5

BINTA KABIRU LIMITED

<table>
<thead>
<tr>
<th></th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
<th>120%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Cost</td>
<td>14,000</td>
<td>16,000</td>
<td>18,000</td>
<td>20,000</td>
<td>24,000</td>
</tr>
<tr>
<td>Variable O’hd Prod’n</td>
<td>2,100</td>
<td>2,400</td>
<td>2,700</td>
<td>3,000</td>
<td>3,600</td>
</tr>
<tr>
<td></td>
<td>16,100</td>
<td>18,400</td>
<td>20,700</td>
<td>23,000</td>
<td>27,600</td>
</tr>
<tr>
<td>Variable Selling</td>
<td>1,400</td>
<td>1,600</td>
<td>1,800</td>
<td>2,000</td>
<td>2,400</td>
</tr>
<tr>
<td>Total Variable Cost</td>
<td>17,500</td>
<td>20,000</td>
<td>22,500</td>
<td>25,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>7,000</td>
<td>7,000</td>
<td>7,000</td>
<td>7,000</td>
<td>7,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>24,500</strong></td>
<td><strong>27,000</strong></td>
<td><strong>29,500</strong></td>
<td><strong>32,000</strong></td>
<td><strong>37,000</strong></td>
</tr>
</tbody>
</table>

**Working:**

Calculation of variable and fixed cost using high or low point method

<table>
<thead>
<tr>
<th>Qty</th>
<th>Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1,000</td>
</tr>
<tr>
<td>Low</td>
<td>700</td>
</tr>
</tbody>
</table>

\[
\text{VC/Unit} = \frac{600}{300} = \text{₦2}
\]

Therefore, variable cost per unit = ₦2
Fixed cost

<table>
<thead>
<tr>
<th></th>
<th>Qty</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Variable (1,000 x 2)</td>
<td></td>
<td>2,000</td>
</tr>
<tr>
<td>Fixed cost</td>
<td>=</td>
<td>2,000</td>
</tr>
</tbody>
</table>

**ILLUSTRATION 10-6**

Sales Director of Hamid Tahir Kabir Box Fabricators has become aware of the disadvantages of static budget. The director asks you as the Management Accountant to prepare a flexible budget for October 2010 for its main brand of boxes.

The following data are available for the actual operation in September 2010:

- Boxes produced and sold: 4,500 units
- Direct Materials costs: ₦180,000
- Direct Manufacturing Labour Costs: ₦135,000
- Depreciation and other fixed Manufacturing costs: ₦101,400
- Average selling price per box: ₦140
- Fixed marketing costs: ₦162,700

Assume no stock of boxes at the beginning or end of the period. A 10% increase in the selling price is expected in October. The only variable marketing cost is a commission of ₦0.50k per unit paid to the manufacturer's representatives, who bear all their own costs of traveling, entertaining customers, etc. A patent royalty of ₦2 per unit manufactured is paid to an independent design firm. Salary increases that will become effective in October are ₦12,000 per year for the production supervisor and ₦15,000 per year for Sales Manager. A 10% increase in direct materials prices is expected to become effective in October. No changes are expected in direct manufacturing labour wage rates or in the productivity of the direct manufacturing labour personnel standard costs for any of its inputs.

**You are required to:**

Prepare a flexible budget for October 2010 showing budgeted amounts at each of these output levels of boxes: 4,000 units, 5,000 units and 6,000 units.
SUGGESTED SOLUTION 10-6

HAMID TAHIR KABIR FABRICATIONS LIMITED
FLEXIBLE BUDGET FOR THE MONTH OF OCTOBER 2010

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>4,000 units</th>
<th>5,000 units</th>
<th>6,000 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>616,000</td>
<td>770,000</td>
<td>924,000</td>
</tr>
<tr>
<td>Less Direct Material Cost</td>
<td>(176,000)</td>
<td>(220,000)</td>
<td>(264,000)</td>
</tr>
<tr>
<td>Direct Labour Cost</td>
<td>(120,000)</td>
<td>(150,000)</td>
<td>(180,000)</td>
</tr>
<tr>
<td>Marketing Variable</td>
<td>(2,000)</td>
<td>(2,500)</td>
<td>(3,000)</td>
</tr>
<tr>
<td>Royalties</td>
<td>(8,000)</td>
<td>(10,000)</td>
<td>(12,000)</td>
</tr>
<tr>
<td><strong>Variable Costs</strong></td>
<td><strong>(306,000)</strong></td>
<td><strong>(382,500)</strong></td>
<td><strong>(459,000)</strong></td>
</tr>
<tr>
<td>Contribution</td>
<td>310,000</td>
<td>387,500</td>
<td>465,000</td>
</tr>
<tr>
<td>Less: Fixed Costs</td>
<td>(266,350)</td>
<td>(266,350)</td>
<td>(266,350)</td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td><strong>43,650</strong></td>
<td><strong>121,150</strong></td>
<td><strong>198,650</strong></td>
</tr>
</tbody>
</table>

WORKINGS

STATEMENT OF COST

<table>
<thead>
<tr>
<th></th>
<th>SEPTEMBER</th>
<th>OCTOBER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material cost</td>
<td>40.00</td>
<td>44.00</td>
</tr>
<tr>
<td>Direct labour cost</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Marketing variable cost</td>
<td>0.50</td>
<td>0.50</td>
</tr>
<tr>
<td>Royalties</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>Total variable cost</strong></td>
<td><strong>72.50</strong></td>
<td><strong>76.50</strong></td>
</tr>
<tr>
<td>Fixed Cost-Depreciation</td>
<td>101,400</td>
<td>101,400</td>
</tr>
<tr>
<td>Marketing</td>
<td>162,700</td>
<td>162,700</td>
</tr>
<tr>
<td>Increase in salary - production</td>
<td>-</td>
<td>1,000</td>
</tr>
<tr>
<td>Increase in salary –marketing</td>
<td>-</td>
<td>1,250</td>
</tr>
<tr>
<td></td>
<td>264,100</td>
<td>266,350</td>
</tr>
<tr>
<td>Selling Price</td>
<td>140</td>
<td>154</td>
</tr>
</tbody>
</table>

ILLUSTRATION 10-7

Abdul Wada Katsina Nigeria Limited had the following budgeted sales and production units for the first three quarters of the year ending 31 December 2010.

<table>
<thead>
<tr>
<th>Quarters</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Units</td>
<td>Units</td>
<td>Units</td>
</tr>
<tr>
<td>Sales</td>
<td>1,000</td>
<td>1,200</td>
<td>1,500</td>
</tr>
<tr>
<td>Production</td>
<td>1,200</td>
<td>1,500</td>
<td>1,800</td>
</tr>
</tbody>
</table>
The standard selling price is N50 per unit, and the budgeted costs, based on the production output figures for the first three quarters are:

<table>
<thead>
<tr>
<th>Quarters</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Direct material</td>
<td>12,000</td>
<td>15,000</td>
<td>18,000</td>
</tr>
<tr>
<td>Direct labour</td>
<td>24,000</td>
<td>30,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Production overhead</td>
<td>14,000</td>
<td>15,500</td>
<td>17,000</td>
</tr>
<tr>
<td>Selling and administration Overhead</td>
<td>6,700</td>
<td>7,000</td>
<td>7,300</td>
</tr>
</tbody>
</table>

Depreciation included in overhead costs is:
Production overhead - N2,000 per quarter;

Selling and administration overhead - N500 per quarter.
In the fourth quarter, the unit cost for direct labour is budgeted to reduce it to 80% of the unit cost in the third quarter. The unit cost of direct materials in the fourth quarter is budgeted to increase by 10% over that of the third quarter. The variable portion of costs fluctuates with output; the fixed portions are not affected by output levels.

Sales in the fourth quarter are uncertain and could be within the range of 2,000 to 2,500.

Customers are allowed a two month credit period and suppliers of direct materials allow three months credit. Wages and overheads are paid as incurred.

**Required:**

(a) Prepare flexible budget figures for the fourth quarter showing Sales, Cost and Profit figures, assuming Sales and Production to be:

(i) 2,000 units;
(ii) 2,200 units; and
(iii) 2,500 units.

Overhead costs should be analyzed under variable and fixed headings with supporting calculations.

(b) Show the budgeted cash flow figures for the fourth quarter for the three Sales and Production levels in (a) above.
**SUGGESTED SOLUTION 10-7**

**ABDUL WADA KATSINA NIGERIA LIMITED**

(a) **FLEXIBLE BUDGET FOR THE FOURTH QUARTER**

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>2,000</th>
<th>2,200</th>
<th>2,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Units</td>
<td>Units</td>
<td>Units</td>
</tr>
<tr>
<td>Sales revenue (N50 per unit)</td>
<td>100</td>
<td>110</td>
<td>125</td>
</tr>
<tr>
<td><strong>Variable Costs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Material (N10+10%=N11 per unit)</td>
<td>22.0</td>
<td>24.2</td>
<td>27.2</td>
</tr>
<tr>
<td>Direct labour (N20 per unit x 80%)</td>
<td>(32.0)</td>
<td>(35.2)</td>
<td>(40.0)</td>
</tr>
<tr>
<td>Production overhead (N5 per unit – W(i) selling and administration)</td>
<td>(10.0)</td>
<td>(11.0)</td>
<td>(12.5)</td>
</tr>
<tr>
<td>Overhead (N1 per unit – W (i))</td>
<td>(2.0)</td>
<td>(2.2)</td>
<td>(2.5)</td>
</tr>
<tr>
<td><strong>Contribution</strong></td>
<td>34.0</td>
<td>37.4</td>
<td>42.5</td>
</tr>
<tr>
<td><strong>Less: Fixed Costs:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Production overhead [(W(i)]</td>
<td>8.0</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Selling and administration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead W(i)</td>
<td>5.5</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td><strong>NET PROFIT</strong></td>
<td>20.5</td>
<td>23.9</td>
<td>29.0</td>
</tr>
</tbody>
</table>

**Working (i)**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Incurred 1,200 units (a)</th>
<th>Increased 1,500 units (b)</th>
<th>Variable in cost for 300 units (c)</th>
<th>Total Variable cost per unit (b ÷ 300)</th>
<th>Balance cost for 1,500 units. (1,500 x c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production overhead</td>
<td>14,500</td>
<td>15,500</td>
<td>1,500</td>
<td>5</td>
<td>7,500</td>
</tr>
<tr>
<td>Selling and Admin. Overhead</td>
<td>6,700</td>
<td>7,000</td>
<td>300</td>
<td>1</td>
<td>1,500</td>
</tr>
</tbody>
</table>

**OR**

**Alternative Working (ii)**

1. Calculation of Direct materials cost per unit
2. Calculation of Direct labour cost per unit

\[
\frac{36,000}{1,800} \times 80\% = \text{₦} 16 \text{ per unit}
\]

3. Separation of production overhead cost into fixed and variable element using High and Low method.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1,800</td>
</tr>
<tr>
<td>Low</td>
<td>1,200</td>
</tr>
<tr>
<td>Difference</td>
<td>600</td>
</tr>
</tbody>
</table>

Variable production overhead per unit = \( \frac{3000}{600} = \text{₦} 5 \) per unit

Fixed production overhead = \( \text{₦} 17,000 \times (\text{₦} 5 \times 1,800) = \text{₦} 8,000 \)

4. Calculation of variable selling and administration overhead using high and low method.

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>Cost (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>1,800</td>
</tr>
<tr>
<td>Low</td>
<td>1,200</td>
</tr>
<tr>
<td>Difference</td>
<td>600</td>
</tr>
</tbody>
</table>

Variable selling and administration overhead

\[
= \frac{\text{₦} 600}{600} = \text{₦} 1 \text{ per unit}
\]

Fixed selling and administration overhead

\[
= \text{₦} 7,300 \times (\text{₦} 1 \times 1,800) = \text{₦} 5,500
\]

(b) **Budgeted cash flow for the fourth quarter**

<table>
<thead>
<tr>
<th>Cash Receipts</th>
<th>Debtors</th>
<th>(2/3 x (₦50 x 1,500)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units</td>
<td>Units</td>
<td>Units</td>
</tr>
<tr>
<td>₦'000</td>
<td>₦'000</td>
<td>₦'000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2,000</th>
<th>2,200</th>
<th>2,500</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>(2/3 x (₦50 x 1,500)</th>
<th>50.00</th>
<th>50.00</th>
<th>50.00</th>
</tr>
</thead>
</table>
1 month from 4th quarter
(1/3 x sales for quarter) 33.30 36.67 41.67
83.30 86.67 91.67

Cash Disbursement
Creditors
- 3rd quarter purchases 18.0 18.0 18.0
Variable direct labour 32.0 35.2 40.0
Variable production overhead 10.0 11.0 12.5
Variable selling and
administration overhead 2.0 2.2 2.5
Fixed production overhead
(excluding depreciation) 6.0 6.0 6.0
Fixed selling and
administration overhead
(excluding depreciation) 5.0 5.0 5.0
73.0 77.4 84.0
Net cash flow 10.33 9.27 7.67

ILLUSTRATION 10-8

Prepare a flexible budget from the following information for Mallama
Dije Kurawa Limited. Possible levels of activity are:

<table>
<thead>
<tr>
<th></th>
<th>Up to 150,000 units</th>
<th>150,000 to 180,000 units</th>
<th>180,000 to 200,000 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales price</td>
<td>₦2.00</td>
<td>₦2.00</td>
<td>₦1.50</td>
</tr>
<tr>
<td>Variable Unit Costs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>₦0.80</td>
<td>₦0.70</td>
<td>₦0.40</td>
</tr>
<tr>
<td>Labour</td>
<td>₦0.40</td>
<td>₦0.40</td>
<td>₦0.20</td>
</tr>
<tr>
<td>Overhead</td>
<td>₦0.20</td>
<td>₦0.20</td>
<td>₦0.15</td>
</tr>
<tr>
<td>Fixed Costs</td>
<td>₦60,000.00</td>
<td>₦60,000.00</td>
<td>₦80,000.00</td>
</tr>
</tbody>
</table>

SUGGESTED SOLUTION 10-8

Mallama Dije Kurawa Limited

<table>
<thead>
<tr>
<th>Level of Activity (in units)</th>
<th>150,000 units</th>
<th>180,000 units</th>
<th>200,000 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Price per unit</td>
<td>₦2.00</td>
<td>₦2.00</td>
<td>₦1.50</td>
</tr>
<tr>
<td>Estimated Sales Revenue</td>
<td>300,000</td>
<td>360,000</td>
<td>300,000</td>
</tr>
<tr>
<td>Variable Costs Material</td>
<td>(120,000)</td>
<td>(126,000)</td>
<td>(80,000)</td>
</tr>
<tr>
<td>Variable Costs Labour</td>
<td>(60,000)</td>
<td>(72,000)</td>
<td>(40,000)</td>
</tr>
<tr>
<td></td>
<td>(30,000)</td>
<td>(36,000)</td>
<td>(30,000)</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Overhead Contribution</td>
<td>90,000</td>
<td>126,000</td>
<td>150,000</td>
</tr>
<tr>
<td>Less: Fixed Cost</td>
<td>(60,000)</td>
<td>(60,000)</td>
<td>(80,000)</td>
</tr>
<tr>
<td>Net Profit</td>
<td>30,000</td>
<td>66,000</td>
<td>70,000</td>
</tr>
</tbody>
</table>

**10.5.2 Zero-base budget (ZBB) or "priority based budgeting"**

ZBB is a budgeting technique which seeks to eliminate the draw backs of traditional incremental budgeting by taking the budgets for service or overhead centres back to a minimal operating level and then requiring increments above this level to be quantified and justified.

'A method of budgeting which requires each cost element to be specifically justified, as though, the budget related were being undertaken for the first time, without approval, the budget allowance is zero" CIMA

ZBB was introduced in the early 1970s in the United States by O. Pharr. It gained prominence because of the fact that it is based on common sense. President Carter, the then President of the United States, directed all US government departments to adopt this technique.

ZBB is concerned with the evaluation of the costs and benefits of alternatives and, implicit in the technique, is the concept of opportunity cost.

**ZBB is applied in three stages:**

(i) **The decision unit:** This means subdividing the organisation into discrete sub-units where operations can be meaningfully and individually identified and evaluated.

(ii) **The decision packages:** Each decision unit manager submits no less than three budget packages, namely: (a) the lowest level of expenditure, (b) the expenditure required to maintain levels of activity and (c) the expenditure required to provide an additional level of service or activity.

(iii) Agreed packages will form the budget.
Advantages of ZBB

(i) Results in a more efficient allocation of resources to activities and departments.

(ii) It focuses attention on value for money.

(iii) ZBB develops a questioning attitude which enables management to determine inefficiency.

(iv) It may lead to cost reduction.

(v) Managers' performances can be monitored.

Disadvantages of ZBB

(i) ZBB is a time consuming process and generates volume of paperwork especially for the decision packages.

(ii) It requires management skill in both drawing decision packages and for the ranking process.

(iii) It encourages the wrong impression that all decisions have to be made in the budget.

(iv) Trade Union always go against ZBB, because they prefer the status quo to remain.

(v) Co-ordination of all activities may be difficult.

10.5.3 Activity based budgeting (ABB)

Activity based budgeting (ABB) which is also known as Activity Cost Management is defined as "A method of budgeting based on an activity framework and utilising cost driver data in the budget-setting and variance feedback processes" (ICMA).

It is a part of planning and control system which tends to support the objectives of continuous improvement. ABB is a form of development of conventional budgeting system. It is also based on activity analysis techniques.

ABB FEATURES

(a) It recognises activities that drive costs with the aim of controlling the causes of cost directly rather than the costs themselves. It enables costs to be managed and understood in the long run.
(b) ABB differentiates and examines activities for their value adding potentials.

(c) The department activities are driven by demands and decisions which are beyond the control of the budget holder.

(d) It encourages immediate and relevant performance measures required than are found in conventional budgeting systems.

**Advantages of ABB**

(i) It provides stronger links between an organisation’s strategic objectives.

(ii) It has ability to tackle cross organisational issues through a participating approach.

(iii) It also uses activity analysis techniques which promote continuous improvement.

**10.5.4 Planning, Programming, Budgeting System (PPBS)**

PPBS analyses the output of a given programme and also seeks for the alternatives to find the most effective means of reaching basic programme activities.

PPBS involves the preparation of a long-term corporate plan that clearly establishes the objectives that the organisation have to achieve. PPBS is the counter part of the long-term process for profit-oriented organisations.

**Aims and Objectives of PPBS**

(i) The aim of PPBS is to enable the management of a non-profit making organization to make more informed decision about the allocation of resources to meet the overall objectives of the organization.

(ii) It enables the management to identify the activities, functions or programmes to be provided thereby establishing a basis for evaluation of their worthiness.

(iii) PPBS provides information that will enable management to assess the effectiveness of its plans.
Stages In PPBS

(i) Calls for a careful specification and overall objectives are made.

(ii) Identify programmes that will achieve these objectives and those programmes which are normally related to the major activities undertaken by government establishments.

(iii) The costs and benefits of each programme are determined, so that budget allocations can be made on the basis of the cost-benefit of the programme.

(iv) Analyses, the alternatives to find the most effective means of reaching basic programme objectives.

(v) These analytical procedures will be established as to systematically form part of budgetary control.

10.5.5 Continuous Budget/Rolling Budget

Continuous budget which is known as rolling budget is a system of budgeting that involves continuously updating budgets by reviewing the actual results of a specific period in the budget and determining a budget for the corresponding time period. It has been described as an attempt to prepare targets and plans which are more realistic and certain by shortening the period of budget preparations. Under this method, instead of preparing a budget annually, there would be budget every three or six months so that as the current period ends, the budget is extended by an extra period; for example, if a continuous budget is prepared every three months, the first three months would be planned in great details and the nine months in lesser details, because of the greater uncertainty about the longer term future. This means that, if a first continuous budget is prepared for April to June, in details to March, in less detail a new budget will be prepared towards the end of June to cover June to September in details and October of the following year in lesser details.

Advantages of Continuous Budget / Rolling Budget

(a) Management is made to be continuously aware of the budgetary process since the figures for the next 12 months are always made available.
(b) It allows for more frequent assessment and revision of the budgets in the light of current trends particularly during the period of inflation, thus, the budget does not become quickly obsolete or outdated.

Disadvantage of Continuous Budget / Rolling Budget

Higher costs and efforts are required for continuous budget due to lack of co-operation and negative attitude of the operating managers to the control techniques. Managers' personal objectives also override the goal congruence of the organisation. This negative and dysfunctional attitude of managers manifest at both the planning stage and implementation stage.

Stages in Budget Preparation

These are:

(a) **Planning Stage**: Assuming the operating managers are involved in preparing a budget; they may:

(i) Intentionally build in slack in the budget.

(ii) Express the opinion that budget is time wasting and that they are always busy to prepare the budget.

(iii) Argue that formalising a budget on paper is too restrictive and that they should be granted some flexibility in making their operational decisions.

(iv) Frequently, prefer incremental system of budgeting to considering alternative options and new ideas.

(v) Have in mind that the budget is unattainable, that is, having negative idea about the achievement of the budget.

(b) **Implementation Stage**

(i) Lack of co-operation and co-ordination with other budget centres.

(ii) Putting in less effort to achieve budget targets without putting all efforts to achieve more than budgeted.

(iii) Managers may disregard a control report which shows negative variances.

(iv) Lack of controlling cost to achieve their own selfish end.

(v) Having much interest in short-term factors to the detriment of more important longer term consequences.
(vi) Blaming budgeting systems for any problems which may occur.

10.6 SOLVING BEHAVIOURAL PROBLEMS IN BUDGETING

(a) Motivation

Horngren (1996) defines motivation as the "need, some selected goal and the resulting drive that influence action towards the goal". He suggested that motivation has two aspects:

(i) Direction or goal congruence exists when managers working in their own best interest also are in harmony with the goals of top management (that is, the organisation as a whole). It is very difficult to obtain the goal congruence in an organization. This is one of the essentially behavioural problems in budgeting.

(ii) Strength with getting subordinates to run rather than work towards the desired goal. Incentive improves the performance of employees and helps to reduce personal or departmental objective.

Motivation helps to improve business results and eliminate misdirected or dysfunctional operation. Horngren argues that accounting system must be designed in such a way as to achieve a motivational response from its use, provided that the costs of providing such a system do not outweigh the expected results. He also acknowledges that human behaviour is inclined to damage the usefulness of formal accounting system.

(b) Participation

Participation by employees in budget setting and the encouragement of a human approach and man - management would remove the drawbacks to effective budgeting. All the operators of the budget should be fully involved in the preparation of the budget.

Participation leads to more positive attitude and higher performance.

Kenis (1979) reports a positive correlation of attitude and performance with participation, while scholars such as Bryan, Locke, Stedry and others, show a negative relationship between participation and performances.

Argyris (1952) on the other hand cautioned against the level of participation, as different organisations use the word participation to describe quite different activities. He suggested that the involvement
of managers should be total, otherwise pseudo-participation could lead to counter-productive results.

(c) **Goal Congruence**

Goal congruence means alignment of individual interest of managers to the overall objective of an organisation. This overall objective should not conflict with the individual or group objectives entirely but recognition must be given to the fact that organisational objectives cannot be set and implemented through budgeting without consideration of the interaction of individual group and departmental objectives.

Hopwood’s (1976) emphasised that there are many problems in achieving goal congruence because:

(i) There may be numerous objectives in one organisation, some of which may conflict.

(ii) Different managers may perceive their objectives differently.

(iii) Departmental rivalries.

(iv) Different and conflicting reward structures.

Other practical realities make perfect goal congruence extremely unlikely.

Efforts should be made to educate both top management and middle management on the importance of goal congruence.

(d) **Management Support**

Top management should be interested in the budgetary system in order to ensure that operating managers give the necessary co-operation.

(e) **Reporting System**

Efforts should be made to isolate uncontrollable cost from controllable ones in order to have meaningful variances reporting system.

(f) **Communicating**

Communication should be adequate with the operating managers at all stages of the budgetary system.
10.7 FORECAST

According to CIMA, forecast is defined as “The technique of business forecasting has been developed to give a logical and comprehensive means of providing management with information to determine the most advantageous plans which can be made within the anticipated resources of the business.” (CIMA).

Despite the uncertainty that exists about the future, business plans are prepared to resolve some of this uncertainty.

10.7.1 Distinction between forecast and budgets

A forecast states the events which are likely to occur in the future while a budget states the plans which the managers will endeavour to turn into actual events. It is a statutory executive order.

10.7.2 Forecasting procedures

There is more than one way of arriving at the sales forecasts. Probably the most satisfactory approach is to use all available methods; each result then provides a check on the others.

Three possible approaches are:

(a) Assessments by staff of sales department: Estimates should be made by the individual salesmen and passed upwards to the sales manager. The advantage of this method is that individual salesmen can give consideration to the particular factors which are relevant in their areas.

(b) Mathematical analysis of past sales: Such analyses should indicate trends and seasonal variations. This information can be adjusted for known factors, such as increased advertising, to give a forecast of future sales.

(c) Senior management judgment: The senior management team, including production manager, administrative manager etc., will meet to discuss sales prospects. The approach brings a variety of skills and experience to the forecasting exercise.

The sales budget will be determined by reference to the sales forecast. However, the budget should be prepared in the light of any constraints on the amount that can be produced.
10.8 BUDGETARY CONTROL

There is a difference between a budget and budgetary control/budgeting. A budget is just an integral part of budgetary control/budgeting. Budgetary control is defined as: "a system of controlling costs which includes the preparation of budgets, coordinating the departments and establishing responsibilities, comparing actual performance with that budgeted and acting upon results, to achieve maximum profitability" (CIMA).

Budgetary control is also defined as, “the establishment of budgets relating the responsibilities of executive to the requirements of a policy, and the continuous comparison of actual with budgeted results either to secure by individual action the objective of that policy or to provide a basis for its revision”.

Certain fundamental principles can be outlined from the above definitions of budgetary control:

(a) Establish a plan or target of performance which co-ordinates all the activities of the business;

(b) Record the actual performance;

(c) Compare the actual performance with that planned;

(d) Calculate the differences or variances, and analyse the reasons for them; and

(e) Act immediately, if necessary, to remedy the situation.

10.8.1 The objectives of budgetary control

These are to:

(a) Combine the ideas of all levels of management in the preparation of the budget;

(b) Co-ordinate all activities of the business;

(c) Centralise control;

(d) Decentralise responsibility of each of the managers involved;

(e) Act as a guide for management decisions, when unforeseeable conditions affect the budget;

(f) Plan and control income and expenditure so that maximum profitability is achieved;
(g) Direct capital expenditure in the most profitable way;
(h) Ensure that sufficient working capital is available for the efficient operation of the business;
(i) Provide a yardstick against which actual results can be compared; and
(j) Show management which action is needed to remedy a situation.

10.8.2 Organisation for budgetary control

These include:

(a) **The Preparation of an Organisation Chart**: This defines the functional responsibilities of each member of management and ensures that he knows his position in the company and his relationship to other members.

(b) The Budget Period is the time to which the plan of action relates. Periodic budgets cover a fixed period of time, most commonly one year. They will be divided into shorter time periods, known as: control periods, for purposes of reporting control. With a one-year period budget, control periods may be 4 weeks [13 periods each year] or one month [12 periods each year]. Long-term budgets [for example, capital expenditure budgets] may be for periods of up to five, ten years, or even longer.

(c) **Budget Manual**: The organisation for budgeting [and budgetary control] should be documented in a budget manual, which has been described as a "procedure or rule book which sets out standing instructions governing the responsibilities of persons, and the procedures, forms and records relating to the preparation and use of budgets". (CIMA)

Even though organizations are different, the content of a manual include:

(a) Description of budgetary planning and control;
(b) Goals of each level of the budgetary process;
(c) Association with long term planning;
(d) Nature of organogram depicting duties and level of budget officers;
(e) Analysis of relevant budgets and association with accounting activities;

(f) Description of principal budgets;

(g) Composition of budget committee and mode of operation;

(h) Modalities for the preparation and publication of budget;

(i) Designation and responsibility of the budget manager;

(j) Chart for codes;

(k) Design and nature of form; and

(l) Mode of operation especially where they concern procedures for accounting, preparation of reports and deadline for the submission of such reports/budgets.

(d) **Budget Committee:** The overall responsibility for budget preparation and administration should be given to a Budget Committee, normally chaired by the chief executive of the organisation, with departmental heads or senior managers as members. The purpose of the committee is to:

(i) Ensure the active co-operation of departmental managers and to act as a forum in which differences of opinion can be argued out and reconciled;

(ii) Ensure that managers in the organisation understand what other departments are trying to do;

(iii) Establish long-term plans around which the budgets should be built, and then to identify budget objectives;

(iv) Review departmental budgets; and

(v) During the year, examine reports showing actual performance compared with budget and expectations.

(e) **The Budget Officer:** He controls the budget administration on a day to day basis. He will be responsible to the budget committee and should ensure that its decisions are transmitted to the appropriate people and relevant data and opinions are presented for its consideration. He will normally have the vital jobs of educating and selling the budget idea. Since the master budget is summarised in cost statements and financial reports the budget officer is usually an accountant.
(f) The Introduction of Adequate Accounting & Records: It is imperative that the accounting system should be able to record and analyse the information required. A chart of accounts should be maintained which corresponds with the budget centres.

(g) The General Instruction on Techniques to all concerned in Operating the System: Each person must feel that he is capable of carrying out the budgeted programme.

(h) Budget Centres: An organisation’s planned activities are divided into separate areas known as budget centres or cost centres. Each area selected as a budget centre must be clearly definable, and should be the natural responsibility of one particular manager (or supervisor). A separate budget is prepared for each budget (or cost) centre. The ‘budget centre budgets’ are known as departmental budgets. Departmental budgets are often used to build up budgets for overhead costs, that is:

(i) The production overhead budget will be compiled from separate budgets for the production departments, maintenance, production planning, quality control, etc.

(ii) The administration budget will be compiled from separate budgets for personnel, finance, management services, information technology, etc.

(iii) The selling and distribution budget will be the amalgamation of budgets prepared by sales office managers, marketing managers, warehouse and transport managers.

(iv) The research and development budget.

(i) Principal Budget Factor: This is also known as the key budgeting factor or limiting budget factor. The first task in budgeting is to identify the factors which impose limitation or ceiling on the level of activity. It is usually sales demand; but it may also be limitations on any resource-materials, labour, machine time, working capital, etc. Once this factor is defined, the rest of the budget can be prepared. It determines priorities in functional budgets, for example, it may be material, labour or plant.

Management may not know in advance which is the principal
budget factor. One method to identify this factor is to prepare a draft sales budget, and then consider whether any resource shortage prevents this level of sales from being met.

(j) Level of Activity: It will be necessary to establish the normal level of activity, that is, the level the company can reasonably be expected to achieve: quantity to produce, quantity to be sold, etc.

10.9 SUMMARY AND CONCLUSIONS

Budgeting or short term planning is the process by which the long term corporate plan is converted into action or activities.

A budgetary system ensures co-ordination, assignment of responsibilities, communication, control, motivation, direction and goal congruency. This will help to avoid sub-optimality.

A budgetary system must fulfill the following conditions for it to be successful: support of the top management, clear definition, full involvement of everyone at all levels, appropriate accounting system put in place and administration in a flexible manner.

Of importance to any budgeting activity is the availability of budget manual, budget committee and budget officer. All the various budgets are related and composite to form the master budget.

The various methods adopted in budgeting are zero base budgeting (ZBB), programme planning and budgeting systems (PPBS), Incremental budgeting method, rolling budget, etc.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

10.10 REVISION QUESTIONS

10.10.1 MULTIPLE CHOICE AND SHORT ANSWER QUESTIONS

1. When preparing a production budget, the quantity to be produced equals

A sales quantity + opening stock + closing stock
B sales quantity - opening stock + closing stock
C sales quantity - opening stock - closing stock
D sales quantity + opening stock - closing stock
E sales quantity.
2. ABIBATU Limited is currently preparing its production budget for Product Z for the forthcoming year. The sales director has confirmed that he requires 60,000 units of Product Z. Opening stock is estimated to be 6,500 units and the company wishes to reduce stock at the end of the year by 50%. How many units of Product Z will need to be produced?
   A  56,750 units
   B  60,000 units
   C  63,250 units
   D  66,500 units
   E  67,250 units.

3. The budgeting process is:
   A  Purely a marketing function
   B  Purely a production function to forestall products deficiency
   C  Purely a purchasing function
   D  An overall company function moderated by the Accountant
   E  Purely an accounting function.

4. A zero-based budget:
   A  is prepared up without regard to historical records.
   B  figures are rounded up to the nearest thousand
   C  uniform incremental percentage of past performances
   D  is also known as flexible budget
   E  is the budget for not-for-profit organizations.

5. In the context of budget preparation the term “goal congruence” is:
   A  the alignment of budget with objectives using feed-forward control
   B  the setting of a budget which does not include budget bias
   C  the alignment of corporate objectives with the personnel objectives of a manager
   D  the use of aspiration levels to set efficiency
   E  fixed in nature.

10.10.2 SHORT ANSWER QUESTIONS

1. What is a master budget?

2. Describe three stages in the budgeting process in chronological order.

3. Mention any three function/purpose of budgets.

4. Explain what is meant by the term “planning, programming, budgeting systems” (PPBS).

5. What is a Discretionary cost?

(Refer to Suggested Solution in Appendix I, page 443)
11.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand the:

♦ Difference between standard cost and standard costing;
♦ Different types of standards and capacity levels;
♦ Standard costing techniques and the associated objectives;
♦ Application of the various principles and computation of variances;
♦ Concept of standard hour and computation of the capacity, efficiency and activity ratios; and
♦ Application of the principles of marginal costing in standard costing.

11.1 A STANDARD COST

This is defined as "the planned unit cost of the products, components or services produced in a period. The standard cost may be determined on a number of bases. The main uses of standard costs are in performance measurement, control, stock valuation and in the establishment of selling prices". (CIMA)

A standard cost, apart from being related to production costs, may also be looked at from the view point of selling and distribution costs, administration costs, etc.

A standard cost can be meaningful if based on good production systems, work methods and measurement, labour and material rate forecasts as well as peculiarities of materials required.

Standard costs can be applied to both absorption and marginal costing techniques, in that:

(a) Fixed costs under absorption costing, are determined on total basis and the machine hour or direct labour hour basis can be adopted to absorb them into the standard unit costs;
(b) The basis for determining the variable cost content of the direct materials and labour is the unit basis; and

(c) Even though the variable overhead costs can be budgeted in total, they can be identified on a unit basis, thus ensuring the determination of hourly cost and unit cost.

11.2 STANDARD COSTING

This is a useful control technique based on the feedback control concept which ensures the determination of standard costs of products or services and compares them with the actual results and costs with the difference being referred to as a variance. This difference can be further explained by a process called variance analysis.

The standard costing technique can be of use in a number of circumstances such as: where there is repetition of jobs and large production activities (process); service industries (hospital, merchandising) etc.

Reasons for adopting standard costing technique

Some of the basic reasons for adopting standard costing technique are to:

(a) Encourage management and employees, since it ensures that they have to plan ahead;

(b) Serve as the basis for quotation for jobs or fixing prices;

(c) Ensure that performance improvement measures are adequately guided;

(d) Provide the basis for setting budgets;

(e) Ensure that standards are put in place and variances properly analysed in order to control costs;

(f) Provide the basis for allocating duties in order to check inefficiencies or take advantage of opportunities;

(g) Serve as basis for determining unprofitable ventures; and

(h) Ensure that stocks and work-in-progress are properly valued.
Drawbacks/Disadvantages of standard costing techniques

The following are the disadvantages of standard costing technique:

(a) Lack of understanding of its application could bring about resistance from the employees.

(b) Confidence of the users may be eroded, especially where they become outdated.

(c) The technique may be very expensive to operate especially where technicalities are involved and set-up time is elongated.

(d) It may not be appropriate for business use, if standard costs are not properly determined.

11.3 SETTING OF STANDARDS

11.3.1 Types of Standards

Performance standards setting are a function of four basic standards:

(a) **Ideal Standards:** These are based on perfect operating conditions whereby there are no wastages, inefficiencies, idletime, breakdown of machines, etc. Variances relating to ideal standards are beneficial in showing aspects requiring verification, thus, bringing about some savings. Ideal standards are not necessarily encouraging in that staff may be of the opinion that the objectives are not achievable, resulting in less efforts being put into the work by the labour force.

(b) **Basic Standards:** These are standards which remained unaltered over a long span of time and they may become outdated as a result of changes in technology, laws, norms etc. They can only be used to express changes in the level of efficiency or performance over a period of time as well as the trend of prices from period to period. Nonetheless, the drawbacks are:

(i) The standard may become useless as a result of the changes in price and efficiency levels; and

(ii) After the first year, the fixed overhead aspect of basic standard cost computed on annual basis from the budget, may have little or no impact.
(c) **Current Standards:** They are based on current conditions of service or production, for example, current losses, inadequacies, etc. However, they do not seem to bring about a higher current level of performance.

(d) **Attainable Standards:** They are a function of normal operating circumstances, thus ensuring that some allowances are available for losses, wastages, inadequacies, etc. They make for a challenging situation for employees in as much as psychological awareness is created.

### 11.3.2 Capacity Levels

Since standards cannot be set on their own, it is therefore necessary for capacity levels that give meaning to standards set to be discussed here. The capacity levels include:

(a) **Full Capacity:** It is the "production volume expressed in standard hours that could be achieved if sales order, supplies and work force were available for all installed work places" (CIMA).

Under this circumstance, full capacity can be related to ideal standards with the assumption that labour shortages, shortfall in supplies, equipment breakdown will not affect the smooth running of the production processes.

(b) **Practical Capacity:** This is "full capacity less an allowance for known unavoidable volume losses" (CIMA). Some examples of unavoidable losses are: repair time for equipment and plants, job resetting times, machine breakdown, etc.

Since full capacity is more than the practical capacity, the latter can be related to attainable standards.

(c) **Budgeted Capacity:** It is the "standard hours planned for the period, taking into account budgeted sales, supplies and work force availability " (CIMA).

In effect, it is the labour hours and machine hours required to have the budgeted units and thus can be a function of current standards that are not peculiar to normal practical capacity over an extended period of time.
(d) **Idle Capacity**: This is the difference between the practical capacity and the budgeted capacity based on standard hours of output. This is the unutilised capacity that is not required, in that, the budgeted volume is less than the practical volume that could be achieved.

### 11.3.3 Need for Revising Standards

The unexpected change(s) in the economy as a result of change(s) in economic and socio-political situations could make for the unreasonableness of standard costs. It should be noted that the said change(s) could bring about inconsistency in the application of the standard costs which may eventually lead to a high cost of operation especially when inflation constitutes a determining factor. Therefore, in practice, the revision of standard cost should be done on a yearly basis, with the action being taken at the beginning of every accounting year.

### 11.3.4 Shortcomings of Setting Standard Costs

The shortcomings that can be associated with the setting of standard costs may include:

(a) The significant influence of quantity discount and cyclical price changes that may make it difficult to determine the prices of materials.

(b) If it is desired to have a mix of the constituent parts of materials, it may be difficult to determine the proportion of the mix of the constituent parts of the materials.

(c) It may not be easy to come up with the appropriate wage efficiency standard.

(d) The manner of introducing the issue of inflation into predetermined unit costs is also a matter of concern.

(e) Even though good materials may be expensive to obtain, the issue of how to determine the quality to be utilised per time may not be easy especially when there is need to reduce material losses and spoilage.
11.4 VARIANCE ANALYSIS

The process of further explaining the difference(s) between the actual costs or results and the predetermined costs or results is referred to as variance analysis. The various variances can be depicted in the form of a diagram in order to have an effective picture of what they look like. See figure 1 below.

![Diagram of Operating Profit Variance]

**Figure 1: Summary of Variances**

11.4.1 Basic Variances

The basic variances can be categorised under four main headings:

(a) Sales variances.

(b) Admin./Selling Distribution Cost Variance.

(c) Variable cost variances, that is, direct materials, direct labour and variable overheads (which can also be sub-divided into spending and efficiency variances).

(d) Fixed overhead cost variances, that is, expenditure and volume variances which can be further categorised into efficiency and capacity variances (which can also be sub-divided into capacity usage and fixed overhead idle-time variance).
(i) **Sales Margin Variance**: is the difference between the predetermined margin from turnover and the actual margin derived when the cost of goods sold is based on the standard cost of manufacturing goods or products.

This can be further analysed into sales margin price variance and sales margin quantity variance with the objective of being able to control the profit from sales whereby all the products are expressed at standard production costs in order to carry out the sales margin variance analysis.

(ii) **Variable Cost Variances**: Variable cost variances, in case of materials, labour or overheads, are all determined in the same manner. The total cost variance for each type of variable costs is classified as:

Price, rate or expenditure variance, whereby:

- The actual price of a unit of raw material is different from the predetermined or standard price.

- The actual rate per direct labour hour is different from the standard labour rate.

- The actual rate per hour of expenditure on variable production overhead is not the same with the standard rate of spending.

Efficiency or usage variance; that is:

**Material usage variance**:

- The quantity of materials put in to have the output is different from the standard or required usage.

- Labour efficiency variance/variable overhead efficiency variance:

  The actual time of spending the output is different from the standard time allowed, with effects on both direct labour and variable production overhead costs.
Direct labour efficiency variance and variable production overhead variance require the same number of hours.

- Labour idle time variance: This involves the actual hours for which no productive efforts were made. Thus, the direct labour costs are affected without any effect on variable overhead expenditure, since they are not incurred when idle time are being accounted for in terms of the variance element.

It is important to note that price or expenditure variances are measured in money terms, for example, Naira, Cedis, etc, while efficiency variances are measured in quantities (hours, kilograms, litres etc) after which they are expressed in monetary terms at the standard cost per unit of labour, material or variable overheads.

**Fixed Cost Variance**

The fixed cost variance is a function of the magnitude of fixed overhead over-absorbed in the production process. Thus:

(a) The manufacturing fixed cost volume variance, is the difference between predetermined and actual production volumes multiplied by the absorption rate in order to have the monetary values of the volume so involved.

(b) The difference between the actual and predetermined production volumes can be expressed in two ways:

(i) Since the efforts put in by the labour force will determine the degree of output, then, the fixed production overhead efficiency variance is the same as the direct labour efficiency variance.

(ii) If the actual hours involved are greater or less than the predetermined hours, thus resulting in more or less output and the predetermined hours put in represent normal capacity, then the capacity variance will be measured in standard hours and expressed in monetary terms at the standard absorption rate per hour.
11.4.2 Why Cost Variances?

Expected standards of performance are set for a firm’s operations taking into account wastage and lost time. The standards try to be realistic by setting levels of attainable performance which do not necessarily correspond with current levels of performance, if management considers that any particular operation for which standards are set is not meeting its capability.

Variances show those situations where actual results are not as budgeted. They depict the difference between standard and actual for each element of cost and sometimes for sales. If actual operations outweigh the planned, a favourable variance is arrived at, (F) and where the reverse is the case, an adverse variance arises (A).

11.4.3 Computation of Variances

Variances may be computed as follows:

(a) Material cost variances

The material cost variance shows the difference between the actual costs incurred and the standard costs. It is calculated as Standard cost less actual cost, that is, \((SC - AC)\).

These variances can be sub-analysed into price and usage variances so that the variance is attributed to the manager who has the responsibility for controlling it. Usage Variance can further be analysed into mix and yield. The standard cost is determined by multiplying the standard specified actual quantity of output by the standard cost per unit of output.

(i) Material price variance

This is derived by multiplying the difference between the standard price and actual price by the actual quantity of materials purchased. It is calculated as: \(AQ \times (SP - AP)\).

This variance may occur because of:

- Material price changes.
- Reduction in supply of materials.
- Ineffective purchasing policy.
Non-availability of storage space.

Insufficient funds.

Purchasing mistakes.

Reversal of specification standards.

(ii) **Material usage variance**

This is determined by multiplying the difference between the standard quantity and the actual quantity by the standard price of quantity used. The standard quantity is expressed as a function of the actual quantity produced at the standard specifications. It is calculated as: \( \text{SP} (\text{SQ} - \text{AQ}) \).

The material usage variance can be sub-divided into mix and yield variances:

- **Material Mix Variance** - This can be computed by multiplying the difference between the standard specification of the material input and the actual mix used by the standard price. That is, \( \text{SP} (\text{SM} - \text{AM}) \).

- **Material Yield Variance** - This can be expressed as the difference between the standard yield and the actual yield from the materials used in production. That is, \( \text{SC} (\text{AQSM} - \text{SQSM}) \).

(b) **Wage cost variance**

Wage cost variance is the difference between the standard wage cost of actual output and the labour cost paid for. It is commonly separated into wage rate variance, an idle time variance and efficiency variance.

Standard cost is the actual quantities produced at standard hours specified multiplied by standard rate per hour. It is calculated as the difference between standard cost and actual cost, that is, \( \text{SC} - \text{AC} \).
- **Wage Rate Variance**

  This is the difference between the standard wage rate and the wage rate actually paid, multiplied by the actual hours worked, that is, AH (SR - AR).

  The foreman is to ensure that the machines are operated by the employees with the requisite skills as the wage negotiation is a national policy and not that of an individual.

- **Wage Usage Variance**

  This is as a result of the difference between standard labour hours of actual output and the labour hours actually paid for multiplied by the standard rate per hour, that is, SR (SH - AH).

  The wage usage variance can be sub-divided into an idle time and efficiency variance.

  Standard hour (SH) is the actual quantity of output based on specific standard hour.

- **Idle Time Variance**

  This is the difference resulting from hours lost through unexpected situations, such as machine breakdown, lack of materials or tools, etc. (unexpected Idle time multiplied by standard hour).

- **Efficiency Variance**

  This is the variance resulting from the difference between the standard labour hours of actual output and the useful labour hours actually worked. This is represented by Standard Labour Cost of Actual output and standard Cost of useful hours worked multiplied by the standard rate of pay; that is, SR (SH - AUH). Therefore, hours paid for, less idle time, equals Actual Useful Hours (AUH).

  (c) **Variable Overhead Variance**

  Variable overhead can be absorbed into production on the basis of units of output produced or standard hours used in production. Where standard hours are adopted as the strength for
determining the level of activity, the variable overhead absorption rate can be computed as:

\[
\text{OAR} = \frac{\text{Predetermined Variable Overhead}}{\text{Predetermined Standard Hours}}
\]

Where the OAR = Overhead Absorption Rate

Therefore, the difference between the variable overhead absorbed for actual production and the actual variable overhead expenditure is termed the total variable overhead variance.

The variable overhead variance can be sub-divided into expenditure variance and efficiency variance.

- **Expenditure Variance**: This is as a result of the difference between actual cost and standard cost for the actual level of activity. It is to be taken that where the determination of level of activity is a function of the actual activity labour hours, the actual activity is the number of labour hours for which the work was performed. It is calculated as the difference between standard rate and actual rate multiplied by the actual hours.

- **Efficiency Variance**: This is as a result of the difference in the labour hours worked and the standard hours equivalent of actual production, multiplied by the standard cost or rate. It is expected that the activity level will be measured in labour hours for the purpose of determining the variable overhead absorption rate. Its formula is SR (SH - AH).

(d) **Fixed Overhead Variance**

Fixed Overhead cost is a cost that will not change within a given level of activity, but overhead absorption rate per unit will be charged to products, nonetheless, it is normal to compute a budgeted fixed overhead absorption rate whenever product costs and valuation of stock are required.

**Fixed Overhead Absorption Rate** (FOAR)

\[
= \frac{\text{Predetermined Fixed Overhead}}{\text{Predetermined Standard Hours}}
\]

Therefore, the difference between the fixed overhead absorbed by the actual production and the actual fixed overhead for the
period is referred to as total fixed overhead variance. Its formula is given as (SC - AC).

(i) **Fixed Overhead Expenditure Variance:** This is the difference between the actual and predetermined cost of overhead. The degree of spending on the fixed overhead is not affected by the volume of activity. Therefore, the difference between the standard overhead stated in the budget and the actual overhead incurred is referred to as expenditure variance. Budgeted Fixed Overhead (BFO) is the budgeted quantities at standard hours specified, multiplied by standard rate per hour. Its formula is BFO - AFO.

(ii) **Fixed Overhead Volume Variance:** This is the difference between the standard fixed overhead elements of actual output and the standard fixed overhead in the budget. Its formula is given as SR (BH - SH).

The fixed overhead volume variance can be further analysed into efficiency and capacity variances.

- **Efficiency Variance:** This is the difference in the standard efficiency and the efficiency actually attained. Its formula is SR (SH - AUH) where SR = Standard Rate, SH = Standard Hour and AUH = Actual Useful Hours.

- **Capacity Variance:** This is the difference in the budgeted activity and the level of activity actually attained. That is, Standard Rate (Budgeted Hours - Actual Useful Hours) - SR(BH - AUH).

(e) **Sales Variance**

A sales variance is used to give effect to the difference between budgeted sales and actual sales and can be further sub-divided into a sales price variance and sales volume variance. These variances may be related to sales profit or sales contribution, with the assertion that those related to profit or contribution ensure the provision of effective information.

(i) **Sales Price Variance:** This variance is used to determine the effect of selling output above or below
the predetermined selling price. Its formula is: AQ (SSP - ASP).

(ii) **Sales Volume Variance**: This variance is used to determine the effect on profit or contribution on selling more or less than the predetermined quantity. Its formula is SP (BQ - A QS), where, BQ = budgeted quantity and AQS = actual quantity sold.

Where the valuation of the variance is based on the standard profit per unit, it shows the difference between budgeted standard profit and the standard profit earned on actual sales. On the other hand, if it is at standard selling price, it shows the difference between budgeted sales revenue and actual sales at a standard price.

Where the standard marginal costing is used, all final products are valued at a standard marginal cost, therefore ensuring, that all fixed overheads are treated as period costs against the contribution made in the budgeted period, thus making it impossible to absorb them into product costs.

The variances under the standard marginal costing approach are the same as those of the budgetary control where the standard costs are not in existence:

(a) Since fixed overheads are not absorbed into product cost, then, there exists fixed overhead expenditure variance and no fixed overhead volume variance.

(b) Sales volume variance can be computed, thus: volume variance in units multiplied by standard contribution per unit.

---

**ILLUSTRATION 11-1**

Bridget Ntagu Ltd produces thatched roofs for houses. The budget for 2009 was as follows:

<table>
<thead>
<tr>
<th>Number of houses to be thatched</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>N</td>
</tr>
<tr>
<td>Standard cost per roof</td>
<td>6,000</td>
</tr>
</tbody>
</table>

---

284
Direct materials:
Thatch: 2 tons @ ₦ 400 per ton 800
Other materials 300
Direct labour 300 hours @ ₦ 5.00 1,500
Variable production overhead
  300 hours at ₦ 1.00 300
Fixed production overhead:
  300 hours @ ₦ 7.00 2,100
Standard cost 5,000
Standard profit 1,000

Note:

(a) The budgeted fixed production overhead was ₦ 147,000, from which the standard absorption rate of 294,000 (140 x 300 hours) = ₦ 7.00 per standard hour was derived.

(b) Since one thatched roof equals 300 standard hours of output, the fixed overhead cost per roof = 300 standard hours = ₦ 2,100.

(c) There is additional budgeted overhead for selling and administration of ₦ 30,000. This expenditure is regarded as a fixed cost.

Actual results in 2009 were as follows:

Number of roofs thatched 150 roofs
Revenue (Selling price per roof ₦ 5,760) ₦ 864,000
Thatch:
Purchase 360 tons, cost ₦ 133,200
Used 340 tons
Other direct material, cost ₦ 48,000
Direct labour:
Hours worked (active time) 44,000 hours
Hours of idle time 8,000 hours
Cost of hours paid for ₦ 288,000
Variable production overhead ₦ 46,000
Fixed production overhead ₦ 304,000
Sales and administration overhead ₦ 32,000

Required:

(a) Prepare an operating statement reconciling the budgeted profit with the actual profit. All closing stock are valued at standard cost.
(b) An explanation of the possible interdependence between variances.

**SUGGESTED SOLUTION 11-1**

**BRIDGET NTAGU LTD**

(a) The budgeted profit, before deducting sales and administration costs was \((140 \times N1,000) = N140,000\).

(b) The calculation of actual profit begins with:

\[
\begin{align*}
\text{Actual sales} & \quad 864,000 \\
\text{Less: Actual standard production cost of sales} \ (150 \times N5,000) & \quad 750,000 \\
\text{Unadjusted profit} & \quad 114,000
\end{align*}
\]

(c) From this unadjusted profit, adjustments are made for cost variances. All cost variances reported are written as an adjustment to the profit and loss account at the end of the accounting period.

(i) Direct Materials

**Direct material price variance**

This variance measures the actual purchase price for materials against the expected price:

\[
\begin{align*}
\text{360 tons of thatch purchased} & \quad 114,000 \\
\text{should cost} \ (360 \times N400) & \quad \text{(expected cost)} \\
\text{but did cost} & \quad 103,200 \\
\text{Material price variance} & \quad 10,800 (F)
\end{align*}
\]

(ii) Direct material usage variance

This variance measures the efficiency in the usage or consumption of a material. Because it is a measure of efficiency (i.e. quantity) it must be measured in quantities - i.e. tons - and then valued in money terms by applying the standard cost per unit (ton) of material.

150 roofs were made and should use \((150 \times 2) 300\) tons of thatch they did use 340 tons of thatch. Material usage variance - (Thatch) 40 tons (A)

Valued at standard price \(N\) 400 per ton
That is, \( \text{₦16,000(A)} \)

Other Direct Materials Variance

Since we are not given the quantity of other materials per roof, or the purchase price per unit of these other materials, the only variance we can calculate is the materials cost variance.

\[
\begin{array}{l}
\text{₦} \\
\text{Actual cost of 150 roofs (other materials) } 48,000 \\
\text{Standard (expected) cost of 150 roofs (x ₦300) } 45,000 \\
\text{Other direct materials cost variance } 3,000(A)
\end{array}
\]

Direct Labour Variances

(a) **The total cost variance for direct labour** is:

\[
\begin{array}{l}
\text{₦} \\
\text{Actual labour cost of 150 roofs } 288,000 \\
\text{Standard labour cost of 150 roofs (x ₦1,500) } 225,000 \\
\text{Direct labour cost variance } 63,000 (A)
\end{array}
\]

This variance need not be calculated, because we can analyse it in greater depth as the sum of the rate, idle time and efficiency variances.

(b) **Direct labour rate variance**: This is the same type of variance as the materials price variance. It measures the actual price or rate paid per hour for labour against the actual rate per hour.

\[
\begin{array}{l}
\text{₦} \\
52,000 	ext{ hours were paid for and cost } 288,000 \\
\text{They should cost (x ₦5 per hour x 52,000) } 260,000 \\
\text{Direct labour rate variance } 28,000(A)
\end{array}
\]

(c) **Idle time variance**: This is an inefficiency variance which is recorded in hours. It is valued in naira by applying the standard per hour, that is, 8,000 hours (A) \( \times \text{₦5 per hour} \) \( = \text{₦40,000(A)} \)

(d) **Direct Labour efficiency variance**: This variance measures the efficiency (or inefficiency) of labour. Since idle time is measured separately, we are concerned with efficiency in active hours worked. It is calculated in the
same way as the materials usage variance; and it is a
variance of quantity (hours) which is costed in N by
applying the standard rate per hour.

150 roofs were made
and should take (x 300) 45,000 hours
they did take (active hours) 44,000 hours
Direct labour efficiency variances 1,000 hours (F)
Valued at standard rate N 5 per hour
that is, N 5,000 (F)

(e) Summary

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate variance</td>
<td>(b) 28,000 (A)</td>
</tr>
<tr>
<td>Idle time variance</td>
<td>(c) 40,000 (A)</td>
</tr>
<tr>
<td>Efficiency variance</td>
<td>(d) 5,000 (F)</td>
</tr>
<tr>
<td>Total labour cost variance</td>
<td>(a) 63,000 (A)</td>
</tr>
</tbody>
</table>

Variable production overhead

(a) The total cost variance for variable production overhead is:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual cost of 150 roofs</td>
<td>46,000</td>
</tr>
<tr>
<td>Standard (expected) cost of 150 roofs (x N 300)</td>
<td>45,000</td>
</tr>
<tr>
<td>Variable production overhead cost variance</td>
<td>1,000 (A)</td>
</tr>
</tbody>
</table>

(b) It is usually assumed that variable overheads are incurred during Active Working Hours, but are not incurred during idle time. This means that the company, in our example, has had to pay for 44,000 hours of variable overhead expenditure, and not 52,000 hours.

(c) Variable Production Overhead Expenditure Variance: Following on from (b) the expenditure variance may now be calculated in the same way as the materials price and labour rate variances.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>44,000 hours of variable overhead expenditure</td>
<td>44,000</td>
</tr>
<tr>
<td>should cost (N 1.00)</td>
<td>44,000</td>
</tr>
<tr>
<td>they cost</td>
<td>46,000</td>
</tr>
<tr>
<td>Variable overhead expenditure variance</td>
<td>2,000 (A)</td>
</tr>
</tbody>
</table>

In other words, during 44,000 active hours of work, the expected spending at the standard hourly rate would
be ₦44,000. The actual hourly rate was in excess of this and the total excess amounted to ₦2,000.

(d) Variable Production Overhead Efficiency Variance: This is exactly the same, in hours, as the direct labour efficiency variance. This is 1,000 hours (F) and is valued in ₦1 at the standard rate per hour for variable overhead (₦1.00).

1,000 hours (F) x ₦1.00 per hour
Variable production overhead efficiency variance = ₦250(F)

(e) Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expenditure variance</td>
<td>(c) 2,000(A)</td>
</tr>
<tr>
<td>Efficiency variance</td>
<td>(d) 1,000(F)</td>
</tr>
<tr>
<td>Total variable production overhead cost variance</td>
<td>(a) 1,000(A)</td>
</tr>
</tbody>
</table>

**Fixed Production overheads**

(a) In standard absorption costing, fixed overheads are absorbed into production costs at a standard cost per unit. For each roof that is thatched, a standard cost of ₦2,100 (300 standard hours of production) is applied to the cost of production.

(b) The standard cost of 150 roofs is therefore 150 x ₦2,100 = ₦315,000

The actual cost of fixed production overhead was ₦304,000

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorbed (standard) fixed overhead</td>
<td>₦315,000</td>
</tr>
<tr>
<td>Actual fixed overhead</td>
<td>₦304,000</td>
</tr>
<tr>
<td></td>
<td>₦11,000(F)</td>
</tr>
</tbody>
</table>

This over-absorbed overhead is the fixed production overhead total cost variance

(c) Fixed production overhead expenditure variance:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted expenditure</td>
<td>₦294,000</td>
</tr>
<tr>
<td>Actual expenditure</td>
<td>304,000</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------</td>
</tr>
<tr>
<td>Fixed production overhead volume variance</td>
<td>10,000 (A)</td>
</tr>
</tbody>
</table>

(d) Fixed production overhead volume variance;
- Budgeted production volume: 140 roofs
- Actual production volume: 150 roofs
- Volume variance: 10 roofs (F)
- Absorption rate (\(= \text{standard rate}\)): N2,100 per roof
  \[ \text{N} 21,000 \] (F)

(e) Fixed production overhead efficiency variance - This is exactly the same as the labour efficiency variance (in hours) but is valued at the standard fixed overhead absorption rate per hour;
- Efficiency variance: 1,000 hours (F)
- Absorption rate per hour: N7.00 per hour
- Fixed production overhead efficiency variance: N7,000 (F)

(f) Fixed production overhead capacity variance
- Budgeted hours of work: 140 roofs x 300 hours = 42,000 hours
- Actual hours of work (active hour only): 44,000 hours
- Capacity variance: 2,000 hours (F)

2,000 hours more work was done than budgeted. The expected over-absorption of overhead as a result of this capacity variance. = 2,000 hours (F) x N7.00 per hour = N14,000 (F)

(g) Summary
- Capacity variance (g): N14,000 (F)
- Efficiency variance (f): N7,000 (F)
- Volume variance (d): N21,000 (F)
- Expenditure variance (c): N10,000 (A)
- Total fixed production overhead variance (b): N11,000 (F)

**Sales Variance**

(a) Sales price variance
- 150 thatched roofs should sell for N6,000
- They did sell for N864,000
- Sales price variance: N36,000 (A)
(b) Sales Volume Variance:

(i) In standard absorption costing, fixed overhead costs increase with output and the standard cost of sales increases by the full standard cost for each extra unit sold. The sales volume (margin) variance is calculated by applying the Standard Profit per unit and not the contribution per unit.

(ii) Standard profit is used because a fixed production overhead volume variance is calculated. This is a further difference, therefore, from the calculation of variances in other types of budgetary control.

◆ if a fixed production overhead volume variance is calculated, the sales volume variance is based on standard profit.

◆ where a fixed production overhead volume variance is calculated, the sales volume variance is based on standard contribution.

(iii) In our example:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted sales volume</td>
<td>140 roofs</td>
</tr>
<tr>
<td>Actual sales volume</td>
<td>150 roofs</td>
</tr>
<tr>
<td>Sales volume variances</td>
<td>10 roofs (F)</td>
</tr>
</tbody>
</table>

Sales volume (margin) variance (10 X 1000) ₦10,000 (F)

Sales and administration overheads are not absorbed into standard units costs. They are fixed costs, and the only variance is an expenditure variances

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted expenditure</td>
<td>30,000</td>
</tr>
<tr>
<td>Actual expenditure</td>
<td>32,000</td>
</tr>
<tr>
<td>Expenditure variance</td>
<td>2,000 (A)</td>
</tr>
</tbody>
</table>

Reconciliation of Operating Statement for 2009

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted profit, before sales and admin. O/H</td>
<td>140,000</td>
</tr>
<tr>
<td>(140 roofs x ₦1,000) overhead</td>
<td></td>
</tr>
<tr>
<td>Sales Variance</td>
<td></td>
</tr>
<tr>
<td>Sales Price</td>
<td>36,000 (A)</td>
</tr>
<tr>
<td>Sales Volume</td>
<td>10,000 (F) 26,000 (A)</td>
</tr>
</tbody>
</table>
Actual Sales minus Standard Production  114,000
Cost of Sales  (F)  (A)
Cost Variance
Direct Materials
  Thatch Price  10,800
  Thatch Usage  16,000
  Other Materials Cost  3,000
Direct Labour:
  Rate  28,000
  Idle Time  40,000
  Efficiency  5,000
Variable Production Overheads:
  Expenditure  2,000
  Efficiency  1,000
Fixed Production Overheads:
  Expenditure  10,000
  Efficiency  7,000
  Capacity  14,000
  17,800  99,000  1,200 (A)
  52,800
Less: Increase in closing stock (20 x £400) 8,000
Actual Profit before sales and admin overhead 44,800
Costs:
Budgeted sales & admin. costs 30,000
Expenditure Variance (30,000 - 32,000) 2,000
Actual Profit 12,800

Confirmation of Actual Profit
Revenue  £864,000
Less Costs:
  Thatch  133,200
  Other Materials  48,000
  Labour  288,000
  Variable Production Overhead  46,000
  Fixed Production Overhead  304,000  819,200
  44,800
  Sales and Admin. Overhead  (32,000)  12,800

11.4.4 Interdependence Between Variances

Interdependence between variances is a term adopted to describe the way in which the reason for one variance may be wholly or partly stated by the reason for another variance. In the example above:
(a) the material price variance for thatch was N10,800 (F) and the usage variance N16,000 (A). It is possible that by buying a cheaper type of thatch (and earning a favourable purchasing variance) the purchasing manager has obtained a lower quality material, which explains the adverse usage in production;

(b) the sales volume variance is favourable (by 10 roofs), but in order to obtain the extra business, the selling price per roof may have been reduced. The favourable sales volume variance and the adverse sales price variance may, therefore be, to a certain extent, interdependent;

(c) the favourable efficiency variances (labour, variable and fixed production costs) may be the result of using more highly skilled labour which is paid higher rate per hour. The favourable efficiency variances and the adverse labour rate variance may be interdependent.

**ILLUSTRATION 11-2**

Elizabeth Anuoluwapo Ltd produces and sells Red soft drinks. The standard direct cost per crate is as follows:

Materials  
100 litres concentrated juice at N2 per litre  
200 litres of carbonated water at N2.50 per litre  
10 labour hours at N9.00 per hour  
The budgeted monthly production and sales is 500 crates and the selling price is N1,000 per crate.

The following details relate to October 2003, when 510 crates of Red soft drinks were produced and sold:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>506,500</td>
</tr>
<tr>
<td>Materials used:</td>
<td></td>
</tr>
<tr>
<td>Concentrated juice -</td>
<td>102,500</td>
</tr>
<tr>
<td>51,600 litres</td>
<td></td>
</tr>
<tr>
<td>Carbonated water -</td>
<td>258,800</td>
</tr>
<tr>
<td>101,500 litres</td>
<td></td>
</tr>
<tr>
<td>Labour:</td>
<td></td>
</tr>
<tr>
<td>5,000 hours cost</td>
<td>45,750</td>
</tr>
</tbody>
</table>

**Required:**

(a) Compute the price and usage variance for each material.

(b) Calculate the wage rate and efficiency variances.
(c) Comment briefly upon the information revealed by each of the variances you have computed.

SUGGESTED SOLUTION 11-2

ELIZABETH ANUOLUWAPOL LIMITED

(a) (i) Material Price Variance

<table>
<thead>
<tr>
<th></th>
<th>Concentrated Juice</th>
<th>Concentrated Carbonated Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Qty x Std. Price (51,600 x 2)</td>
<td>103,200</td>
<td>253,750</td>
</tr>
<tr>
<td>101 x 2.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual Qty x Actual Price</td>
<td>102,500</td>
<td>258,800</td>
</tr>
<tr>
<td>Variance</td>
<td>700F</td>
<td>5,050A</td>
</tr>
<tr>
<td>Total Material Price Variance</td>
<td>4,350A</td>
<td></td>
</tr>
</tbody>
</table>

(ii) Material usage variance

<table>
<thead>
<tr>
<th></th>
<th>Concentrated Juice</th>
<th>Concentrated Carbonated Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Qty x Std. Price for 510 containers (510 x 100 x 2)</td>
<td>102,000</td>
<td></td>
</tr>
<tr>
<td>101,500 x 2.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual Qty x Std. Price (51,600 x 2)</td>
<td>103,200(101,500 x 200)</td>
<td>253,750</td>
</tr>
<tr>
<td>Variance</td>
<td>1,200 A</td>
<td>1,250 F</td>
</tr>
<tr>
<td>Total Material Price Variance</td>
<td>50F</td>
<td></td>
</tr>
</tbody>
</table>

(b) (i) Wage rate variance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Rate x Actual Hours (₦9 x 5000)</td>
<td>45,000</td>
</tr>
<tr>
<td>Actual Rate x Actual Hours</td>
<td>45,750</td>
</tr>
<tr>
<td>VARIANCE</td>
<td>750A</td>
</tr>
</tbody>
</table>

(ii) Efficiency variance

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Rate x Std. Hours for 510 containers (₦9 x 5100)</td>
<td>45,900</td>
</tr>
<tr>
<td>Std. Rate x Actual Hours ₦9 x 5000</td>
<td>45,000</td>
</tr>
<tr>
<td></td>
<td>900F</td>
</tr>
</tbody>
</table>
(c) Comments

Material Price Variance

Concentrated Juice gave a favourable variance while Carbonated Water gave adverse.

It could be due to any of the following:

(i) Unexpected change in the price of materials

(ii) Faulty determination of standard price.

Material Usage Variance

Concentrated Juice gave an adverse variance while Carbonated Water gave an almost compensating figure of favourable variance. Considered in total, the net effect could be misleading, but considered separately, we may be able to discover the following:

(i) The use of employees with varying levels of experience in production leading to either minimum or excess wastages.

(ii) The use of either better or inferior quality material

(iii) The condition of the machinery used in production would have an effect on materials consumption and waste generation.

Wage Rate Variance

The adverse variance recorded here may be due to paying higher rates than anticipated, or the use of skilled labour where unskilled labour was earlier planned for.

Labour Efficiency Variance

This gave a favourable variance. If skilled labour was used instead of unskilled, the favourable efficiency variance could be the result.
ILLUSTRATION 11-3

Toyin Popoola Limited manufactures one product and the entire product is sold as soon as it is produced. There are no opening or closing stocks and work in progress is negligible. The company operates a standard absorption costing system and analysis of variance is made every month. The standard cost card for the product "Lucodene" is as follows:

- Direct materials 0.5 kilos at ₦4.00 per kilo 2.00
- Direct wages 2 hours at ₦2.00 per hour 4.00
- Variable overheads 2 hours at ₦0.30 per hour 0.60
- Fixed overhead 2 hours at ₦3.70 per hour 7.40
- Standard cost 14.00
- Standard profit 6.00
- Standard selling price 20.00

Budgeted output for the month of June 2009 was 5,100 units.

Actual results for June 2009 were as follows:

Production of 4,850 units was sold for ₦95,600

Materials consumed in production amounted to 2,300 kilos at a total cost of ₦9,800.

Labour hours paid for amounted to 8,500 hours at a cost of ₦16,800.

Actual operating hours amounted to 8,000 hours.

Variable overheads amounted to ₦2,600.

Fixed overheads amounted to ₦42,300.

Selling and administration expenses amounted to ₦18,000.

You are required to:

(a) Calculate all variances;

(b) Prepare an operating statement for the month ended 30 June 2009; and

(c) Show the relevant ledger accounts including a variance account.
SUGGESTED SOLUTION 11-3

TOYIN POPOOLA LIMITED

Direct materials cost variance
(a) Actual cost
   Standard cost @ actual output (4,850 x 2)
   Total material cost variance

(b) 2,300 kg of material should cost (x N4)
    did cost
    Materials price variance

(c) 4,850 Lucodene made should use (x 0.5)
    did use
    Material usage variance
    Valued at Std costs of N4 per kg
    Material usage variance

(d) Labour cost variance
    SC = 4,850 x 2 x N2
    AC =

(e) 8,500 hours of labour should cost (x N2)
    did cost
    Labour rate variance

(f) 4,850 Lucodene made should take (x 2)
    did take (active hours)
    Labour efficiency variance
    Valued at std cost of
    Labour efficiency variance

(g) Idle time variance 500 hrs(A) x N2 =

(h) Variable overhead cost variance
    4,850 units should cost
    4,850 units actually cost

(i) 8,000 hours incurring variable overhead expenditure
    should cost (x N0.3)
    did cost
    Variable overhead expenditure variance
| (j) | Variable overhead efficiency variance = same as labour efficiency variance: |
|     | 1,700 hours (F) x N 0.30 per hr = N 510 (F) |
| (k) | Fixed overhead cost variance |
|     | 4,850 units at budgeted cost per N 7.40 = N 35,890 |
|     | 4,850 units actually incurred N 42,300 |
|     | N 6,410 (A) |
| (l) | Budgeted fixed overhead (5,100 units x N 7.40) 37,740 |
|     | Actual fixed overhead cost incurred 42,300 |
|     | Fixed overhead expenditure variance (4,560) (A) |
| (m) | Budgeted production volume 5,100 units |
|     | Actual production volume 4,850 units |
|     | Production volume variance 250 units (A) |
|     | x Std fixed overhead rate per unit N 7.40 |
|     | Fixed (production) overhead volume variance 1,850 (A) |
| (n) | Fixed overhead efficiency variance = same as labour efficiency variance |
|     | = 1,700 hours (F) x 3.70 per hr = N 6,290 (F) |
| (o) | Budgeted production capacity (hours worked) (5,100 x 2 hrs) 10,200 hrs |
|     | Actual production capacity (active hrs worked) 8,000 hrs |
| (p) | Capacity overhead variance 2200 hrs |
|     | Budgeted hour (5,100 x 2): |
|     | Actual hour 8,000 |
|     | 2,200 |
|     | At standard fixed overhead absorption rate N 3.70 |
|     | N 8,140 (A) |
| (q) | Sales Price Variance |
|     | 4,850 Lucodene should sell for (x N 20) 97,000 |
|     | did sell for 95,600 |
|     | Sales price variance 1,400 (A) |
| (r) | Budgeted sales volume 5,100 Lucodene |
|     | Actual sales volume 4,850 Lucodene |
|     | Sales volume variance 250 Lucodene (A) |
|     | x Std profit per unit N 6 |
|     | Sales volume variance 1,500 (A) |
Reconciliation of Operating statement for the month ended 30 June 2009.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted profit, before sales and admin. costs</td>
<td>30,600</td>
<td></td>
</tr>
<tr>
<td>5,100 Lucodene x N 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sales price variance</td>
<td>1,400(A)</td>
<td></td>
</tr>
<tr>
<td>Sales volume variance</td>
<td>1,500(A)</td>
<td></td>
</tr>
<tr>
<td>Actual sales (N 95,600) less the standard production cost of sales (4,650 x N 14)</td>
<td>27,700</td>
<td></td>
</tr>
<tr>
<td>Cost variance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material price</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Material usage</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Material usage</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>3,400</td>
<td></td>
</tr>
<tr>
<td>Rate</td>
<td>4,560</td>
<td></td>
</tr>
<tr>
<td>Idle Time</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Variable Overhead:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenditure</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>510</td>
<td></td>
</tr>
<tr>
<td>Fixed Overhead Expenditure:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Efficiency</td>
<td>6,290</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>8,140</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10,900</td>
<td>14,500</td>
</tr>
<tr>
<td>Actual profit before Sales and Admin. costs</td>
<td>24,100</td>
<td></td>
</tr>
<tr>
<td>Sales and Administration Cost</td>
<td>18,000</td>
<td></td>
</tr>
<tr>
<td>Actual Profit</td>
<td>6,100</td>
<td></td>
</tr>
</tbody>
</table>

Confirmation of Actual Result:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>95,600</td>
<td></td>
</tr>
<tr>
<td>Less Cost of:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td>9,800</td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>16,800</td>
<td></td>
</tr>
<tr>
<td>Variable Overhead</td>
<td>2,600</td>
<td></td>
</tr>
<tr>
<td>Fixed Overhead</td>
<td>42,300</td>
<td></td>
</tr>
<tr>
<td>Sales and admin. costs</td>
<td>18,000</td>
<td>89,500</td>
</tr>
<tr>
<td>Actual profit</td>
<td>6,100</td>
<td></td>
</tr>
</tbody>
</table>

(c) Cost accounting entries

Variances are written to a variance account. There may be separate variance accounts for materials price, materials usage, labour rate etc. or there may be one single account for all the variances.

You should check the following T-accounts, carefully, but the basic principles are:
(a) material price variance is usually recorded in the stores account;
(b) labour rate variance is usually recorded in the wages account;
(c) material usage, labour efficiency and the idle time variances are recorded in the work in progress (WIP) account; and
(d) the cost ledger control account, in a system where cost accounts and financial accounts are not integrated, represents all those items which appear in the financial accounts but which are excluded from the cost accounts (e.g. debtors, creditors, cash, reserves, etc.)

(a) Cost Ledger Control Account (CLC)

<table>
<thead>
<tr>
<th></th>
<th>£</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>95,600</td>
<td></td>
</tr>
<tr>
<td>Stores account</td>
<td>9,800</td>
<td></td>
</tr>
<tr>
<td>Direct wages account</td>
<td>16,800</td>
<td></td>
</tr>
<tr>
<td>Variable production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead account</td>
<td>2,600</td>
<td></td>
</tr>
<tr>
<td>Fixed production o’hd a/c</td>
<td>42,300</td>
<td></td>
</tr>
<tr>
<td>Sales admin. Costs a/c</td>
<td>18,000</td>
<td></td>
</tr>
<tr>
<td>P &amp; L a/c (profit)</td>
<td>6,100</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>95,600</td>
<td>95,600</td>
</tr>
</tbody>
</table>

(b) Stores Ledger Control Account

<table>
<thead>
<tr>
<th></th>
<th>£</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchases (CLC)</td>
<td>9,800</td>
<td></td>
</tr>
<tr>
<td>WIP (2,300Kg X N4)</td>
<td>9,200</td>
<td></td>
</tr>
<tr>
<td>Material Price Variance (variance a/c)</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>9,800</td>
<td>9,800</td>
</tr>
</tbody>
</table>

(c) Direct Wages Control Account

<table>
<thead>
<tr>
<th></th>
<th>£</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CLC)</td>
<td>16,800</td>
<td></td>
</tr>
<tr>
<td>WIP (8,500hrs X N2)</td>
<td>17,000</td>
<td></td>
</tr>
<tr>
<td>Rate Variance (variance a/c)</td>
<td>200</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>17,000</td>
<td>17,000</td>
</tr>
</tbody>
</table>
(d) **Variable Production Overhead Control**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CLC)</td>
<td>2,600</td>
<td>WIP (8,000 hours at No. 3) 17,000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expenditure variance 200</td>
</tr>
<tr>
<td></td>
<td>2,600</td>
<td>2,600</td>
</tr>
</tbody>
</table>

(e) **Fixed Production Overhead Control Account**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>(CLC)</td>
<td>42,300</td>
<td>WIP (8,000 hours at N3.70) 29,600</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Expenditure variance 4,560</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Capacity variance 8,140</td>
</tr>
<tr>
<td></td>
<td>42,300</td>
<td>42,300</td>
</tr>
</tbody>
</table>

(f) **Sales and Administration Cost Account**

<table>
<thead>
<tr>
<th>(CLC)</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>18,000</td>
<td>Cost of sales a/c 18,000</td>
</tr>
</tbody>
</table>

(g) **Work in Progress Control Account**

<table>
<thead>
<tr>
<th>Stores account</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct wages account</td>
<td>17,000</td>
<td>Finished goods account (4,850x N14) 67,900</td>
</tr>
<tr>
<td>Variable production overhead a/c</td>
<td>2,400</td>
<td>Idle time variance 1,000</td>
</tr>
<tr>
<td>Fixed production overhead a/c</td>
<td>29,600</td>
<td></td>
</tr>
<tr>
<td>Labour efficiency variance</td>
<td>3,400</td>
<td></td>
</tr>
<tr>
<td>Material usage variance</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Variable o/hd efficiency variance</td>
<td>510</td>
<td></td>
</tr>
<tr>
<td>Fixed o/hd efficiency variance</td>
<td>6,290</td>
<td></td>
</tr>
<tr>
<td></td>
<td>68,900</td>
<td>68,900</td>
</tr>
</tbody>
</table>

(h) **Finished Goods Control Account**

<table>
<thead>
<tr>
<th>WIP a/c</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>67,900</td>
<td>Cost of sales a/c 67,900</td>
</tr>
</tbody>
</table>

(i) **Cost of Sales Control**

<table>
<thead>
<tr>
<th>Finished goods a/c</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales and admin</td>
<td>18,000</td>
<td>P &amp; L a/c 85,900</td>
</tr>
<tr>
<td></td>
<td>85,900</td>
<td>85,900</td>
</tr>
</tbody>
</table>

(j) **Sales Account**

<table>
<thead>
<tr>
<th>P &amp; L Account</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLC</td>
<td>95,600</td>
<td>95,600</td>
</tr>
</tbody>
</table>
(k) Variances Account

<table>
<thead>
<tr>
<th></th>
<th>ₙ</th>
<th></th>
<th>ₙ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stores a/c (material price)</td>
<td>600</td>
<td>Direct wages (rate)</td>
<td>200</td>
</tr>
<tr>
<td>Variable overhead expenditure</td>
<td>200</td>
<td>Variable overhead efficiency (WIP)</td>
<td>510</td>
</tr>
<tr>
<td>Fixed overhead expenditure</td>
<td>4,560</td>
<td>Fixed overhead efficiency (WIP)</td>
<td>6,290</td>
</tr>
<tr>
<td>Fixed overhead capacity</td>
<td>8,140</td>
<td>Labor efficiency (WIP)</td>
<td>3,400</td>
</tr>
<tr>
<td>Idle time (WIP a/c)</td>
<td>1,000</td>
<td>Material usage (WIP)</td>
<td>500</td>
</tr>
<tr>
<td>P &amp; L a/c</td>
<td></td>
<td></td>
<td>3,600</td>
</tr>
<tr>
<td></td>
<td>14,500</td>
<td></td>
<td>14,500</td>
</tr>
</tbody>
</table>

(l) Profit and Loss Account

<table>
<thead>
<tr>
<th></th>
<th>ₙ</th>
<th></th>
<th>ₙ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of sales account</td>
<td>85,900</td>
<td>Sales account</td>
<td>95,600</td>
</tr>
<tr>
<td>Variance account</td>
<td>3,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit (CLC)</td>
<td>6,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>95,600</td>
<td></td>
<td>95,600</td>
</tr>
</tbody>
</table>

Note: That sales are recorded at the actual amount invoiced and that there are no sales variances at all in the accounts.

11.5 ADVANCED VARIANCES

11.5.1 Material Variances - Mix and Yield

In Section 11.4.1 of this chapter, the basic material variances were explained. In some situations, it may be necessary to further analyse the materials usage variances into direct material mix variance and direct material yield variance. This may be possible in situations where the manufacturing process require a mix of various material inputs in order to achieve the expected output such as: production of paints, textiles, roofing sheets, etc. As in a normal process, losses could be caused by pilferage, machine break downs, power failure, evaporation, etc.

There are basically two approaches to analysing material usage variance into mix and yield variances. The first is the individual price method under which individual standard prices are adopted for the components and the second is that which involves the usage of weighted average price for all components.

11.5.2 Individual Materials Method - (Direct Price mix variance)

Direct Materials Mix Variance is "a subset of the direct usage variance, applicable when materials are applied in a standard proportion showing the effect on cost of variations from the standard proportions." (CIMA)
Direct material yield variance

Direct material yield variance is "a subset of the direct materials usage variance applicable when materials are combined in standard proportion." (CIMA)

Mix and yield formulae (individual price method)

\[
\text{Direct Materials Mixture Variance} = \frac{\text{Budgeted Cost of the actual quantity of the actual mixture}}{\text{Budgeted Cost of the actual quantity of the Budgeted Mixture}}
\]

\[
\text{Direct Materials Yield Variance} = \frac{\text{Budgeted Cost of the actual quantity of the Budgeted mixture}}{\text{Budgeted Cost of the Budgeted Quantity of the Budgeted mixture}}
\]

Notes:
(a) The mix and yield variances use only budgeted prices;
(b) The change of expressions from actual to budgeted values; and
(c) The yield variance measures abnormal process losses or gains.

ILLUSTRATION 11-4

A paint is made by mixing and processing three components, R, S, and T. The standard cost data are:

<table>
<thead>
<tr>
<th>Components</th>
<th>Standard Proportion</th>
<th>Standard Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>40%</td>
<td>₦25 per kg</td>
</tr>
<tr>
<td>S</td>
<td>40%</td>
<td>₦30 per kg</td>
</tr>
<tr>
<td>T</td>
<td>20%</td>
<td>₦40 per kg</td>
</tr>
</tbody>
</table>

A standard process loss of 5% is anticipated.
In a period, the output was 94 kg and the inputs were as follows:

<table>
<thead>
<tr>
<th>Actual usage</th>
<th>Actual price</th>
<th>Actual cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>50 kg</td>
<td>₦18 per kg</td>
</tr>
<tr>
<td>S</td>
<td>40 kg</td>
<td>₦21.50 per kg</td>
</tr>
<tr>
<td>T</td>
<td>10 kg</td>
<td>₦45 per kg</td>
</tr>
</tbody>
</table>

Calculate all the relevant material variances using the individual price method.
SUGGESTED SOLUTION 11-4

The total variance is calculated thus: (SC - AC)

Standard cost for 1 kg

<table>
<thead>
<tr>
<th>Components</th>
<th>R</th>
<th>0.4 kg @ 300</th>
<th>= 120</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>0.4 kg @ 30</td>
<td>= 120</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>0.2 kg @ 40</td>
<td>= 80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300</td>
</tr>
</tbody>
</table>

1 kg of input at standard produced 0.95 kg of output, so the standard cost per kg of output is:

\[
\frac{30}{1} \times \frac{100}{95} = \text{N} 31.58
\]

Standard cost of actual output = 94 x N 31.58 = N 2,968.50

Actual cost of output = N 2,210.00

Total Variance = N 758.50 (F)

The three relevant variances are: Price, Mix and Yield which are to be calculated in that order. The usage variance is merely the total of the mix and yield variances.

Notes:

(a) Actual usage, actual mix, actual price is the cost given in the question, i.e N 2,210

(b) The actual usage in the actual proportions is evaluated at the budgeted price i.e. N (50 x 25) + (40 x 30) + (10 x 40) = N 2,850

(c) The budgeted mix is found by putting the actual total quantity (100 tonnes) into the budgeted proportions(40%, 40% and 20%), i.e. 40R 40S, and 20T.

These are determined at the budgeted prices and compared with the values from (b).

<table>
<thead>
<tr>
<th>Components</th>
<th>Actual usage</th>
<th>Total usage in budgeted proportions</th>
<th>Difference</th>
<th>Budgeted price</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>50</td>
<td>40</td>
<td>-10</td>
<td>25</td>
<td>250 (A)</td>
</tr>
<tr>
<td>S</td>
<td>40</td>
<td>40</td>
<td>0</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>T</td>
<td>10</td>
<td>20</td>
<td>+10</td>
<td>40</td>
<td>400 (F)</td>
</tr>
<tr>
<td>100</td>
<td>100</td>
<td>Total Mix Variance = 150 (F)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(d) The budgeted usage is found by working back from the actual output (94 kg) to determine what the budgeted total quantity of inputs should be, assuming a normal process loss of 5%. That is, budgeted output quantity = 95% budgeted input quantity.

1 budgeted input quantity = \( \frac{100}{95} \times \) actual output quantity

\[ = \frac{100}{95} \times 94 \text{kg} = 98.95 \text{kg} \]

This value is apportioned in the budgeted ratios calculated at the budgeted price and compared with the values from (c) thus:

<table>
<thead>
<tr>
<th>Components</th>
<th>Actual usage</th>
<th>Total usage in budgeted proportions</th>
<th>Difference</th>
<th>Budgeted price</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kg</td>
<td>Kg</td>
<td>Kg</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>R</td>
<td>40 (98.95 x 40%)</td>
<td>39.58</td>
<td>-0.42</td>
<td>25</td>
<td>10.5</td>
</tr>
<tr>
<td>S</td>
<td>40(98.95 x 49%)</td>
<td>39.58</td>
<td>-0.42</td>
<td>30</td>
<td>12.6</td>
</tr>
<tr>
<td>T</td>
<td>20(98.95 x 20%)</td>
<td>19.79</td>
<td>-0.21</td>
<td>40</td>
<td>8.4</td>
</tr>
<tr>
<td>100</td>
<td>98.95</td>
<td>Total Yield Variance</td>
<td>31.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11.5.3 Direct Materials Mix Variance / Weighted Average Price Method (Alternative Method)

Direct materials mix variance is, "the difference between standard quantity of inputs for the output achieved and the actual quantity used priced at the difference between individual standard prices and weighted average standard price". (CIMA)

Direct materials yield variance is the difference between the standard quantity of inputs for the output achieved and the actual quantity used priced at the weighted average standard price.

ILLUSTRATION 11-5

Using illustration 11-4, calculate all relevant material variances based on the weighted average price method.

SUGGESTED SOLUTION 11-5

Using illustration 11.4, the direct material cost variance remains at ₦758.5 FAV and the direct material price variance is at ₦640 FAV, even though computed in the same manner.
To determine the weighted average mix and yield variances, the input quantity differences and the weighted average standard components price are computed as follows:

<table>
<thead>
<tr>
<th>Components</th>
<th>Actual usage Kg</th>
<th>Budgeted usage for output in proportions (kg) Kg</th>
<th>Input Differences Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>50</td>
<td>39.58</td>
<td>10.42</td>
</tr>
<tr>
<td>S</td>
<td>40</td>
<td>39.58</td>
<td>0.42</td>
</tr>
<tr>
<td>T</td>
<td>10</td>
<td>19.79</td>
<td>(9.79)</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>98.95</td>
<td>1.05</td>
</tr>
</tbody>
</table>

The weighted average budgeted and component price is calculated thus:

\[ \text{Components} \quad \text{Budgeted price less weighted average price} \]

\[ R \quad 0.4 \times 25 = 10.0 \]
\[ S \quad 0.4 \times 30 = 12.0 \]
\[ T \quad 0.2 \times 40 = 8.0 \]
\[ \quad \text{Total Mix Variance} \quad 30.0 \]

Therefore, weighted average component cost is N30 per kg.

The mix variance is determined as follows:

<table>
<thead>
<tr>
<th>Components</th>
<th>Input differences</th>
<th>Budgeted price less weighted average price N</th>
<th>Variance N</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>10.42</td>
<td>N(25 - 30) = -5</td>
<td>52.10 A</td>
</tr>
<tr>
<td>S</td>
<td>0.42</td>
<td>N(30 - 30) = 0</td>
<td>0</td>
</tr>
<tr>
<td>T</td>
<td>-9.79</td>
<td>N(40 - 30) = 10.0</td>
<td>97.9 A</td>
</tr>
</tbody>
</table>

Yield Variance

<table>
<thead>
<tr>
<th>Components</th>
<th>Input differences</th>
<th>Weighted average budgeted price (N)</th>
<th>Variance N</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>10.42</td>
<td>30</td>
<td>312.60 F</td>
</tr>
<tr>
<td>S</td>
<td>0.42</td>
<td>30</td>
<td>12.60 F</td>
</tr>
<tr>
<td>T</td>
<td>-9.79</td>
<td>30</td>
<td>293.70 A</td>
</tr>
</tbody>
</table>

Total Yield Variance 31.50 A
11.5.4 Sales Margin Variances

Apart from the cost variance analysis carried out for control reasons, other factors required for the realisation of planned profit is the effect of the sales margin whether as profit margin in the case of absorption costing or the contribution margin where the marginal costing technique is applied. Under this circumstance, all products are valued at the standard factory cost in order to give effect to sales margin variance analysis. Therefore, the standard sales margin is actually the difference between the budgeted selling price of a product and the related standard cost which could also be referred to as the budgeted profit for a product.

♦ Total sales margin variance

This is the difference between the standard margin from sales and the actual margin when the cost of sales is treated at the standard cost of production. This can be sub-analysed into the sales margin price and quantity variances.

♦ Sales margin price variance

This is “the difference between the standard margin per unit and the actual margin per unit for the quantity of units on sale in the period”. (CIMA)

♦ Sales margin quantity variance

This is the difference between the predetermined number of units sold and the actual number of units sold valued at the standard margin per unit.

However, where the products sold are more than one, the sales margin quantity variance may be sub-analysed into mix variance and volume variance whereby the mix variance gives the effect on profits of difference from the budgeted sales mixture while the volume variance gives the effect of the unit volume variations from the budget. The definitions of the above sub-analysed variances are:

♦ Sales margin mixture variance

"The difference between the actual total number of units at the actual mix and the actual total number of units at standard mix valued at the standard margin per unit" (CIMA)
♦ Sales margin volume variance

"That portion of the sales margin quantity variance which is the difference between the actual total quantity of units sold and the budgeted total number of units at the standard mix valued at the standard margin per unit". (CIMA)

**ILLUSTRATION 11-6**

Ijaodola Ltd. produces and sells three product brands of lime. In a period, the budgeted and actual results were as follows:

<table>
<thead>
<tr>
<th>Products</th>
<th>Volume units</th>
<th>Budget price</th>
<th>Margin</th>
<th>Total sales</th>
<th>Total Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Jar</td>
<td>500</td>
<td>20</td>
<td>8</td>
<td>10,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Medium Jar</td>
<td>250</td>
<td>30</td>
<td>12</td>
<td>7,500</td>
<td>3,000</td>
</tr>
<tr>
<td>Large jar</td>
<td>800</td>
<td>50</td>
<td>20</td>
<td>2,500</td>
<td>1,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Products</th>
<th>Volume units</th>
<th>Budget price</th>
<th>Margin</th>
<th>Total sales</th>
<th>Total Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Jar</td>
<td>430</td>
<td>18</td>
<td>6</td>
<td>7,740</td>
<td>2,580</td>
</tr>
<tr>
<td>Medium Jar</td>
<td>230</td>
<td>34</td>
<td>15</td>
<td>7,820</td>
<td>3,450</td>
</tr>
<tr>
<td>Large jar</td>
<td>700</td>
<td>48</td>
<td>18</td>
<td>1,920</td>
<td>720</td>
</tr>
</tbody>
</table>

**Required:**

Determine the following variances:
(a) Sales price;
(b) Sales margin mix;
(c) Sales margin volume; and
(d) Sales margin quantity variance.

**SUGGESTED SOLUTION 11-6**

**IJAODOLA LTD.**

1. **Total sales margin variance = (BQ - AQ)**
   where $BQ = \text{Budgeted quantity at Standard Margin}$
   $AQ = \text{Actual quantity sold at actual margin}$

<table>
<thead>
<tr>
<th>Budgeted Sales</th>
<th>Actual Sales</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2. Sales margin price variances AQS (Standard Margin - Actual Margin)
where AQS = Actual Quantity sold.

\[ \text{Small jar} \quad 430 (8 - 6) = 860A \\
\text{Medium jar} \quad 230 (12 - 15) = 690F \\
\text{Large jar} \quad 40 (20 - 18) = 250A \]

3. Sales margin volume variance = Standard Margin (BQM - SQM)
   BQM = Budgeted Quantity Sales Mix
   SQM = Standard Quantity Mix, that is, Budgeted mix in the proportion of actual mix.

\[ \text{Small jar} \quad 8 (500 - 438) = 496A \\
\text{Medium jar} \quad 12 (250 - 219) = 372A \\
\text{Large jar} \quad 20 (50 - 43) = 140A \\
\text{Total} = 1,008A \]

4. Sales Margin Mix Variance = Standard Margin (SM - AM)
   Standard mix in this case has to do with the standard proportion at actual mix (62.5%, 31.25%, 0.0625%)
   \[ = (438 + 219 + 43) = 700 \]

\[ \text{Small jar} \quad 8 (438 - 430) = 64A \\
\text{Medium jar} \quad 12 (219 - 230) = 132F \\
\text{Large jar} \quad 20 (43 - 40) = 8F \]

11.6 STANDARD MARGINAL COST

It is noteworthy to state that the total absorption costing principles form the basis on which standard costing systems operate. However, the marginal costing principles can also be introduced into standard costing operations, in which case, it may be referred to as standard marginal costing. It should also be recalled that marginal costing operates on the contribution approach, whereby costs are separated into variable and fixed costs and the latter are not part of product costs but are treated as period costs.

The standard marginal costing technique adopts the following principles and characteristics:
(a) Standards are evolved in the usual manner on standard cost card, without the inclusion of the fixed costs. The direct materials, direct labour, direct expenses and variable overheads are recorded on it.

(b) The standard selling price is determined by adding the budgeted contribution for every product to the budgeted marginal cost. Therefore, the budgeted sales margin is the budgeted contribution.

(c) The budgeted sales levels and fixed overhead cost can be used to come up with the budgeted profit statement for the subsequent operating period. The format would appear as below.

Budgeted Profit Statement for the Period ended 20xx

<table>
<thead>
<tr>
<th>Budgeted sales</th>
<th>XXX</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Budgeted no. of units times budgeted selling price)</td>
<td></td>
</tr>
<tr>
<td>less: Budgeted cost of goods sold</td>
<td></td>
</tr>
<tr>
<td>(Budgeted no. of units times budgeted marginal cost per unit)</td>
<td>XXX</td>
</tr>
<tr>
<td>Budgeted Contribution</td>
<td>XXX</td>
</tr>
<tr>
<td>less: Budgeted fixed costs</td>
<td>XXX</td>
</tr>
<tr>
<td>Budgeted profit</td>
<td>XXX</td>
</tr>
</tbody>
</table>

With the non-inclusion of the fixed overhead volume variance and the sub-analysed variances (the capacity and efficiency variances), the analysis of variances becomes easier.

**ILLUSTRATION 11-7**

Mallam Fatima Bello Ltd that produces and sells a single product employs standard marginal costing technique in presenting its results. The budgeted and actual results are given as below:

<table>
<thead>
<tr>
<th></th>
<th>Budget</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>11,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Sales</td>
<td>11,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Sales</td>
<td></td>
<td>330,000</td>
</tr>
<tr>
<td>Less standard</td>
<td></td>
<td>320,000</td>
</tr>
<tr>
<td>marginal cost</td>
<td></td>
<td>Less actual marginal cost</td>
</tr>
<tr>
<td>- materials</td>
<td>66,000</td>
<td>materials</td>
</tr>
<tr>
<td>- Labour</td>
<td>176,000</td>
<td>Labour</td>
</tr>
<tr>
<td>- Variable Overheads</td>
<td>33,000</td>
<td>Variable overheads</td>
</tr>
<tr>
<td></td>
<td>275,000</td>
<td></td>
</tr>
<tr>
<td>=contribution</td>
<td>55,000</td>
<td>=contribution</td>
</tr>
<tr>
<td>Less Fixed Costs</td>
<td>26,000</td>
<td>Less Fixed Costs</td>
</tr>
<tr>
<td>=Profit</td>
<td>29,000</td>
<td>=Profit</td>
</tr>
</tbody>
</table>

The standard cost card shows the following information in respect of the product:
Material Cost Variance (SC - AC)

\[
\begin{array}{l}
SC = 10,000 \times 4\text{KG} \times 1.50 = 60,000 \\
AC = \quad \quad = 55,000 \\
\quad \quad \quad \quad = 5,000 \text{ F}
\end{array}
\]

Material Price Variance: AQ x (SP - AP)

\[
\text{Note: AQ x SP} = 45,000 \times \text{N} 1.50 = \text{N} 67,500
\]

Material Usage Variance: SP (SQ - AQ)

\[
\begin{array}{l}
\text{Note: AH x SR} = 22,000 \times \text{N} 8 = \text{N} 176,000 \\
\text{Labour Efficiency: SR (SH - AH)}
\end{array}
\]

Production Variable Overhead: (SC - AC)

\[
\begin{array}{l}
\text{Note: Production Variable Overhead (SC - AC)}
\end{array}
\]
Production Variable Overhead Expenditure Variance: (AH x SR - AR)
\[ = 22,000 \times 1 - 50,000 \]
\[ = N28,000 \]

Production Variable Overhead Efficiency Variance: SR(SH - AH)
\[ = 1.0 \times (30,000 - 22,000) \]
\[ = N8,000 \]

Sales Price Variance: AQS (SSP - ASP)
\[ = 10,000 \times (N30 - N32) \]
\[ = N20,000 \]

Sales Volume Variance Standard Contribution per unit: (BQ - AQS)
\[ = N5 \times (11,000 - 10,000) \]
\[ = 5,000 \]

Reconciliation Statement (Operating Statement)

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted Contribution</td>
<td>55,000</td>
<td></td>
</tr>
<tr>
<td>Sales Price Variance</td>
<td>20,000</td>
<td>F</td>
</tr>
<tr>
<td>Sales Volume Variance</td>
<td>5,000</td>
<td>A</td>
</tr>
</tbody>
</table>

Cost Variances

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Price Variance</td>
<td></td>
<td>12,500</td>
</tr>
<tr>
<td>Material Usage</td>
<td>7,500</td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>NIL</td>
<td>NIL</td>
</tr>
<tr>
<td>Product Variable Expenditure</td>
<td>28,000</td>
<td></td>
</tr>
<tr>
<td>Product Variable Volume Variance</td>
<td>8,000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Contribution</td>
<td></td>
<td>55,000</td>
</tr>
<tr>
<td>Less: Fixed Costs</td>
<td></td>
<td>25,000</td>
</tr>
<tr>
<td>Actual Profit</td>
<td></td>
<td>30,000</td>
</tr>
</tbody>
</table>

11.7 OPPORTUNITY COST APPROACH TO VARIANCES

These variances conform to the terminologies of the CIMA. It is not uncommon in practice for additional 'special' variances to be included within a reporting system, to reflect the unique characteristics of a company's operations. For example, a flour or sugar manufacturer might include an item in his standard costs for losses due to damaged or broken packs.

Nevertheless, most variance reporting systems conform, on the whole, to the conventional type. In spite of the above, a school of thought, however, suggested a different approach to the calculation of variances.
Demski (1977) argues that, “existing internal accounting techniques of flexible budgeting and variance analysis are thought to be general purpose in nature, because of their emphasis on comparison between actual and planned results”. Analysis of differences between actual and planned results, leads to the taking of remedial action as well as learning. Unfortunately, the price of this generality is an accounting model that merely monitors performance relative to the original plan, except as signaled by implication or use of an adjusted budget. Put another way, because of its emphasis on comparison between actual and planned results, and consequent disregard of changes in these planned results, the traditional accounting model does not act as an opportunity cost system.

11.7.1 Opportunity Cost Approach

An opportunity cost approach “compares what a firm actually accomplished during some planning period with what it deems on the basis of hindsight, it should have accomplished. It is an opportunity cost approach in the sense that what a firm actually accomplished during some planning period is what it should have accomplished in the ex-post optimum programme”. Demski therefore argues that in order to provide control information which guides managers towards better control decisions, it is necessary to show what realistically could have been achieved during a period, rather than what the possibly-out-of-date budget plan intended to be achieved. ‘Instead of comparing actual results with ex ante standard results, this system compares actual results with revised optimum results.

“This implies that the proper standard to be used in supplying variance information is a standard based on actual conditions; that is ‘those that would have been incorporated in the original plan if the actual conditions had been known in advance’. This can be called an ex-post (currently attainable) standard”.

The opportunity cost approach considers:
(a) Actual results;
(b) Budgeted results; and
(c) “Ex-post” optimum results. Traditional variance analysis does not do this.

ILLUSTRATION 11-8

Lydia Oluwaseun Ltd budgeted to make and sell 400 units of its product, the "PLASCO" in the four week period No. 16 in 1998 as follows:
Budgeted Sales (100 units per week for 4 weeks) 40,000
Less:
Variable Costs (400 units x ₦60) 24,000
Contribution 16,000
Fixed costs 10,000
Profit 6,000

At the beginning of the second week, production came to a halt because stocks of raw materials ran out and a new supply was not received until the beginning of the third week. As a consequence, the company lost one week's production and sales.

During the enforced idle time, the labour force (a fixed cost item) spent some hours overhauling their machinery. This will save the company the cost of having the overhaul done in overtime in period No. 20 at a budgeted cost of ₦2,500.

Actual results in period 16 were as follows:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>32,000</td>
</tr>
<tr>
<td>Less:</td>
<td></td>
</tr>
<tr>
<td>Variable Costs (320 units x ₦60)</td>
<td>19,200</td>
</tr>
<tr>
<td>Contribution</td>
<td>12,800</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>10,000</td>
</tr>
<tr>
<td>Actual profit</td>
<td>2,800</td>
</tr>
</tbody>
</table>

What is the opportunity cost approach to reporting the variance?

**SUGGESTED SOLUTION 11-8**

**LYDIA OLUWASEUN LIMITED**

In retrospect, it might be decided that the optimum budget, given the loss of production facilities in the third week, would have been to produce only 300 units in the period.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted sales volume (ex-ante budget)</td>
<td>400 units</td>
</tr>
<tr>
<td>Realistic (ex-post) sales volume</td>
<td>300 units</td>
</tr>
<tr>
<td>Variance</td>
<td>100 units (A)</td>
</tr>
<tr>
<td>x Std Contribution per unit</td>
<td>40</td>
</tr>
<tr>
<td>Opportunity cost of material shortage</td>
<td>₦4,000(A)</td>
</tr>
</tbody>
</table>

However, the work done in period No. 16 to save costs in period No. 20 would also be reported.
There would be another sales volume variance, as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Realistic (ex post) sales volume</td>
<td>300 units</td>
</tr>
<tr>
<td>Actual sales volume</td>
<td>320 units</td>
</tr>
<tr>
<td>Sales volume variance</td>
<td>20 units (F)</td>
</tr>
</tbody>
</table>
(possibly due to production efficiency
or marketing efficiency)
\(x \text{ N40 Contribution} \quad \text{N800 (F)}\)

<table>
<thead>
<tr>
<th>Operating statement, Period No.16</th>
<th>N</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted profit</td>
<td></td>
<td>6,000</td>
</tr>
<tr>
<td>Opportunity cost of materials storage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Volume</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine overhaul spending</td>
<td>4,000 (A)</td>
<td>2,500 (F)</td>
</tr>
<tr>
<td></td>
<td>1,500 (A)</td>
<td></td>
</tr>
<tr>
<td>Sales volume variance (due to production Efficiency)</td>
<td>800 (F)</td>
<td>700 (A)</td>
</tr>
<tr>
<td>Profit, including saving in period No. 20 is</td>
<td></td>
<td>5,300</td>
</tr>
<tr>
<td>Of which, saving in period No. 20</td>
<td></td>
<td>2,500</td>
</tr>
<tr>
<td>Actual profit in period No. 16</td>
<td></td>
<td>2,800</td>
</tr>
</tbody>
</table>

**ILLUSTRATION 11-9**

Raphael Olalekan Limited makes a single product which has the following standard variable costs;

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material</td>
<td>6</td>
</tr>
<tr>
<td>Direct labour (3 hours)</td>
<td>9</td>
</tr>
</tbody>
</table>

\[
\text{Total} = 6 + 9 = 15
\]

The standard sales price per unit is N20. Total labour capacity for one week is 3,000 hours but the company expects to make and sell only 900 units in week No.17.

The difference between the total budgeted labour cost of 3,000 hours x N3 = N9,000 and the direct labour cost of production (900 units x N9) = N8,100 is budgeted as 300 hours of idle time at a cost of N900. Budgeted fixed costs, excluding idle time, amount to N2,000. The company holds no stocks of finished goods at any time.

A power cut on the first day of week No. 17 halted production for the entire day and actual production and sales in week No. 17 were only 700 units. Revenue was N14,000, and direct material costs were N4,400. The direct labour force was paid in full, a total of N9,000 for the week, and actual fixed costs, excluding idle time were N2,000.

It is expected that during week No. 18, it will be possible to make up lost production and sales of 100 units by making use of idle capacity. All other unsatisfied sales demand in week No. 17 will be lost forever.
Analyse the variances using an opportunity cost approach. (Labour costs will be treated as a fixed cost, because of the idle time element)

**SUGGESTED SOLUTION 11-9**

**RAPHAEL OLALEKAN LIMITED**

The contribution per unit is N14, since direct labour is being treated as a fixed cost item. The ex-post realistic budget, given the loss of one day’s output, would have been to eliminate idle time entirely, and produce 800 units in the week.

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total hours in week No. 17</td>
<td>3,000</td>
</tr>
<tr>
<td>Hours lost on inactive day (one-fifth)</td>
<td>600</td>
</tr>
<tr>
<td>Remaining hours for working</td>
<td>2,400</td>
</tr>
<tr>
<td>Hours per unit</td>
<td>3 hours per unit</td>
</tr>
<tr>
<td>Feasible production and sales in week No. 17</td>
<td>800 units</td>
</tr>
<tr>
<td>Actual production and sales</td>
<td>700 units</td>
</tr>
<tr>
<td>Lost sales volume</td>
<td>100 units (A)</td>
</tr>
<tr>
<td>x Contribution</td>
<td>N14</td>
</tr>
<tr>
<td></td>
<td><strong>N 1,400</strong> (A)</td>
</tr>
</tbody>
</table>

Failure to achieve the feasible production of 800 units would be due to either:

(a) Inefficiency in the hours worked. In 4 days, if idle time is unused, the company should produce 4/5 of the budgeted output, that is, 4/5 of 900 units = 720 units. Since 700 units were made, there would appear to be an adverse efficiency variance of 20 units of output, or N280 in contribution forgone;

OR

(b) Failure to utilize the available spare labour capacity. Since the budgeted idle time for week 17 totaled 300 hours, of which 60 hours (one-fifth) were presumably expected on the day actually lost to production, there were 240 available hours of idle time in the budget which could have been used to produce output of 80 units, at 3 hours per unit. Failure to use this idle time is therefore an adverse opportunity cost of 80 units of lost production and sales, or N1,120 in contribution foregone.

Budgeted profit was N1,600.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted sales in week 17 (900 x N20)</td>
<td>18,000</td>
</tr>
<tr>
<td>Direct material costs N6 per unit</td>
<td>5,400</td>
</tr>
<tr>
<td>Contribution (at N14 per unit)</td>
<td>12,600</td>
</tr>
</tbody>
</table>
Less: Direct Labour (including idle time)  9,000

3,600

Less: other fixed costs  2,000

Budgeted profit  1,600

There was an actual loss of N1,400 as follows:

| Item                      | Amount
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>14,000</td>
</tr>
<tr>
<td>Direct materials</td>
<td>4,400</td>
</tr>
<tr>
<td>Direct labour</td>
<td>9,000</td>
</tr>
<tr>
<td>Other fixed costs</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15,400</td>
</tr>
</tbody>
</table>

Reconciliation of Operating Statement, Week No. 17.

| Item                      | Amount
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted Profit</td>
<td>1,600</td>
</tr>
<tr>
<td>Material Cost Variance</td>
<td>200 (A)</td>
</tr>
<tr>
<td>Loss of sales volume due to power cut</td>
<td>1,400 (A)</td>
</tr>
<tr>
<td>Loss of sales volume due to failure to utilize available idle time</td>
<td>1,120 (A)</td>
</tr>
<tr>
<td>Loss of sales volume due to inefficiency</td>
<td>280(A)</td>
</tr>
<tr>
<td>Reported loss in week 17</td>
<td>3,000 (A)</td>
</tr>
<tr>
<td>Expected recovery of sales volume in week 18 (100 units x N14)</td>
<td>(1,400)</td>
</tr>
<tr>
<td>Net profit, after crediting the value of recovery work</td>
<td>NIL</td>
</tr>
</tbody>
</table>

11.7.2 Marginal Costing and Opportunity Costs

It must have been noticed that in the previous examples, marginal costing variances were calculated, that is, sales volume variances were valued at contribution foregone and there are no fixed cost volume variances. This is because contribution foregone, in terms of lost revenue or extra expenditure incurred is the nearest equivalent to opportunity cost which is readily available to management accountants (who assume linearity of costs and revenues within a relevant range of activity).

11.7.3 The Opportunity Cost of Capacity Variances

Horngren (1990) suggested that a 'contribution foregone' approach to reporting capacity variances would be preferable to the traditional absorption costing capacity variance.
ILLUSTRATION 11-10

The master budget of Jones Ltd for 2010 is to make and sell 100 units of its product each month, at a contribution of N50 per unit. However, at the beginning of May, the scheduled production for the month was reduced to 95 units because of difficulties in making sales to customers. Each unit takes 4 hours to make, and actual production and sales in May amounted to 90 units in 360 hours of work. Calculate the opportunity cost of the capacity variances.

SUGGESTED SOLUTION 11-10

(a)  Scheduled production for May in the Master Budget  400 hours
     Schedule production at the beginning of the month 380 hours
     Marketing capacity variance 20 hours (A)

     At N50 per unit (N12.5 per hour), the contribution foregone is N250 by the failure of the sales department to achieve the expected sales.

(b)  Similarly;
     Scheduled production at the beginning of the month 380 hours
     Actual hours worked 360 hours
     Production capacity 20 hours (A)

     The contribution foregone is N250 by the failure of the production department to meet its output targets.

(c)  
     |                      | N  |   |
     |----------------------|----|----|
     | Budgeted Contribution| 5,000 |
     | Opportunity cost of   |     |
     | Marketing Capacity Variance | 250 (A) |
     | Production Capacity Variance | 250 (A) | 500 |
     | Actual Contribution (90 units x N50) | 4,500 |

11.7.4 The Opportunity Cost of Efficiency Variances

The same argument might be applied to efficiency variances. If inefficiency, by restricting output below what it should have been, also results in lost sales, the cost of inefficiency will include the contribution foregone by losing the sales.
ILLUSTRATION 11-11

Ayo Wale Ltd budgets to make and sell 200 units of its product during a period. Unit costs are as follows:

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Direct materials</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Direct labour (5 hours per unit)</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Contribution</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

During the period, the production department works for 1,000 hours and produces 175 units. The actual contribution was

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales (175 units at ₦18)</td>
<td></td>
<td>3,150</td>
</tr>
<tr>
<td>Direct Materials</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Direct Labour</td>
<td>2,000</td>
<td>3,000</td>
</tr>
<tr>
<td>Actual contribution</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

Analyse the variances from an opportunity cost approach.

SUGGESTED SOLUTION 11-11

175 units should take (x 5 hours) 875 hours
but did take 1,000 hours
Efficiency variance 125 hours (A)
X ₦2 per hour ₦250 (A)

Inefficiency of 125 hours (A) has also cost the company lost production and sales of 25 units, and the contribution foregone from these sales at ₦2 per unit is ₦50 (A).

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted Contribution</td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>Efficiency Variance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour costs</td>
<td>250 (A)</td>
<td></td>
</tr>
<tr>
<td>Lost sales volume</td>
<td>50 (A)</td>
<td></td>
</tr>
<tr>
<td>300 (A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material cost variance</td>
<td>50 (F)</td>
<td>250 (A)</td>
</tr>
<tr>
<td>Actual contribution</td>
<td></td>
<td>150</td>
</tr>
</tbody>
</table>

11.8 PLANNING AND OPERATIONAL VARIANCES

Traditional variances imply that actual performance is always at fault, as a result of the method of analysing variances between operational and planning factors, that cause failure to achieve budgeted profit, in that, faulty standards could be identified separately.
Planning and operational variances provide additional relevant information as they separate the variances into components which are the results of good planning and operation.

When planning, variances may not be separated, as some elements which are uncontrollable may work against the planning system. It must however be remembered that the Planning and Operational approach does not make the traditional approach absolute, but rather make the information of things more relevant especially in controlling the operation of the organisation. The main difficulty in this approach is the ability of the management to separate the total variances into their planning as well as operational sources, hence most organisations are slow in modifying their systems in this direction.

11.8.1 Calculation of Planning and Operational Variances

In calculating planning and operational variances, we have to understand the following terms:

(a) **Ex-Ante**: this is the first target set.

(b) **Ex-Post**: this is the later situation during the year or immediately, which were not foreseen during the first target (Budget);

(c) **Actual Result**: this is actual result at the end of the period

Planning Variances \[= \text{Ex-Ante} \, \text{minus} \, \text{Ex-Post}\]

Operational Variances \[= \text{Ex-Post} \, \text{minus} \, \text{Actual Result}\]

Planning variances are those variances which are not within the control of management (Uncontrollable).

Operational variances are variances which are controllable by the management.

Planning variances may be due to the following:

(a) New government policy on importation;

(b) New government policy on taxation; and

(c) Inflation.
ILLUSTRATION 11-12

In January 2009, Obisesan Limited set a standard marginal cost for its major product at ₦50 per unit. The standard cost is re-calculated once each year.

Actual production costs during August 2009 were ₦608,000, when 8,500 units were made.

With the benefit of hindsight, the management of Jaye Limited realises that a more realistic standard cost for current conditions would be ₦80 per unit. The planned standard cost of ₦50 is unrealistically low.

Calculate the planning and operational variances.

SUGGESTED SOLUTION 11-12

OBISESAN LIMITED

With the benefits of hindsight, the realistic standard should have been ₦80. The variances caused by favourable or adverse operating performance, that is, the material price and usage, labour rate and efficiency variances etc. - should be calculated by comparing actual results against this realistic standard. Since the variance should then be a true reflection of operating performance, they will be called operational variances, that is, (Ex-post less Actual Result).

\[
\begin{align*}
\text{N} & \\
8,500 \text{ units should (realistically have cost (x ₦80)} & = 680,000 \\
\text{But did cost} & = 608,000 \\
\text{Total Operating Variances} & = 72,000 \text{ F} \\
\text{The planning variance reveals the extent to which the original standard would be at fault (Ex-Ante less Ex-post).}
\end{align*}
\]

\[
\begin{align*}
\text{The original (ex-ante) standard cost} & = 425,000 \\
8,500 \text{ units x ₦50 per unit} & = 425,000 \\
\text{The realistic retrospective (ex-post) standard cost} & = 680,000 \\
8,500 \text{ units x ₦80 per unit} & = 680,000 \\
\text{Planning Variance} & = 255,000 \text{ A}
\end{align*}
\]

(Note: It is an adverse variance because the original standard was too optimistic, that is, over-estimating the expected profits by understating the standard cost)
<table>
<thead>
<tr>
<th>Planning variance</th>
<th>N 255,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating variances</td>
<td>(N 72,000)</td>
</tr>
<tr>
<td>Total</td>
<td>N 183,000</td>
</tr>
</tbody>
</table>

If traditional variance analysis had been used, the total cost variance would have been the same, but the “blame” would all appear to lie on actual results and operating inefficiencies.

| Standard cost (ex-ante) of 8,500 units (x N 50) | N 425,000 |
| Actual cost of 8,500 units                      | N 608,000 |
| Total Cost Variance                            | N 183,000 |

Bromwich (1990) would argue that:

(a) the total cost variance reported by the traditional method would not be helpful for management control purposes;

(b) planning and operating variances give a better idea of why actual results failed to reach the original budget expectations. Operating variances may or may not be controllable, whereas planning variances tend to be uncontrollable. If the standard is wrong, no amount of control-action to adjust operating resources will reconcile actual results to the faulty budget. Nevertheless, planning variance reveals a severe weakness in a business organization in that failure to budget correctly may lead a company into severe financial difficulties or at best poor financial results for the accounting period. They need to be identified, albeit in hindsight, and eliminated as much as possible in future planning.

**ILLUSTRATION 11-13**

Imohbio Limited budgeted to sell 10,000 units of a new product during 2009. The budget sales price was N 20 per unit, and the variable cost N 6 per unit. Although actual sales in 2009 were 10,000 units and variable costs of sales were N 60,000, sales revenue was only N 10 per unit.

With the benefit of hindsight, it is realised that the budgeted sales price of N 20 was hopelessly optimistic, and a price of N 9 per unit would have been much more realistic.

Required: Analyse the variances into operating and planning variances.
SUGGESTED SOLUTION 11-13

IMOHBIO LIMITED

Budgeted Contribution 140,000 (₦ 14 per unit)
Actual contribution 40,000 (₦ 4 per unit)
Total Variances 50,000 (A)

The only variances are sales price variances.
Operating (sales price) variance
10,000 units sold for ₦ 10 each 100,000
but should (realistically) have been sold for ₦ 9 each 90,000
10,000 (F)

Planning (sales price) variance:

<table>
<thead>
<tr>
<th>Volume</th>
<th>Sales price</th>
<th>Variable cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution</td>
<td>₦</td>
<td>₦</td>
<td>₦</td>
</tr>
<tr>
<td>Ex-ante (original) budget</td>
<td>10,000 units</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Ex-post (realistic) budget</td>
<td>10,000 units</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Planning Variance</td>
<td>A per unit</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

The total difference between budgeted and actual profit of ₦50,000 (A) can be analysed as:

<table>
<thead>
<tr>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating variance (sales price) 5,000 (F)</td>
</tr>
<tr>
<td>Planning Variance 55,000 (A)</td>
</tr>
<tr>
<td>50,000 (A)</td>
</tr>
</tbody>
</table>

ILLUSTRATION 11-14

Gani Alakese Ltd budget includes raw material costs per unit of product of 2kg of gold at ₦ 1,000 per kg = ₦ 2,000

Due to a rise in world prices for gold during the year, the average market price of gold rises to ₦ 1,500 per kg. An alternative raw material, platinum, which could have been chosen instead of gold (and used in the same quantities) had an average market price of ₦ 1,200 per kg.

During the year, 1,000 units were produced at a cost of ₦ 3,250,000 of gold for 2,200kg. What are the planning and operational variances?
SUGGESTED SOLUTION 11-14

GANI ALASHE LIMITED

(a) Operational variances (applying a realistic standard cost for gold of ₦1.500 per kg):

(i) Material usage variance (2000 - 2200) x ₦1,500 = 300(A)

(ii) Material price variance

\[(2,200kg \times ₦1,500 - ₦3,250,000)\]

50(F)

Total operational variance

\[250(A)\]

(b) Planning variances:

(i) Ex-ante standard cost 1000 units x 2kg x ₦1,000 = 2,000

Ex-post realistic standard cost, using gold as the Material 1000 units x 2kg x ₦1,500

3,000

Total planning variance

1,000

(ii) A possibly avoidable planning variance is the saving that would have been made by using platinum instead of gold:

Ex-post standard cost, using platinum

\[₦’000\]

1000 units x 2kg x ₦1,500

3,000

Possibly achievable standard cost, using platinum

1000 units x 2kg x ₦1,200

2,400

Possibly avoidable variance

600 (A)

(iii) An unavoidable planning variance is the amount by which the planned material price was different from the minimum practicable price:

Ex ante standard cost, using gold

\[₦’000\]

1000 units x 2kg x ₦1,000

2,000

Minimum realistic standard cost, using platinum

1000 units 2kg x ₦1,200

2,400

Unavoidable variance

400 (A)

(c) Summary

\[₦’000\]

Standard material cost

of 1,000 units (₦2,000 x 1,000)

2,000

Operational variances:

Material prices

50(F)

Material usage

300(A) 250(A)
Planning variances:

<table>
<thead>
<tr>
<th></th>
<th>₦’000</th>
<th>₦’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibly avoidable</td>
<td>600(A)</td>
<td></td>
</tr>
<tr>
<td>Unavoidable</td>
<td>400(A)</td>
<td>1,000(A)</td>
</tr>
<tr>
<td>Total planning and operational variances</td>
<td>1,250(A)</td>
<td></td>
</tr>
<tr>
<td>Actual material cost of 1,000 units</td>
<td></td>
<td>3,250</td>
</tr>
</tbody>
</table>

(d) The traditional approach to variance analysis would have been as follows:

<table>
<thead>
<tr>
<th></th>
<th>₦’000</th>
<th>₦’000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,200 kg of platinum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>should cost (x 1,000)</td>
<td>2,200</td>
<td></td>
</tr>
<tr>
<td>did cost</td>
<td>3,250</td>
<td></td>
</tr>
<tr>
<td>Material price variance</td>
<td></td>
<td>1,050(A)</td>
</tr>
<tr>
<td>Material Usage Variance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200kg (A), ₦1,000</td>
<td>200(A)</td>
<td></td>
</tr>
<tr>
<td>Total 'Traditional' variances</td>
<td>1,250(A)</td>
<td></td>
</tr>
</tbody>
</table>

ILLUSTRATION 11-15

In the examples described so far, there has only been one 'planning error' in the standard cost. When two planning errors occur, there may be some difficulty in deciding how much of the total planning variance is due to each separate error.

For example, assuming that Holts Limited estimates that the standard direct material cost for a product should be:

\[4 \text{kg} \times ₦5 \text{ per kg} = ₦20\]

Actual production of 1,000 units consumed 6,200kg of material at a cost of ₦23,800. In retrospect, it is realized that the standard cost should have been 6kg x ₦4 per kg = ₦24 per unit.

Required: Calculate the planning and operating variances.

SUGGESTED SOLUTION 11-15

(a) Operating variances

(i) Material Usage Variance

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000 units should use</td>
<td></td>
<td>6,000kg</td>
</tr>
<tr>
<td>did use</td>
<td></td>
<td>6,200kg</td>
</tr>
<tr>
<td>Usage variance</td>
<td></td>
<td>200kg(A)</td>
</tr>
<tr>
<td>x Ex-post standard cost ₦4</td>
<td></td>
<td>800(A)</td>
</tr>
</tbody>
</table>
(ii) Material price variance: 
\[
\begin{align*}
6,200 \text{kg should cost} & \times \mathcal{N}4 \\
\text{did cost} & \mathcal{N}23,800 \\
\text{Material price variance} & \mathcal{N}1,000 \text{(F)}
\end{align*}
\]

(iii) Total operating variance

Note: Ex-post standard 
Cost (1000 units \times \mathcal{N}24) \quad \mathcal{N}24,000 
Actual costs \quad \mathcal{N}23,800 
Total operating variance \quad \mathcal{N}200 \text{(F)}

(b) Planning variance

\[
\begin{align*}
\text{Ex-ante standard cost} & \ 1000 \text{ units} \times 4 \text{kg} \times \mathcal{N}5 \\
& \mathcal{N}20,000 \\
\text{Ex-post standard cost} & \ 1000 \text{ units} \times 6 \text{kg} \times \mathcal{N}4 \\
& \mathcal{N}24,000 \\
\text{Planning variance} & \mathcal{N}4,000 \\
\end{align*}
\]

Within the total planning variance, there is:

(i) A planning usage variance of 1000 units \times (6-4) \text{kg or 2,000 kg} \text{(A)}

(ii) A planning price variance of \mathcal{N}1 \text{ per kg (F)}

The problem, however, is now found in putting a total variance to these variances. This can be done in two ways:

(c)(i) Planning usage variance \ 2,000 \text{kg} \text{(A)} \times \text{ex-ante price of} \ \mathcal{N}5 \\
Planning price variance \mathcal{N}1 \text{ per kg (F)} \text{ ex post standard} \\
\text{Usage} \ 6,000 \text{ kg} \quad \mathcal{N}6,000 \text{(F)} \\
\text{Total} \quad \mathcal{N}4,000 \text{(A)}

\[
\begin{align*}
\text{(ii) Planning usage variance} & \ 2,000 \text{ kg} \text{(A)} \times \text{ex-post price of} \ \mathcal{N}4 \\
& \mathcal{N}8,000 \\
\mathcal{N}1 \text{ per kg (F) ex ante usage of} & \ 4,000 \text{ kg} \\
& \mathcal{N}4,000 \\
\text{Total} & \mathcal{N}4,000 \text{(A)}
\end{align*}
\]

Since the analysis can be done either way, it is doubtful whether there is much value in splitting the total planning variance. However, this point may be examinable and is worth learning. There is much literature on the opportunity cost approach to variances, but the traditional approach is used in practice by most companies with a standard costing system. Developments in this area of management accountancy should be watched with interest.
11.8.2 Importance and shortcomings of Planning and Operational Variances

Even though, the conventional variances may not be analysed into the planning and operational elements, the importance cannot be underestimated because it:

(a) Ensures an orderly manner of reviewing standards as well as the associated basis for setting them up;

(b) Prompts the realistic nature of standard costing and variance analysis, especially where circumstances change and are drastic;

(c) Ensures the usage of updated information, especially in the operational variances adopted for determining present levels of efficiency;

(d) Since standard costing as a technique is realistic and informative, its acceptability will be on the high side and encourage motivation; and

(e) Since the planning efforts are enhanced, problem areas can easily be identified and actions taken as at when due.

Nonetheless, the shortcomings of the variances include:

(a) The responsibility centres may experience some form of pressure especially where interpretations are involved in terms of controllable and uncontrollable activities or internal or external factors affecting planning and operating duties;

(b) The determination and up-dating of additional variances entail many clerical and managerial efforts on a continuous basis; and

(c) The determination of the ex-post element may be subjective, hence resulting in the allotment of the planning and operational causal factors being political in nature.

11.9 CONTROL RATIOS

The units of output can be shown in different forms for the purpose of standard costing. They are identified as a peculiar element/unit, that is, the standard hour which is referred to as the quantity of production that should be produced in an hour.

A standard hour is a measure of the work content in an hour and not that of time involved or taken to produce. For example, if 500 units of a product should be produced in one hour, then an output of 2000 units is equivalent to 4 standard hours.
Therefore, the relationship between standard hours and actual production can be expressed as control ratios. These are used to show the degree of efficient or inefficient utilisation of resources at the disposal of management.

The following ratios can be computed:

(a) **Activity Ratio**

This ratio compares the actual level of production with the planned level of production.

It can be expressed as:

\[
\frac{\text{Standard hours equivalent of production}}{\text{Budgeted hours}} \times \frac{100}{1}
\]

It is not a measure of efficiency, but it indicates the level of activity which has, in fact, been achieved.

(b) **The Efficiency Ratio**

This ratio measures the efficiency with which production has been achieved. Actual time taken to achieve the actual production is compared with the time such production should have taken.

The efficiency ratio can be expressed as:

\[
\frac{\text{Standard hours equivalent of actual production}}{\text{Actual hours worked}} \times \frac{100}{1}
\]

(c) **The Capacity Ratio**

This ratio assesses the utilisation of the available capacity by comparing actual hours worked with budgeted hours. This can be expressed as:

\[
\frac{\text{Actual hours worked}}{\text{Budgeted hours}} \times \frac{100}{1}
\]

It should be noted that:

Activity ratio = capacity ratio $\times$ efficiency ratio.
ILLUSTRATION 11-16

One of the departments of Akintoye Rufus Company Limited produces two products "Gas oil" and "kerosene". The standard times for the production of the products are 30 minutes for Gas oil and 24 minutes for kerosene. The budget for July is 24,000 units of Gas oil and 10,000 units of kerosene. During the month, 12,000 labour hours were worked and 20,000 units of Gas oil and 8,000 units of kerosene were produced.

You are required to compute:
(a) The activity ratio;
(b) The efficiency ratio; and
(c) The capacity ratio and interpret your results.

SUGGESTED SOLUTION 11-16

AKINTOYE RUFUS

The Standard hours equivalent to actual production for July is:

<table>
<thead>
<tr>
<th>Product</th>
<th>Standard Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas oil</td>
<td>20,000 x ( \frac{30}{60} ) = 10,000</td>
</tr>
<tr>
<td>Kerosene</td>
<td>8,000 x ( \frac{24}{60} ) = 3,200</td>
</tr>
</tbody>
</table>

The budget in terms of standard hours is:

<table>
<thead>
<tr>
<th>Product</th>
<th>Budgeted Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas oil</td>
<td>24,000 x ( \frac{30}{60} ) = 12,000</td>
</tr>
<tr>
<td>Kerosene</td>
<td>10,000 x ( \frac{30}{60} ) = 5,000</td>
</tr>
</tbody>
</table>

The control ratios are:

\[ \text{a) Activity Ratio} = \frac{\text{Standard Hours}}{\text{Budgeted Hours}} \]
\[ \frac{13,200}{17,000} \times \frac{100}{1} = 77.6\% \]

This means that the actual level of production is less than the budgeted level by 22.6%.

(b) Efficiency Ratio \[ \frac{\text{Standard hours}}{\text{Actual hours}} \times \frac{100}{1} \]
\[ = \frac{13,200}{12,000} \times \frac{100}{1} = 110\% \]

This means that the actual level of production was achieved in less time than standard by working at a rate which was nearly 10% above the normal level of efficiency.

(c) Capacity Ratio \[ \frac{\text{Actual hours worked}}{\text{Budgeted hours}} \times \frac{100}{1} \]
\[ = \frac{12,000}{17,000} \times \frac{100}{1} = 70.5\% \]

This means that the actual hour worked were less than the budgeted hours by 30%.

11.10 SUMMARY AND CONCLUSIONS

Standard costing involves comparing actual costs with predetermined costs.

The various types of standard are: basic standard, ideal standard, attainable standard and current standard.

Standards are expected to be reviewed on a periodic basis, for example, half yearly or yearly.

Variance analysis is the process of analysing the total difference between planned and actual performance into its components parts. They should not be considered in isolation.

The basic variances are those of material, labour and overhead.

The basic material variances measure the differences between actual and standard price and between actual and standard usage.
The basic labour variances measure the differences between actual and standard wage rates and actual and standard labour efficiency.

A standard hour is a unit measure of production not of time.

If total absorption principles of fixed and variable costs are absorbed into production, variances relating to both fixed and variable overheads will arise while in marginal costing only variable overheads are absorbed into production overheads.

Material usage variance can be sub-divided into mix and yield variances.

Sales marginal variances can be sub-divided into price and quantity variances.

Traditional variances can be separated into planning and operational variances with the attendant benefits. Planning variances seek to measure that part of the total variance which is due to planning deficiencies whilst the operating variances seek to measure operating results as compared to a realistic current standard.

*(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)*

### 11.11 REVISION QUESTIONS

#### 11.11.1 MULTIPLE CHOICE AND SHORT ANSWER QUESTIONS

1. A control technique which compares standard costs and revenues with actual results to obtain variances which are used to stimulate improved performance is known as

   A Standard costing
   B Variance analysis
   C Budgetary control
   D Budgeting
   E Responsibility Accounting

2. Adverse material usage variances might occur for the following reasons:
   I Defective material
   II Excessive waste
   III Theft
   IV Unforeseen discount received.

   A (i) only
   B (i) and (ii) only
   C (i), (ii) and (iii) only
   D (i), (ii), (iii) and (iv)
   E (ii), (iii) and (iv) only
3. A standard which can be attained under most favourable conditions with no allowance for normal losses, waste and machine breakdown is known as:
   A  Basic Standards
   B  Conditional Standards
   C  Attainable Standards
   D  Potential Ideal Standards
   E  Regular or loose standards

4. An ideal standard is ________
   A  Attainable only under the most favourable conditions.
   B  Easily attainable
   C  Attainable of all concerned can be dedicated.
   D  Not attainable
   E  Meant for statistical purposes only.

5. Which of the following statements is CORRECT?
   A  The operating standards set for production should be the most ideal possible.
   B  The operating standards set for production should be minimal level.
   C  The operating standards set for production should be attainable level
   D  The operating standards set for production should be the maximum level.
   E  The operating standards set for production should be easily met.

6. During a period, 17,500 hours were worked at a standard cost of ₦6.50 per hour. The labour efficiency variance was ₦7,800 favourable. How many standard hours were produced?
   A  1,200
   B  16,300
   C  17,500
   D  18,700
   E  18,400.

7. Femi Limited has the following budget and actual data:
   Budgeted fixed overhead cost  ₦100,000
   Budget production (units)    20,000
   Actual fixed overhead cost    ₦110,000
   Actual production (units)    19,500

   The fixed overhead volume variance is:
   A  ₦500 Adverse
   B  ₦2,500 Adverse
   C  ₦10,000 Adverse
   D  ₦17,500 Adverse
   E  ₦17,600 Favourable.

8. Lawani Limited uses standard costing system. It purchases a small component for which the following data are available.
   Actual purchase quantity  6,800 units
   Standard allowance for actual production  5,440 units
Standard price ₦0.85
Material price variance (₦544) Adverse

What was the actual price per unit?
A  ₦0.75K
B  ₦0.77K
C  ₦0.93K
D  ₦0.95K
E  ₦1.00K.

9. In a period, 11,280 kgs of materials were used at a total standard cost of ₦46,248. The material usage variance was ₦492 adverse. What was the standard allowed weight of material for the period?

A  11,520kgs
B  11,280kgs
C  11,394kgs
D  11,160kgs
E  11,180kgs.

10. Hanam Santo Limited has prepared the following standard cost information for one unit of product X
Direct materials 2 kg at ₦13 per kg ₦26.00
Direct Labour 3.3hrs at ₦4 per hr ₦13.20

Actual results for the period were recorded as follows:

Production 12,000 units
Materials 26,400kg costing ₦336,600
Labour 40,200 hours costing ₦168,840

The direct material price and direct rate variances are:

<table>
<thead>
<tr>
<th>Material Price</th>
<th>Labour Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>A  ₦66,600(F)</td>
<td>8040(A)</td>
</tr>
<tr>
<td>B  ₦6,600(F)</td>
<td>8090(A)</td>
</tr>
<tr>
<td>C  ₦31,200(F)</td>
<td>8040(F)</td>
</tr>
<tr>
<td>D  ₦32,200(A)</td>
<td>8090(F)</td>
</tr>
<tr>
<td>E  ₦40,250(A)</td>
<td>8060(A)</td>
</tr>
</tbody>
</table>

11.11.2 SHORT ANSWER QUESTIONS

1. Under what circumstances will a material mix and material yield variance arise?

2. What is the formula for calculating sales mix variance?

3. Explain "Ex-Ante" and "Ex-Post" as planning variances concepts.

4. Tayo purchased 19,000kgs raw materials at ₦11 per unit. The standard price is ₦10 per unit. What is the material price variance?

5. State the two classifications of planning variances.
6. The difference between the actual hours worked and the actual hours paid for is __________

7. What are the two types of performance standards?

8. Idle time variances are always adverse. True or False?

9. The two sub-divisions of variable production overheads are __________ and __________

10. A useful device, particularly for the identification of trends in the variance is a __________

(Refer to Suggested Solution in Appendix I, page 443)
DIVISIONAL PERFORMANCE EVALUATION

12.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

- The term decentralization and the various decision areas involved and those that can be delegated, with the attendant benefits/or draw-backs;
- Responsibility accounting and the characteristics of the various centres;
- The various divisional performance evaluation techniques;
- The issues involved in appraising multinational and government agencies; and
- The effect of value for money audit.

12.1 INTRODUCTION

Many large business organisations have complex structures. These type of set-up have their own advantages and problems. While it may be possible for a single proprietor to monitor and oversee the detailed operation of a small business outfit, it may be impossible for the individual to oversee all the operations of a large scale organisation and take all the relevant decisions required.

In view of the above, it becomes necessary to transfer some management functions to subordinate managers leading to some form of decentralisation.

Decentralisation is defined as a system in which the authority for decision making is delegated to the other levels of management. The lower in the organisation that the authority for decision making exists, the greater the decentralisation. In practice, it is impossible to have either a completely centralised organisation or a completely decentralised organisation. In effect, decentralisation is a matter of degree along a continuum. It must be noted that decentralisation is more evident in profit-seeking organisations than in non-profit organisations.
12.1.1 Advantages of Decentralisation

The following are the advantages of decentralisation:

(a) Senior management are relieved from mundane or trivial matters leaving them with more time for overall review and consideration of issues of more strategic importance.

(b) It speeds up operational decisions as the manager at the division swiftly reacts to changing local circumstances.

(c) It provides better training ground to junior staff who aspire to be at the topmost level of the organisation.

(d) The more responsibility a manager has for the performance of his unit, the more he is motivated and the more he will strive to be at his productive best.

(e) It increases flexibility and reduces communication gap.

12.1.2 Disadvantages of Decentralisation

The following are the disadvantages of decentralisation:

(a) It often leads to duplication of services which may be less expensive when centralised.

(b) Managers tend to take decision improving their own sub-unit's performance at the expense of the entire organisation, that is, sub-optimal decision.

(c) It leads to frequent rise in the cost of accumulating and processing information.

(d) It may result in friction between divisional managers particularly, where the performance of one division is dependent on another division.

(e) Decentralisation often encourages narrow mindedness in that a divisional manager only knows what is going on in his division.

Additional problems may arise in the following areas:

(a) Apportionment of overhead cost into individual profit centres.

(b) Introduction of appropriate recording and measuring procedures.
(c) Determination of the form, content and effective basis for the preparation of budget at different levels of management.

(d) The extent of decentralisation of the accounting function and the attendant problems of communication.

(e) Monitoring and evaluation of results.

12.2 DECISION AREAS RETAINED BY TOP MANAGEMENT

Top management often retain some important decisions while others are delegated. The following are the ones retained by management:

(a) Appointment of senior staff

(b) Determination of the corporate objectives of the organisation.

(c) Centralised services such as legal services.

(d) Decision relating to sourcing of funds and investment of surplus funds.

(e) Approval for all major capital expenditure proposals.

(f) Product line closure and departmental closure decisions.

(g) Monitoring overall result and settling inter-departmental disputes (for example, transfer pricing).

12.3 DECISION AREAS DELEGATED TO OTHER LEVELS OF MANAGEMENT

The following are the main areas of decision usually delegated to other levels of management, particularly, lower and functional line management:

(a) Divisional planning and control;

(b) Divisional profitability and financial control;

(c) Appointment and dismissal of junior staff;

(d) Transfer pricing decisions;

(e) Short-term financing arrangement;

(f) Granting credit to customers; and

(g) Stock carrying decisions.

12.4 RESPONSIBILITY ACCOUNTING

Responsibility accounting is defined as, "a system of accounting that segregates revenues and costs into areas of personal responsibility in order
to assess the performance attained by persons to whom authority has been assigned” (CIMA).

With responsibility accounting, it is possible to identify or recognise decision centres within an organization for the purpose of tracing costs to the individual managers who are charged with the responsibility of making decisions about costs and revenues in an organisation.

Within the concept of divisional performance evaluation, there are three types of responsibility centres: cost centre, profit centre and investment centre. Each of the centres will be considered appropriately with the conditions that need to exist for its adoption.

12.5 COST CENTRE

A cost centre is defined as “a location, function, department or section, in respect of which costs may be ascertained and related to cost units for control purpose only”. (CIMA).

To adopt a cost centre:

(a) The cost centre should be relatively easy to establish.
(b) The cost centre should form the basis for building up cost records for measurement, budgeting and control.
(c) Managers of functional departments might be treated as cost centres and made responsible for their costs.

12.6 PROFIT CENTRE

A profit centre is any sub-unit of any organisation (for instance, a division of a company) which is responsible for revenue, cost and profit. In other words, it is a unit to which both revenue and costs are assigned, such that the profitability of the sub-unit can be measured. The following conditions must exist before the adoption of profit centres:

(a) There must be units of the organisation to which both revenues and costs can be separately attributed.
(b) The revenue might come from external sources through sales of goods or services or from internal work done for other profit centres for which transfer price can be charged.
(c) There should be sufficient decentralisation of authority within the company to permit profit centre managers to make decisions about selling prices (include transfer prices) and output levels at those prices.
12.7 INVESTMENT CENTRE

This is a unit of an organisation where a divisional manager is allowed to exercise some discretion about the amount of investment undertaken by the division. In assessing the result of the investment centre, the profit earned must be related to the amount of capital invested. Performance here is measured by return on capital employed (ROCE) otherwise referred to as return on investment (ROI).

The following conditions must exist before a centre is adopted as an investment centre:

(a) All the conditions listed under profit centre above.
(b) The centre must make use of assets which can be separately attributed to it.
(c) The centre must make use of assets which the centre manager has control over in terms of new investment decisions, asset replacement decisions, etc.

12.8 CHARACTERISTICS OF COST, PROFIT AND INVESTMENT CENTRES

(a) Cost centre manager has control over costs (only controllable cost items).
(b) Profit centre manager has control over costs, sales prices (including transfer prices) and output volumes.
(c) Investment centre manager in addition to the characteristics of the profit centre has control over investment in fixed and current assets.

12.9 MEASURES OF DIVISIONAL PERFORMANCE

The following are measures of divisional performance:

(a) Return on Capital Employed
(b) Absolute divisional profit
(c) Residual income
(d) increase in market share
(e) Share of goodwill
(f) Growth of assets
(g) Growth of sales.

The first three are the most common measures and are considered in detail.
12.10 RETURN ON CAPITAL EMPLOYED (ROCE)

This is otherwise referred to as return on investment (ROI). It measures overall profitability by relating net income to the level of investment. ROCE can be defined by using a simple formula:

\[ \text{ROCE} = \frac{\text{Net Income}}{\text{Investment}} \times \frac{100}{1} \]

The return on investment here is tied to the capital base, hence:

(a) It is devoid of any dispute. It is the most objective,

(b) It gives consideration to the capital base of each division, thereby considering each division as an autonomous investment unit,

(c) It enables divisions with different sizes to be compared, and

(d) It has the benefit of facilitating interpretation on the part of the manager because it makes use of data input contained in the conventional financial report.

However, it suffers some serious setbacks. For example, the variables in its constituent such as net income, investment or capital employed are subject to many definitions. Taking net income for instance, should it be income before tax or after tax? Similarly, different bases are used to value the capital employed in a division. Should the investment be valued at book value, gross book value or current replacement costs? Caution must, therefore, be exercised to ensure that bias from accounting procedure does not undermine the level of operational efficiency.

Another shortcoming is that managers of those divisions with an existing ROI in excess of the company's cost of capital incorrectly reject projects with positive net present value. It is, therefore, an unsatisfactory measure of divisional managers' performance where a manager can significantly influence the amount which is invested in working capital.

12.11 ABSOLUTE DIVISIONAL PROFIT

This is profit from divisional operation. The measure of performance by absolute divisional profit is derived as divisional profit less non-controllable cost. The divisional profit might then be compared with budgeted profit, past profit or other divisions' profit dealing in the same line of market. The advantage of this method is that, it derives the needed profit figure from the normal accounting profit. The following are the disadvantages:

(a) Difficulty in comparing divisions of unequal sizes; and

(b) Difficulty in determining controllable overhead costs.
12.12 RESIDUAL INCOME (RI)

This is defined as divisional profit less imputed interest charges on the net assets employed by the division. The word imputed in the definition means that, the charge is made irrespective of whether the company as a whole, has actually incurred an interest cost in the ordinary sense of cash disbursement. The rate used represents the minimum acceptable for investment in that division. This method encourages managers to act in the interest of both his division and the company. In other words, as a performance measurement method, it ensures that sub-optimal decisions are reduced to the minimum while goal congruence is encouraged. However, it suffers the same set-back as the ROI in terms of what should constitute the division's cost of capital.

ILLUSTRATION 12-1

Adeniyi Adeniji Limited. has four divisions operating in Ibadan, Sokoto, Calabar and Maiduguri.

The following data are in respect of them.

<table>
<thead>
<tr>
<th></th>
<th>Ibadan</th>
<th>Sokoto</th>
<th>Calabar</th>
<th>Maiduguri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>12m</td>
<td>10m</td>
<td>14m</td>
<td>18m</td>
</tr>
<tr>
<td>Total Sales</td>
<td>20m</td>
<td>30m</td>
<td>36m</td>
<td>28m</td>
</tr>
<tr>
<td>Total Costs</td>
<td>18m</td>
<td>27m</td>
<td>33.6m</td>
<td>26m</td>
</tr>
<tr>
<td>Cost of Capital (%)</td>
<td>14</td>
<td>18</td>
<td>16</td>
<td>10</td>
</tr>
</tbody>
</table>

Required:
(i) Calculate the annual returns on investment
(ii) Calculate the residual income

SUGGESTED SOLUTION 12-1

ADENIYI ADENIJI LIMITED

<table>
<thead>
<tr>
<th></th>
<th>Ibadan</th>
<th>Sokoto</th>
<th>Calabar</th>
<th>Maiduguri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Sales</td>
<td>20m</td>
<td>30m</td>
<td>36m</td>
<td>28m</td>
</tr>
<tr>
<td>Less: Total Cost</td>
<td>(18m)</td>
<td>(27m)</td>
<td>(33.6m)</td>
<td>(26m)</td>
</tr>
<tr>
<td>Profit</td>
<td>2m</td>
<td>3m</td>
<td>2.4m</td>
<td>2m</td>
</tr>
</tbody>
</table>

Return on Investment (ROI)

\[
\text{ROI} = \frac{\text{Net Income}}{\text{Investment}} \times 100
\]
(ii) Calculation of Residual Income

<table>
<thead>
<tr>
<th></th>
<th>Ibadan</th>
<th>Sokoto</th>
<th>Calabar</th>
<th>Maiduguri</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit</td>
<td>2.00</td>
<td>3.00</td>
<td>2.40</td>
<td>2.00</td>
</tr>
<tr>
<td>Less: Imputed Interest</td>
<td>1.68</td>
<td>1.80</td>
<td>2.24</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>0.32</td>
<td>1.20</td>
<td>0.16</td>
<td>0.20</td>
</tr>
</tbody>
</table>

ILLUSTRATION 12.2

(a) In the context of performance evaluation, distinguish between a profit centre and an investment centre.
(b) Mention three advantages of divisionalisation.
(c) Standard Ltd currently uses the Return on Investment (ROI) to measure the performance of its two operating divisions K and B. Summary of the annual reports from the two divisions for the past year is given below. The company's cost of capital is 12%.

<table>
<thead>
<tr>
<th></th>
<th>Division K</th>
<th>Division B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Investment</td>
<td>₦60,000</td>
<td>₦100,000</td>
</tr>
<tr>
<td>Net Income</td>
<td>12,000</td>
<td>18,000</td>
</tr>
<tr>
<td>ROI</td>
<td>20%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Required:

(i) As a Management Accountant, what performance measurement would you recommend that will show more clearly the relative profitability of the two divisions and why?

(ii) Which division is more profitable? Support your answer with suitable calculations.

(iii) Assume that the manager of Division K was offered a one-year project that would increase his investment base (for that year) by ₦25,000
and shows a net profit of N3,750, would the manager accept this project if he were re-evaluated on the basis of his divisional Return on Investment (ROI)?

Note: Both divisions are investment centres.

**SUGGESTED SOLUTION 12-2**

Refer to the text for answers to (a) and (b).

(c) (i) The Return on Investment (ROI) is not a very good measure of divisional performance in that it results in taking sub-optimal decisions. The residual income as earlier explained will be more favoured because it critically evaluates divisional performance. It is defined as divisional controllable profit less imputed cost of capital on investment (that is, divisional controllable investment).

(ii) **Determination of Profitable Division**

<table>
<thead>
<tr>
<th></th>
<th>Division K</th>
<th>Division B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Invested</td>
<td>N60,000</td>
<td>N100,000</td>
</tr>
<tr>
<td>Net Income</td>
<td>N12,000</td>
<td>N18,000</td>
</tr>
<tr>
<td>Less imputed cost of capital (12% of capital invested)</td>
<td>N7,200</td>
<td>N12,000</td>
</tr>
<tr>
<td></td>
<td>N4,800</td>
<td>N6,000</td>
</tr>
<tr>
<td>ROI</td>
<td>20%</td>
<td>18%</td>
</tr>
</tbody>
</table>

Comment: Going by the ROI given, one will be tempted to say that Division K is more profitable than Division B. However, with the above calculations it is apparent that Division B is indeed more profitable than Division K judging from absolute profits generated by the divisions.

Division K

<table>
<thead>
<tr>
<th></th>
<th>N25,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional Capital</td>
<td></td>
</tr>
<tr>
<td>Increment in Net Income</td>
<td>3,750</td>
</tr>
<tr>
<td>Less imputed cost of capital (12 x 25,000)</td>
<td>3,000</td>
</tr>
<tr>
<td>Residual Income</td>
<td>750</td>
</tr>
</tbody>
</table>

Divisional ROI = \( \frac{3,750}{25,000} \times \frac{100}{1} = 15\% \)
**Comment:** If the manager is re-evaluated on the basis of ROI, he would likely reject the new project under the pretext that it would reduce his current ROI of 20% to 17.5% [that is, \((120\% + 15\%) / 2\)]. However, going by the computation in (iii) using residual income approach, the project should be accepted in that it makes an additional return of ₦750 to the overall income of the company.

**ILLUSTRATION 12-3**

AHAMBA DAVIES has just formed a new division and the following four investment opportunities are available to the division. The firm required a minimum return of 20%.

<table>
<thead>
<tr>
<th>Opportunity</th>
<th>Income</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>171,000</td>
<td>950,000</td>
</tr>
<tr>
<td>2</td>
<td>16,800</td>
<td>700,000</td>
</tr>
<tr>
<td>3</td>
<td>151,200</td>
<td>540,000</td>
</tr>
<tr>
<td>4</td>
<td>149,600</td>
<td>680,000</td>
</tr>
</tbody>
</table>

**Required:**

(a) Calculate the Return on Investment for each project.

(b) If you were the division manager and you were evaluated based on ROI, which investment opportunities would you accept? What would be the ROI for the division?

(c) If you were evaluated based on Residual Income, which investment(s) would you accept? What would be the Residual Income for division?

(d) If you were president of AHAMBA DAVIES Incorporated, which project(s) would you want the division to accept? Which performance measure would you use to encourage this action?

**SUGGESTED SOLUTION 12-3**

(a) **Computation of Return on Investment**

Project 1: ₦171,000 / ₦950,000 x 100 = 18%

Project 2: ₦168,000 / ₦900,000 x 100 = 24%

Project 3: ₦151,200 / ₦540,000 x 100 = 28%

Project 4: ₦149,600 / ₦680,000 x 100 = 22%

(b) Project 3 will be selected because it was the highest ROI of 28%
(c) Since the minimum rate of return (cost of capital) is 20%, only project 2, 3 and 4 would be selected. This is because a project with a ROI lower than 20% will produce a negative residual income.

Residual Income for the division would be N84,800 as computed below:

\[
\begin{align*}
\text{Total Returns (N168,000 + N151,200 + N149,600)} & = 468,800 \\
\text{Less: Imputed Cost (N700,000 + N540,000 + N680,000) x 20%} & = 384,000 \\
\text{Residual Income} & = 84,800 \\
\end{align*}
\]

(d) Projects 2, 3 and 4, then Residual Income approach would be adopted.

ILLUSTRATION 12-4

Christopher Olusola Company Ltd is a large integrated conglomerate with shipping, metals and mining operation throughout the country. The General Manager of the shipping division has been directed by the Board to submit his proposed capital budget for 2003 for inclusion in the company wide budget. The divisional manager is considering the following projects, all of which require an outlay of capital and have equal risk.

<table>
<thead>
<tr>
<th>Project</th>
<th>Investment required</th>
<th>Return</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N'000</td>
<td>N'000</td>
</tr>
<tr>
<td>1</td>
<td>24,000</td>
<td>5,520</td>
</tr>
<tr>
<td>2</td>
<td>9,600</td>
<td>3,072</td>
</tr>
<tr>
<td>3</td>
<td>7,000</td>
<td>980</td>
</tr>
<tr>
<td>4</td>
<td>4,800</td>
<td>864</td>
</tr>
<tr>
<td>5</td>
<td>3,200</td>
<td>640</td>
</tr>
<tr>
<td>6</td>
<td>1,400</td>
<td>392</td>
</tr>
</tbody>
</table>

The divisional manager must decide which of the projects to accept. The company has a cost of capital of 15%. An amount of N60 million is available to the division for investment purposes.

Required:

Compute the total investment, total return on capital invested and residual income on each of the following assumptions stating, selected projects:

(a) The company has a rule that all projects promising at least 20% or more should be accepted.
(b) The divisional manager is evaluated on his ability to maximise his return on capital invested.
(c) The divisional manager is expected to maximise residual income as computed by using the 15% cost of capital.
**SUGGESTED SOLUTION 12-3**

**CHRISTOPHER OLU SOLA COMPANY**

<table>
<thead>
<tr>
<th>Project</th>
<th>Investment Required</th>
<th>Returns ₦'000</th>
<th>ROCE/ROI ₦'000</th>
</tr>
</thead>
</table>
| 1       | 24,000              | \[
\frac{5,520}{24,000} \times \frac{100}{1} = 23\%
\] |               |
| 2       | 9,600               | \[
\frac{3,072}{9,600} \times \frac{100}{1} = 32\%
\] |               |
| 3       | 7,000               | \[
\frac{980}{7,000} \times \frac{100}{1} = 14\%
\] |               |
| 4       | 4,800               | \[
\frac{864}{4,800} \times \frac{100}{1} = 18\%
\] |               |
| 5       | 3,200               | \[
\frac{640}{3,200} \times \frac{100}{1} = 20\%
\] |               |
| 6       | 1,400               | \[
\frac{392}{1,400} \times \frac{100}{1} = 28\%
\] |               |

(a) Assumption: Assuming that all projects promising at least 20% or more should be selected.
Accept Projects 1, 2, 5 and 6 with ROCE greater than 20%

Therefore,

(i) Total Investment will be:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Investments ₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24,000,000</td>
</tr>
<tr>
<td>2</td>
<td>9,600,000</td>
</tr>
<tr>
<td>5</td>
<td>3,200,000</td>
</tr>
<tr>
<td>6</td>
<td>1,400,000</td>
</tr>
<tr>
<td></td>
<td><strong>38,200,000</strong></td>
</tr>
</tbody>
</table>

(ii) Total Returns will be:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Returns ₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,520,000</td>
</tr>
<tr>
<td>2</td>
<td>3,072,000</td>
</tr>
<tr>
<td>5</td>
<td>640,000</td>
</tr>
<tr>
<td>6</td>
<td>392,000</td>
</tr>
<tr>
<td></td>
<td><strong>9,624,000</strong></td>
</tr>
</tbody>
</table>
(iii) Return on Capital Invested

\[
\text{Return on Capital Invested} = \frac{\text{Total Returns}}{\text{Total Investment}} \times \frac{100}{1}
\]

\[
= \frac{9,624,000}{38,200,000} \times \frac{100}{1}
\]

\[
= 25.5\%
\]

(iv) Residual Income

\[
\text{Residual Income} = \text{Total Returns less imputed cost of capital}
\]

\[
\begin{align*}
\text{Total Returns} & = 9,624,000 \\
\text{Less Imputed cost} & = 3,894,000 \\
(15\% \text{ of } N38,200,000) & = 5,730,000
\end{align*}
\]

(b) The assumption here is the maximisation of ROI. Project 2 should be chosen in that it provides the highest ROI of 32%.

(i) Total Investment = N9,600,000

(ii) Total Return = N3,072,000

(iii) Returns on Capital Invested

\[
\text{Returns on Capital Invested} = \frac{3,072,000}{9,600,000} \times \frac{100}{1}
\]

\[
= 32\%
\]

(iv) Residual Income

\[
\begin{align*}
\text{Residual Income} & = \text{Total Returns} - \text{Less: Imputed Cost} \\
& = 3,072,000 - 1,440,000 \\
(15\% \text{ of } N9,600,000) & = 1,632,000
\end{align*}
\]

(c) The assumption here is maximisation of residual income.

Project 1: RI = 5,520,000 - (15% of 24,000,000) = N1,920,000

Project 2: RI = 3,072,000 - (15% of 9,600,000) = N1,632,000

Project 3: RI = 980,000 - (15% of 7,000,000) = (N70,000)

Project 4: RI = 864,000 - (15% of 4,800,000) = N144,000

Project 5: RI = 640,000 - (15% of 3,200,000) = N160,000

Project 6: RI = 392,000 - (15% of 1,400,000) = N182,000
**Decision:**

Choose all the projects that have positive RI. Therefore, projects 1, 2, 4, 5, and 6 should be selected.

(c) (i) Total Investment will be:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Investment (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>28,800,000</td>
</tr>
<tr>
<td>2</td>
<td>9,600,000</td>
</tr>
<tr>
<td>4</td>
<td>4,800,000</td>
</tr>
<tr>
<td>5</td>
<td>3,200,000</td>
</tr>
<tr>
<td>6</td>
<td>1,400,000</td>
</tr>
<tr>
<td></td>
<td><strong>43,000,000</strong></td>
</tr>
</tbody>
</table>

(ii) Total Return will be:

<table>
<thead>
<tr>
<th>Projects</th>
<th>Investment (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,520,000</td>
</tr>
<tr>
<td>2</td>
<td>3,072,000</td>
</tr>
<tr>
<td>4</td>
<td>864,000</td>
</tr>
<tr>
<td>5</td>
<td>640,000</td>
</tr>
<tr>
<td>6</td>
<td>392,000</td>
</tr>
<tr>
<td></td>
<td><strong>10,488,000</strong></td>
</tr>
</tbody>
</table>

(iii) Return on Investment

\[
\text{Return on Investment} = \frac{10,488,000}{43,000,000} \times 100 \times 1 = 24.4\%
\]

(iv) Residual Income

\[
\text{Returns} = 10,488,000
\]

Less imputed cost (15% of 43,000,000) = 6,450,000

\[
\text{Residual Income} = 4,038,000
\]
12.13 PERFORMANCE APPRAISAL IN MULTI-NATIONAL ORGANISATIONS

Performance appraisal also takes place in multi-national concerns and establishments who operate on cross-border basis with activity or establishments spread all over various nations. However, control becomes an issue to be taken seriously because of the level of activities, the variability of circumstance and categories of workers involved as well as the separation due to distance in areas to be covered. Other short-comings envisaged are:

(a) Inadequacy of information due to communication gap.
(b) Different local taxation and corporate regulations.
(c) Government policies and restrictions in the different countries.
(d) Pricing and tariff regulations established by the governments of a particular country.
(e) Exchange rate difficulties due to fluctuations.
(f) Transportation delivery problems and transfer pricing difficulties concerned with trade between divisions.
(g) Accounting standards and policies may not be the same across the borders of the various countries.
(h) Discouragement may set in where there is disparity in staffing policies as compared to those of the home country.

12.14 PERFORMANCE APPRAISAL AND MEASUREMENT IN THE PUBLIC SECTOR

By public sector, it is meant government owned establishments such as ministries, parastatals, agencies, as well as local, state and federal governments and other related organisations.

Therefore, performance evaluation is required to ensure probity, accountability and honesty in the discharge of responsibilities to the public from whom taxes are collected.

Even though performance evaluation is a good thing, the following are considered to be the areas that call for attention:

(a) Costs are not easily attributable to inputs, thus making output immeasurable.

(b) Objectives may be many, thereby making it difficult to ascertain the relationships between causes and effects.
12.15 VALUE FOR MONEY AUDIT (VFM)

Value for money audit can be defined as “an investigation into whether proper arrangements have been made for securing economy, efficiency and effectiveness in the use of resources.” (CIMA).

(a) Effectiveness is a measure of ability to attain desired goals.
(b) Efficiency is a measure of the relatedness of inputs and outputs, in order to measure the extent of usage of resources to realize the set goals of a company.
(c) Economy is getting the desired goals at the least costs without compromising the quality of input.

VFM audits are usually carried out in the public sector establishments such as local, state and federal governments and their associated departments, parastatals, agencies, ministries and related organisations as the case may be. It can also be of use in the private sector of an economy.

VFM audits cover wide areas of operation especially where corporate governance is the order of the day. The following are determined and weighed:

(a) Staffing policies including selection, training encouragement etc.
(b) Means of forecasting and gauging expenses.
(c) Decision matters as they relate to strategic and tactical issues.
(d) Effective safeguard of all fixed assets such as equipment, motor vehicles etc.
(e) Organisation depicting the chain of command
(f) specific initiatives to improve economy, effectiveness and efficiency
(g) The manner of monitoring performance and the basis of comparison with goals.

12.16 STEPS IN A VFM AUDIT

VFM audit involves the following six steps:

**Step 1.** Determine the goals of the public sector establishment or system being verified.

**Step 2.** Ascertain the systems and controls utilized to attain the goals. That is how to determine the procedures for engaging and valuing the success attained.

**Step 3.** Have a detailed documentation of the system/procedures/set up being examined including the ascertainment of the main control elements.
Step 4. Examine and carry out a test of the system/procedure in existence with a focus on the economy involved.

Step 5. Verify the adequacy of the system with emphasis on the utilisation of resources involved. (Link with Step 2).

Step 6. Evaluate the effectiveness of the organization, in order to determine the applicability of the system to the achievement of set goals. (Link with Step 1).

12.17 SUMMARY AND CONCLUSIONS

An individual cannot oversee all the operations of a large scale establishment and at the same time take all the relevant decisions required, thus, the need to delegate some management functions to subordinate managers leading to some form of decentralisation that will enhance motivation, communication, planning, etc.

Decentralisation is not without its short-comings and these include increased cost of accumulating and processing information, friction between managers, duplication of services, narrow mindedness of managers, sub-optimal decision-making, etc.

Performance appraisal systems should promote goal congruency, provide meaningful feedback, encourage initiative and longer-term view.

Performances may be appraised by using the ROCE, residual income and absolute divisional profit methods amongst others.

Responsibility accounting ensures that recognition is given to cost centres, profit centres and investment centres.

Value for money audits are usually carried out in government establishments with emphasis on staffing policies, strategies and tactical issues, effective safeguard of assets, the manner of monitoring performance and the basis of comparison with goals. It is to ascertain the economy, efficiency and effectiveness in the utilisation of resources.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)

12.8 REVISION QUESTIONS

12.18.1 MULTIPLE CHOICE QUESTIONS

1. As a general rule, which of the following current ratios is considered acceptable?
(a) 4 to 1  
(b) 3 to 1  
(c) 2 to 1  
(d) 1 to 1  
(e) 1 to 1.5

2. Which of the following ratios is a stricter test of a company's ability to pay its bill when due?

(a) Current ratio
(b) Quick ratio
(c) Debt to equity ratio
(d) Profit margin
(e) Return on investment.

3. The debt ratio is a measure of:

(a) Liquidity
(b) Leverage
(c) Profitability
(d) Efficiency
(e) Effectiveness.

4. In order for a business to remain in existence in the long run, it is necessary that cash be generated:

(a) From the sale of stock
(b) From the sale of bonds
(c) From long term borrowings
(d) From operations
(e) From the sale of fixed assets

Use data below to answer questions 5 and 6
Jokotola Limited is considering a project with an initial investment of ₦50,000. The project will produce cash inflow of ₦17,350 per year for 4 years. The cost of capital is 10% and there is nil scrap value.

5. The NPV of the project is:

(a) ₦4,960  
(b) ₦4,996  
(c) ₦4,936  
(d) ₦4,956  
(e) ₦4,969.

6. The Residual profit of the project in year 1 using straight-line depreciation is:

(a) ₦(250)  
(b) ₦150  
(c) ₦(150)  
(d) ₦250  
(e) ₦(170).
7. Which of the following perspectives are encompassed in a balanced scorecard?

   i. customer perspective
   ii. financial perspective
   iii. supplier perspective

   (a) i and ii only
   (b) i and iii only
   (c) ii and iii only
   (d) i, ii and iii
   (a) iii only.

Use the data below to answer questions 8 and 9. Blending division of Tom James has assets of $200,000 and operating profit of $60,000.

8. The division's return on investment is:

   (a) 30%
   (b) 35%
   (c) 32%
   (d) 33%
   (e) 36%.

9. If the interest is imputed at 14%, the residual income is:

   (a) $31,400
   (b) $31,000
   (c) $31,500
   (d) $32,500
   (e) $32,000.

12.18.2 SHORT ANSWER QUESTIONS

1. State any one objective of decentralization.

2. Distinguish between profit and investment centres.

3. Muhlbadeen Industries, a division of El-Najaj Investment Limited, has the following data for the Division:

   Divisional Net Income after tax $900,000
   Annual Investment capital $10,000,000
   Imputed interest 8%

   You are required to calculate the Residual Income (RI)

4. Use the above information in question 3 compute the Returns on Capital Employed (ROCE) of the company.

5. What is Value for money audit?

6. What are the secondary performance ratios?

(Refer to Suggested Solution in Appendix I, page 443)
13

TRANSFER PRICING SYSTEM

13.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

♦ The objectives of transfer pricing;
♦ The different transfer pricing methods;
♦ Merits and demerits of transfer pricing methods;
♦ Factors that must be considered when setting transfer prices for multinational transactions; and
♦ The nature and meaning of dual transfer pricing system.

13.1 INTRODUCTION

This is the monetary value attached to goods and services exchanged between divisions of the same organisation. It is peculiar to all divisionalised organisations where the activities are segmented into autonomous units and a great deal of authority delegated to the divisional heads.

13.2 OBJECTIVES OF TRANSFER PRICING

The following are the objectives of transfer pricing:

(a) Goal Congruency

There is a need to select the transfer pricing method that will ensure that any optimal decision taken by the division will also be optimal from the corporate perspective. In other words, any method chosen must reduce sub-optimality to the barest minimum.

(b) Performance Evaluation

There is a need to select the transfer method that management would be in a position to adopt in evaluating the performance of each divisional manager as effectively as possible. Sequel to this, the contribution made towards the corporate profit by each division should not be distorted by the transfer pricing method chosen.
(c) **Autonomy:** There is a need to select the method that will preserve the independence of each division so that the failure of one will not affect the success of the other.

### 13.3 BROAD CATEGORIES OF TRANSFER PRICING METHODS

Transfer pricing may be based on:

(a) Cost  
(b) Market  
(c) Negotiation  
(d) Arbitrary.

### 13.4 COST-BASED TRANSFER PRICING

The selling division sells to the buying division at the cost of production incurred by the selling division. The following are the various types of cost based transfer pricing methods:

(a) Full cost, that is, at full cost or at a full-cost-plus price.  
(b) Marginal cost, that is, at marginal cost or with a gross profit margin on top of marginal cost.  
(c) Standard cost.  
(d) Cost plus mark up.

**Advantages**

(i) It is very useful in decision making analysis especially with the use of marginal cost approach.  
(ii) It assists in measuring production efficiency by comparing actual cost with budgeted cost.  
(iii) No unrealised profit is involved in stock computation.  
(iv) The transfer pricing could be fixed and agreed in advance without being subject to external function.  
(v) It offers the only available opportunity for products that have no market.

**Disadvantages**

(i) It may lead to unpredictable month by month fluctuations unless standard costs are used.  
(ii) The cost of the selling division maybe rejected by the buying division on the ground that it is inefficient especially when the full cost method is used.  
(iii) Profitability of the autonomous divisions cannot be effectively measured as revenues are completely ignored.
(d) When transfers are made at cost plus, the selling division is
guaranteed a certain level of profits which the division may
not be capable of earning in an open market situation.
(e) With the use of cost based method, the incentive required for
divisional planning and motivation is lacking.

13.5 MARKET-BASED TRANSFER PRICING

Under this method, the selling division sells to the buying division at the
prevailing market price. In other words, the two divisions will be operating
at arms length.

Advantages

(a) There is goal congruency
(b) Divisional autonomy is maintained
(c) It is most adequate for measuring performance and motivating
managers.
(d) Marketing prices are objective and verifiable.
(e) Top management's time is not devoted to the bargaining process.
(f) The method has no influence on the efficiency or inefficiency of the
manufacturing units.

Disadvantages

(a) The element of profit often complicates stock valuation.
(b) Accurate information about the market may not be readily available
(c) The market price for intermediate products is not often determinable
since the market is either non existing, ill-structured or imperfect.
(d) The method may act as a disincentive to the use of any spare capacity
in the division under some peculiar circumstances.

13.6 NEGOTIATED TRANSFER PRICING

Under this method, the selling division and the buying division agree in
advance to use a mutually acceptable transfer price.

Advantages

(a) With the use of this method, the motivational impact will be stronger.
(b) There are less disputes on the transfer price fixed because many factors
would have been effectively considered.
(c) Performance evaluation by central management will be devoid of any
disputes on the part of the divisional managers.
Disadvantages
(a) Negotiation may be time consuming.
(b) A negotiated price may be influenced by the negotiating ability, personality and fluency of the managers involved.
(c) The corporate interest may be subordinated to individual divisional interest.
(d) A negotiated price will not be fixed forever. It may need constant review.

13.7 ARBITRARY TRANSFER PRICING
Under this method, the transfer price is determined centrally based on what top management conceived to be most beneficial to the company as a whole. Individual divisional managers may have some say but no control over the price set.

Advantages of Arbitrary Transfer Pricing
(a) The time spent in negotiation is saved.
(b) Uniformity and stability tend to prevail.

Disadvantages of Arbitrary Transfer Pricing
(a) The autonomy granted divisional managers is eroded.
(b) Profit and cost consciousness may suffer where arbitrarily fixed price is not considered realistic.

ILLUSTRATION 13-1
Babatunde & Olawuyi Industries Limited is a decentralised company that evaluates its divisions based on ROI. Division R has the capacity to make 2,000 units of a product. Division R’s variable costs are ₦400 per unit.

Division J can use the product as a component in one of its products. Division J would incur ₦300 of variable costs of convert the component into its own product which sells for ₦1,500.

The following requirements are independent of each other:
(a) Division R can sell all that it produces for ₦900 each. Division J needs 100 units. What is the transfer price?
(b) Assume Division R can sell 1800 units at ₦1,300. Any excess capacity will be unused unless the units are purchased by the J division which could use up to 100 units:
(i) Determine the floor of natural bargaining range.
(ii) What is the ceiling of the natural bargaining range.
SUGGESTED SOLUTION 13-1

BABATUNDE & OLAWUYI INDUSTRIES LIMITED

(a) If Division R can sell all its production in the open market, then the ideal transfer price would be the market price, that is,₦900.

(b) i. The floor of natural bargaining range is the variable manufacturing cost of ₦400.

ii. The ceiling of the natural bargaining ranges the transfer price that results in a zero contribution margin on the goods for the buying division, that is, (₦1,500 - ₦300) = ₦1,200

ILLUSTRATION 13-2

The Godspower J. Chukwu Company Limited is a multi divisional company and its managers have been delegated full profit responsibility and complete autonomy to accept or reject transfers from other divisions. Division A produces a subassembly with a ready competitive market. This sub-assembly is currently used by division B. A charges division B market price for the sub-assembly which is ₦700 per unit. Variable costs are ₦520 and ₦600 for divisions A and B respectively. The manager of Division B feels that Division A should transfer the sub assembly at a lower price than the market price because at this price, Division B is unable to make a profit.

Required:

(a) Compute Division B’s contribution margin if transfers are made at the, market prices and also the total contribution to profit for the company.

(b) Assume that Division A can sell in the open market only 500 units at ₦700 per unit out of the 1000 units that it can produce every month and that a 20% reduction in price is necessary to sell at full capacity. Should transfers be made?

If so, how many units should it transfer and at what price? Submit a schedule showing comparisons of contribution margins under four different alternatives to support your decision.
SUGGESTED SOLUTION 13-2

GODSPOWER J. CHUKWU COMPANY LIMITED

(a) Contribution margin of Division B if transfer price is ₦700

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Cost Per Unit</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Transfer Price</td>
<td>700</td>
<td>1,300</td>
</tr>
<tr>
<td>Contribution of Division B</td>
<td>(100)</td>
<td></td>
</tr>
</tbody>
</table>

Contribution margin to the company if Division B buys from Division A

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price of Division B</td>
<td>1,200</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Cost: Div. A</td>
<td>520</td>
<td></td>
</tr>
<tr>
<td>Div. B</td>
<td>600</td>
<td>1,120</td>
</tr>
<tr>
<td>Contribution margin of the company</td>
<td>₦ 80</td>
<td></td>
</tr>
</tbody>
</table>

Alternatively, the contribution margin of the company, ₦80 can be arrived at through another approach as explained below.

<table>
<thead>
<tr>
<th></th>
<th>Div. A</th>
<th>Div. B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer Price/Selling Price</td>
<td>700</td>
<td>1,200</td>
</tr>
<tr>
<td>Less: Variable Cost</td>
<td>(520)</td>
<td>(600)</td>
</tr>
<tr>
<td>Transfer Price</td>
<td>------</td>
<td>(700)</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>180</td>
<td>(100)</td>
</tr>
</tbody>
</table>

The company's contribution margin 180 + (100) = ₦80

(b) In this case, Division A is operating at full capacity. We need to compare the contribution margin of the company if A transfers to B and when A fails to sell to B.

As earlier computed, the contribution margin to the company if A transfers to B is ₦80.

However, the contribution margin to the company if A does not transfer to B is calculated below.

<table>
<thead>
<tr>
<th></th>
<th>Div A</th>
<th>Div B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling Price</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>Less: Variable Cost</td>
<td>520</td>
<td>0</td>
</tr>
<tr>
<td>Contribution margin</td>
<td>180</td>
<td>0</td>
</tr>
</tbody>
</table>
Contribution margin to the company = ₦180 + ₦0 = ₦180

Decision:

Division A should not transfer to Division B because the contribution margin to the company if there is transfer is only ₦80 whereas the contribution margin to the whole organization if there is no transfer is ₦180.

If so, the question of "at what price" is not relevant since the decision is that there should not be any transfer whatsoever.

Alternative strategies:
(i) Sell 500 units at ₦700 per unit and transfer 500 units
(ii) Sell 1000 units at ₦560 and transfer nothing
(iii) Sell 500 units at ₦700 per unit and transfer nothing
(iv) Transfer 1000 units.

Calculation of total contribution to the company.

<table>
<thead>
<tr>
<th>ALTERNATIVE STRATEGIES</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Revenue</td>
<td>₦1,200,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Div A</td>
<td>350,000(W1)</td>
<td>560,000</td>
<td>350,000</td>
<td></td>
</tr>
<tr>
<td>Div B</td>
<td>600,000</td>
<td>-</td>
<td>1,200,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>950,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Variable Cost</td>
<td>₦1,120,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Div A</td>
<td>520,000(W2)</td>
<td>520,000(W4)</td>
<td>260,000</td>
<td>520,000</td>
</tr>
<tr>
<td>Div B</td>
<td>300,000(W3)</td>
<td>600,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>820,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Contribution</td>
<td>130,000</td>
<td>40,000</td>
<td>90,000</td>
<td>80,000</td>
</tr>
</tbody>
</table>

(That is, TR - TVC)

The optimal alternative is strategy I and it requires 1,000 units to be produced and distributed as follows:

(i) Sell 500 units at ₦700 per unit
(ii) Transfer 500 units to B

Workings
1. 500 units @ ₦1200 per unit = ₦600,000
2. Note: A produced 1000 units. Hence the total variable cost incurred by A = ₦520 x 1000 = ₦520,000.
3. B obtained 500 units from A. B's variable cost per unit = ₦600. Hence, total variable cost incurred by B is 500 x ₦600 = ₦300,000.

4. A produced 1000 units at variable cost per unit of ₦520.

Therefore, total variable cost = ₦520 x 1,000 = ₦520,000.

At what relevant price?

The transfer price should be such that will induce transfer i.e. it should be acceptable to the two divisions. Consequently, the following should be satisfied:

(i) The minimum transfer price must be greater than the variable cost of Division A, that is ₦520.

(ii) The maximum transfer price must be less than the contribution margin of Division B before the transfer price is recognized, that is, ₦600. (₦1,200 - ₦600). Hence, any price between the range ₦520 and ₦600 will be acceptable to the two divisions.

ILLUSTRATION 13-3

A transportation-equipment manufacturer, BOSE Limited is heavily decentralized. Each divisional head has full authority on all decisions regarding sales to internal or external customers. Division P has always acquired a certain equipment component from Division S. However, when informed that Division S was increasing its unit price to ₦220, Division P's management decided to purchase the component from outside suppliers at a price of ₦200. Division S had recently acquired some specialized equipment that was used primarily to make this component. The manager cited the resulting high depreciation charges as the justification for the price hike. He asked the chairman of the company to instruct Division P to buy from Division S at the ₦220 price. He supplied the following:

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity/Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division P's annual purchase of component</td>
<td>2000 units</td>
</tr>
<tr>
<td>Division S's variable cost per unit</td>
<td>₦190</td>
</tr>
<tr>
<td>Division S's fixed cost per unit</td>
<td>₦20</td>
</tr>
</tbody>
</table>

**Required:**

(a) Suppose that there are no alternative uses of the S facilities, will the company as a whole benefit if P buys from the outside suppliers for ₦200 per units? Show computation to support your answer.

(b) Suppose that internal facilities of S would not otherwise be idle, the equipment and other facilities would be assigned to other production operations that would otherwise require an additional annual outlay of ₦29,000. Should P purchase from outsider at ₦200 per unit?
(c) Suppose that there are no alternative uses for S's internal facilities and that selling price drops by N15. Should P purchase from outsiders?

(d) As the chairman, how would you respond to the request of the manager of S? Would your response differ, depending on the specific situation described in requirements (a) through (c) above? Why?

**SUGGESTED SOLUTION 13-3**

(a) If P buys from outsiders at N200 per unit:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Outflow through P (N200 x 2000)</td>
<td>400,000</td>
</tr>
<tr>
<td>Cash Savings through S (N190 x 2000)</td>
<td>380,000</td>
</tr>
<tr>
<td>Loss to the Group if P buys from outside</td>
<td>N20,000</td>
</tr>
</tbody>
</table>

Note 1: If P buys from outside, then no variable cost will be incurred so it is a savings to the company.

(b) If P buys from outsiders at N200 per unit:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Outflow through P (N200 x 2000)</td>
<td>400,000</td>
</tr>
<tr>
<td>Savings:</td>
<td></td>
</tr>
<tr>
<td>S's Variable Cost</td>
<td>380,000</td>
</tr>
<tr>
<td>Initial Outlay</td>
<td>29,000</td>
</tr>
<tr>
<td>Savings to the Group if P buys from outside</td>
<td>N9,000</td>
</tr>
</tbody>
</table>

(c) If P buys from outsiders at N185 per unit:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Outflow through P (N185 x 2000)</td>
<td>370,000</td>
</tr>
<tr>
<td>Cash Savings through S (N190 x 2000)</td>
<td>380,000</td>
</tr>
<tr>
<td>Loss to the Group if P buys from outside</td>
<td>N10,000</td>
</tr>
</tbody>
</table>

(d) As the chairman of the organization, I will not grant the request of Division S because of the following reasons:

(i) It will be contrary to the organizational policy which states emphatically that each division head has full authority on all decisions regarding sales to internal and external customers.

(ii) It will amount to an erosion of the autonomy of the divisional manager. This could have negative consequences on morale, productivity and even profitability of the divisions especially in the long run.

The group will benefit in situations (b) and (c) but the group would lose in situation (a). The loss in situation (a) perhaps maybe the sacrifice that the group may have to make in order to maintain the present divisionalised structure and to enjoy all the potential benefits associated with it.
13.8 DUAL TRANSFER PRICING SYSTEM

It is instructive to note that no single transfer pricing method is capable of satisfying the three broad objectives of transfer pricing. In fact, it is just not possible to have a single transfer price. The buying division and the selling division have different interests in the transfer price.

Of recent, a case has been made for dual transfer hypothetical pricing system. In a dual pricing situation, the buying division is charged a hypothetical market price while the selling division is given credit for either full cost plus a normal mark-up. The income for the company as a whole will be less than the total income for the divisions. However, in preparing financial statements, intra-company eliminations would have to be made for these differences.

Finally, it has been established that only dual transfer pricing system is capable of promoting goal congruence, motivation, autonomy and performance evaluation under all conditions.

ILIustrATION 13-4

A and B are two divisions of a company. There is inter-divisional trading between the two division in respect of 150,000 units of an intermediate product. The transfer price is set at the supplying division's (A) marginal cost of ₦20 per unit for the intermediate product. In order to give effect to the goals to transfer pricing, the supplying division transfer price received is set at marginal cost plus 50%, giving a price of ₦30, which is required to cover the division's fixed costs and provide a profit contribution. The sales price of the final product is ₦100.

You are required to show the reported outcomes of each division and the projected financial statement from inter-group trading using the above dual-rate transfer prices.
SUGGESTED SOLUTION 13-4

REPORTED OUTCOMES FOR EACH DIVISION

<table>
<thead>
<tr>
<th></th>
<th>N'000</th>
<th></th>
<th>N'000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplying Division (A)</td>
<td></td>
<td>Receiving Division (b)</td>
<td></td>
</tr>
<tr>
<td>Transfer to the supplying division N'30 (150,000 units at N'20 plus 50%)</td>
<td>4,500</td>
<td>Sales of the final product at N'100 (150,000 units)</td>
<td>15,000</td>
</tr>
<tr>
<td>Less: Marginal processing costs</td>
<td>3,000</td>
<td>Less Marginal costs: Supplying division transfers (150,000 units at N'20)</td>
<td>(3,000)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(150,000 units at N'60)</td>
<td>(9,000)</td>
</tr>
<tr>
<td>Contribution</td>
<td>1,500</td>
<td>Contribution</td>
<td>3,000</td>
</tr>
</tbody>
</table>

Projected Financial Statement from inter-group trading

Sales of final product: 150,000 units @ N'100 15,000,000

Marginal costs:
Supplying division processing costs (150,000 units @ N'20) 3,000,000
Processing division commission costs (150,000 units @ N'60) 9,000,000 12,000,000 3,000,000

13.8.1 DEMERITS OF DUAL TRANSFER PRICING

The dual-rate transfer prices are not widely used in practice for several reasons, which include:

(a) The use of different transfer prices causes confusion, particularly when the transfers spread outside two divisions;
(b) They are considered to be artificial;
(c) They limit the divisional motivation to compete effectively, thus, reducing their productivity; and
(d) Top-level executives do not like to double count internal profits because these can result in misleading information and create a false impression of divisional profits.

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13.9 INTERNATIONAL TRANSFER PRICING

With the advent of multinational corporations and their continued growth, they have added another more complicated dimension to transfer pricing. In setting an international transfer price, a company will usually concentrate on satisfying a single objective i.e. minimise income taxation. The other broad objectives of transfer pricing are considered secondary. By minimizing income taxes through the use of transfer pricing, the company’s profit after tax will increase. It should be noted, however, that national tax authorities of countries involved (that is, the home country of the multi-national corporation and the host country) are now taking a very close look at whether the international transfer price constitutes an "arm’s length price", that is, the price the two parties would have agreed to, if they had not been related.

Benke and Edwards (1980) recognised some other issues that merit consideration in the setting of international transfer prices. These include import duty minimisation, adjusting for currency fluctuations, avoiding economic restrictions and presenting a favourable financial picture for a foreign affiliate in order to enhance borrowing opportunity or provide a temporary competitive edge.

Lucey (2003) stressed that the level of the transfer price can also affect the amount of import duties to be paid and is a way of repatriating dividends. In fact, some countries place restrictions on the amounts of dividends that can be paid from the branches of multi-national companies in their country. Where this restriction exists, it may be partially avoided by charging a high transfer price in the particular country.

13.10 SUMMARY AND CONCLUSIONS

Transfer pricing is the monetary value attached to goods and services exchanged between divisions of the same organisation segmented into autonomous units and with a great deal of authority delegated to the divisional heads. The objectives of transfer pricing are mainly those of goal congruency, performance evaluation and ensuring the independence of each division.

The broad categories of the basis on which transfer pricing are based include: cost, market, negotiated and arbitrary.

The dual transfer pricing system is to tackle the area of difficulties in the application of the various bases of pricing a firm's products or services.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)
13.11 REVISION QUESTIONS

13.11.1 MULTIPLE CHOICE QUESTIONS

1. The main objectives of transfer prices are stated below, except:

A  Goal Congruence  
B  Price Determination  
C  Motivation  
D  Performance appraisal  
E  Divisional Autonomy.

2. The following are methods for determining the transfer price, except:

A  Variable cost  
B  Skimming cost  
C  Full cost  
D  Market price  
E  Negotiated price.

Use the data below to answer questions 3 and 4
Selected data from Fatima Bello Company’s Limited records the following:

Sales  ₦700,000
Average investment  ₦350,000
Net Income  ₦50,000
Minimum rate of return 12%.

3. Return on investment is:

A  ₦10,900  
B  ₦10,500  
C  ₦10,000  
D  ₦12,000  
E  ₦12,500.

4. Residual Income is:

A  14.9%  
B  14.5%  
C  14%  
D  15%  
E  16%.

5. The process of determining the price at which goods are transferred from one profit to another profit centre within same company is:

A  Market pricing  
B  Skimming pricing  
C  Pro-rata pricing  
D  Arm’s-length pricing  
E  Transfer pricing.
13.11.2 SHORT ANSWER QUESTIONS

1. State two objectives which transfer pricing should achieve.
2. What is the theoretically optimum transfer price?
3. What is negotiated transfer pricing?
4. Explain dual transfer pricing.
5. State two advantages of the Market Based Transfer Pricing.

(Refer to Suggested Solution in Appendix I, page 443)
THE APPLICATION OF QUANTITATIVE TECHNIQUES TO MANAGEMENT ACCOUNTING

14.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand:

- Learning curve theory and the situations when it can be applied;
- Computation of average and incremental labour for different output levels;
- Advantages and limitations of the learning curve theory;
- Various ways of classifying stock, control techniques and their applications;
- Weaknesses of the various stock control techniques;
- Application of the Linear Programming technique and the concept of “shadow price”; and
- The application of Markov Chain technique to assist management in decision making.

14.1 LEARNING CURVE THEORY

Learning curve theory was first developed in 1925 at the Wright Patterson Airforce Base in Ohio, United States. It was observed that as output doubled, the labour hours required reduced by 20%. This was regarded as an 80% learning factor. The theory assumes that as a worker becomes familiar with a new job, his experience increases resulting in a decline in time required by him to perform the job. The learning curve theory states that whenever a repetitive job is performed, the average time spent in producing a unit falls by a specific percentage whenever the activity level is doubled.

This can be explained by the simple reason that as a worker carries out a repetitive task:

(a) His dexterity will improve;
(b) The initial bottleneck associated with the task will be overcome gradually; and
(c) He becomes familiar with the problem areas and finds an appropriate solution to take care of such areas.

As a result of all these, a lot of time is saved and the time used in the task reduces. However, it must be appreciated that the reduction in time will not continue indefinitely as it will get to a particular point where it will no longer be possible for the average time spent in producing a unit to fall further. This is illustrated graphically in figure 14.1 below:

![Learning Curve Graph](image)

**Fig.14.1: Learning Curve Graph**

At level of activity $Q_1$ the cumulative time spent is $T_1$, with the level of activity increased to $Q_2$, there is a sharp reduction in cumulative time to $T_2$. At $Q_3$, there was a further decline in cumulative time spent to $T_3$. By the time the activity level increases to $Q_4$, the reduction in time becomes less pronounced and the curve becomes relatively stable.

Looking at the graph, at the onset, the concept of learning effect is heavily pronounced because of the simple reason that, as more units are produced, the initial bottleneck or problem starts to diminish. With continuous doubling of the activity level the initial bottleneck is fully overcome and eliminated as shown by $T_2Q_2$ and $T_3Q_3$.

With a continuous increase in production and repetitive performance the rate of efficiency continues to increase also until a point is reached when it will no longer be possible for the average time spent in producing a unit to fall. This is because it is not possible for a worker to spend a zero time in producing a particular unit or performing a particular task.
14.1.1 **Conditions under which Learning Curve Theory Operate**

For the learning curve to operate, the following conditions must exist:

(a) The task must be repetitive in nature;

(b) The task must be such that it is labour intensive. In other words, the labour content of the task must be very high. With mechanised task, there is little or no scope for a reduction in operating time;

(c) Management must be able to motivate workers to be at their productive best;

(d) There should be little or no labour turnover; and

(e) The task must be continuous, that is, no frequent breaks.

14.1.2 **Learning Curve Applications**

Learning curve may be applied to the following situations:

(a) Cost estimation, for example, determination of the cost of prototype and the expected cost of future production;

(b) Pricing tenders for contracts, where the price must be competitive, but at the same time profitable over the contract period;

(c) Project evaluation;

(d) Deciding wage incentive plans;

(e) Production scheduling and manpower planning which could improve customer relationships and possibly result in increased future sales; and

(f) Cost control - the learning curve expectations of time to do a job may be much more appropriate than a customer standard, thus efficiency being improved upon.

14.1.3 **Learning Curve Procedures**

The following steps or procedures must be followed in determining the Learning curve:

(a) Ascertain the learning rate or factor;

(b) Calculate the time expected to be used to produce the first unit;

(c) Determine the average time taken per unit for the first batch;

(d) Calculate the average time taken per unit for the second batch;

(e) Calculate the cumulative time taken; and
(f) Repeat the calculations for each subsequent batch.

In applying the learning factor, it will be noticed that the batches are being doubled each time. Where the batches do not double, the tabular approach described above will collapse and the use of the algebraic approach will be feasible.

The algebraic approach is expressed as:

\[ Y = ax^b \]

where

- \( Y \) = Expected average time per unit based on expected output.
- \( a \) = average time per unit spent on the first batch.
- \( x \) = index of learning given as expected output divided by Number of units in the first batch.
- \( b \) = \( \frac{\log \text{ of learning curve}}{\log \text{ of 2}} \)

**ILLUSTRATION 14-1**

A customer has asked a firm to produce a bill for the supply of 1,600 units of a product. Production will be in batches of 100 units. The firm has estimated that the time for the first batch of 100 units will average 50 hour per unit. The firm also expects that an 80% learning curve will apply to the cumulative labour hours on his contract.

**Required:**

(a) Prepare an estimate of labour hours of fulfilling this contract.

(b) Estimate the incremental hours of extending the production run of producing an additional 1,600 units.

(c) Estimate the incremental hours of extending the production run from 1,600 to 2,000 units.
SUGGESTED SOLUTION 14-1

(a) and (b) using the Tabular Approach

<table>
<thead>
<tr>
<th>Units Produced</th>
<th>(1) Cumulative Unit</th>
<th>(2) Time Spent</th>
<th>(3) Cumulative Time Per Unit</th>
<th>(4) Average Time</th>
<th>(5) Workings</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>5,000</td>
<td>5,000</td>
<td>50</td>
<td>-</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
<td>3,000</td>
<td>8,000</td>
<td>40</td>
<td>50 x 0.80</td>
</tr>
<tr>
<td>200</td>
<td>400</td>
<td>4,800</td>
<td>12,800</td>
<td>320</td>
<td>40 x 0.80</td>
</tr>
<tr>
<td>400</td>
<td>800</td>
<td>7,680</td>
<td>20,480</td>
<td>25.6</td>
<td>32 x 0.80</td>
</tr>
<tr>
<td>800</td>
<td>1600</td>
<td>12,288</td>
<td>32,768</td>
<td>20.48</td>
<td>25.6 x 0.80</td>
</tr>
<tr>
<td>1600</td>
<td>3200</td>
<td>19,660.8</td>
<td>52,428.8</td>
<td>16.38</td>
<td>20.48 x 0.80</td>
</tr>
</tbody>
</table>

The average labour hour for the first batch of 100 units is given as 50 hours per unit. The average time per unit is shown in column (5) and the units in the first batch which is 100 is shown in column (1). The cumulative unit is 100 as shown in column (2). The cumulative time spent is column (2) x column (5), giving us column (4). To double the level of activity, that is the units to produce the cumulative unit becomes 200. The average time per unit for these units will be 50 hours x 0.8 giving us 40 in column 5. The cumulative time spent becomes 200 x 40 giving us 8,000. The time spent on the additional units of 100 is given as 8,000 - 5,000 = 3,000 as shown in column (3).

To double the level of activity again, the cumulative unit will become 400 units.

Average time per unit = 40 x 0.80 = 32 hours. Cumulative time will be 400 x 32 = 12,800. The time spent for the additional units will be 12,800 - 8,000 = 4,800. The process is to continue as long as there is doubling in the level of activity.

To answer the question from table above,

(a) An estimate of labour hours of producing the 1,600 units = 32,768 hours, that is 1,600 x 20.48.
(b) The incremental labour hours of extending the production run to produce an additional 1,600 units is 52,428.8 - 32,768 = 19,660 hours.
(c) The incremental hours of extending the production from 1,600 units to 2,000 units cannot be determined with tabular approach since 2,000 units does not amount to doubling 1,600 units, hence the algebraic approach will be used.

\[ Y = \frac{\log 80}{\log 2} \]
= 50 \times \left\{ \frac{200}{100} \right\} \\
= 50[20]^{-0.3219} \\
= 19.06 \text{ hours}

Therefore, total hours for producing 2000 units will be $2,000 \times 19.06$ hours = 38,120 hours

To determine the incremental hours of producing 2,000 units

Cumulative Hours of producing 2,000 units [2,000 x 19.06] = 38,120
Cumulative Hours of producing 1,600 units [1,600 x 20.48] = 32,768
Incremental Hours of producing 400 units = 5,352

**ILLUSTRATION 14-2**

The average cost of producing the first batch of 2000 litres of flavoured milk by a certain diary company is $\mathbf{20}$ per litre. From past experience, the company's operating cost decreases by 25% each time the output is doubled.

**Required:**

Use the data given above to demonstrate your understanding of the theory by finding the learning curve ratio and the average cost of producing 64,000 litres of the product.

**SUGGESTED SOLUTION 14-2**

If the company's operating cost reduces by 25% each time the output is doubled, it implies that the learning curve ratio of the company is 75%.

Determination of the average cost of producing 64,000 litres.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2,000</td>
<td>2,000</td>
<td>40,000</td>
<td>40,000</td>
<td>20</td>
<td>20 x 0.75</td>
</tr>
<tr>
<td>2,000</td>
<td>4,000</td>
<td>20,000</td>
<td>60,000</td>
<td>15</td>
<td>15 x 0.75</td>
</tr>
<tr>
<td>4,000</td>
<td>8,000</td>
<td>30,000</td>
<td>90,000</td>
<td>11.25</td>
<td>11.25 x 0.75</td>
</tr>
<tr>
<td>8,000</td>
<td>16,000</td>
<td>45,040</td>
<td>135,040</td>
<td>8.44</td>
<td>8.4 x 0.75</td>
</tr>
<tr>
<td>16,000</td>
<td>32,000</td>
<td>67,520</td>
<td>202,560</td>
<td>6.33</td>
<td>6.3 x 0.75</td>
</tr>
<tr>
<td>32,000</td>
<td>64,000</td>
<td>101,446</td>
<td>304,000</td>
<td>4.75</td>
<td></td>
</tr>
</tbody>
</table>

From the table, the average cost of producing 64,000 litres of the product is $\mathbf{4.75}$

Alternatively this can be determined through the algebraic method thus:

\[
\log \frac{0.75}{\log 2}
\]
$$Y = a x^b$$
$$= 20 \left( \begin{array}{c} 64,000 \\ 1000 \end{array} \right)^{0.4150}$$
$$= 20 \times 0.2373$$
$$= \text{N}4.75$$

**ILLUSTRATION 14-3**

You have been asked about the application of the learning curve as a management accounting technique.

Using the data given below:
- Direct labour needed to make the first machine hours: 1,000
- Learning curve: 80%
- Direct Labour cost: N3 per hour
- Direct Material cost: N1,800 per machine
- Fixed Cost for either size order: N8,000

You are required to:

(a) Define the term Learning Curve.
(b) Explain the Theory of Learning Curve
(c) Indicate the areas where Learning Curve may assist in management accounting.
(d) Illustrate the use of Learning Curve for calculating the expected average unit cost of making:
   (i) 4 machines
   (ii) 8 machines

**SUGGESTED SOLUTION 14-3**

Cost per unit of making 4 machines will be

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>1,800</td>
</tr>
<tr>
<td>Direct Labour Cost (640 x N3)</td>
<td>1,920</td>
</tr>
<tr>
<td>Fixed Cost (N8,000/4)</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,720</strong></td>
</tr>
</tbody>
</table>
Expected Average Unit Cost of making 8 machines

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td>1,800</td>
</tr>
<tr>
<td>Direct Labour Cost (512 x $,3)</td>
<td>1,536</td>
</tr>
<tr>
<td>Fixed Cost ($8,000/8)</td>
<td>1,000</td>
</tr>
<tr>
<td></td>
<td>4,336</td>
</tr>
</tbody>
</table>

14.1.4 Advantages of Learning Curve Theory

(a) It is very useful in planning number of personnel as well as other related cost;
(b) It is useful in estimating cost of future production;
(c) It can be used in deciding wage incentive plans;
(d) It is an effective basis of exercising cost control; and
(e) It is an effective means of setting labour standard time.

14.1.5 Limitations of Learning Curve Theory

The learning curve theory suffers from some setbacks which can be listed as follows:

(a) It is only applicable to labour intensive operations;
(b) It is not applicable to situation where continuous increase in production does not occur;
(c) It assumes that there would be stable condition at work whereas there could be high labour turnover;
(d) There may be insufficient data, hence there may be difficulty in knowing what the learning curve is; and
(e) It may be difficult to highlight cost reduction due to the effect of learning curve in a situation where a new machinery-and improved techniques are introduced leading to increased output and reduced cost.

14.2 INVENTORY CONTROL TECHNIQUES

In most manufacturing companies, inventories or materials carry a large proportion of the investments, hence the need for proper control in order to ensure that losses due to wastage, theft, production stoppages, idleness of employees, absenteeism, goodwill, sales reduction, etc. are brought to the barest minimum.

However, for one to appreciate the importance attached to the element of material inventory, a proper classification need be made as follows:
(a) Raw materials which are to be used in manufacturing a good or product, for example, limestone, used for making cement; wheat used for making beer and bread; cassava used for making "apu" or "fufu", even though they might have gone through some forms of processing;

(b) Work-in-progress which are used to maintain continuity within the production cycle;

(c) Finished goods which are used to satisfy customers’ demand and sustain goodwill; and

(d) Consumable supplies which are items used proportionately to the quantity or volume of a manufactured product, but which because of their small value are identified for costing purposes with the cost centres where they are used rather than with the cost units to which they relate, for example, nuts, bolts, screws, nails, stationeries, lubricants, petrol, etc.

14.2.1 Objectives of Inventory Control

The main objectives of inventory control are:

(a) To maintain adequate stocks and thus minimise the risk of shortages which could disrupt production or cause customer dissatisfaction;

(b) To avoid excessive stock level and consequent tying up of capital; and

(c) To relieve management of taking frequent procurement decisions for each item maintained in the store.

14.2.2 Factors Considered for Effective Inventory Control

From the cost point of view, the essentials of materials control before the normal usage in the production process are:

(a) Materials of adequate quality and size should be bought only when needed and properly authorised.

(b) In choosing the supplier(s) for the materials, proper care needs to be taken in terms of quality, price and other terms of delivery;

(c) There should be adequate receipt and inspection of materials;

(d) The basis for pricing materials for production of goods;

(e) There should be adequate storage facilities and the consistent checking of stock levels;

(f) Cost centre should be appropriately charged with the indirect materials consumed by them;
(g) Stock taking should be well organised to ensure availability of stock quantities when needed; and

(h) The documentation, accounting procedures and controls at each stage must be designed to be efficient.

14.2.3 Purposes for Holding Inventory

There are three reasons or purposes for holding inventory.

(a) **Transaction Motive:** This purpose is to meet demand for the stock item, where the size of demand is known with certainty or replenishment of stock is immediate when stock-out occurs;

(b) **Precautionary Motive:** Where either (or both) the demand for the stock item or the re-supply or re-order is uncertain because it varies between one occasion and the next, there will be need to avoid customer dissatisfaction and lost sales. Therefore, safety stocks may be held to reduce the likelihood of the company running out of supply; and

(c) **Speculative Motive:** A decision may be taken to increase current stocks in anticipation of a price rise, so as to make a speculative profit. The major control issue for speculative profit stock holding is administrative; there is a clear need to ensure that limits to a firm's financial risks in speculative stock holding are established and observed.

14.2.4 Factors Influencing Stock Holding Decisions

The factors influencing stock holding decisions are:

(a) Amount of cash available;
(b) The storage space available;
(c) The storage costs (insurance, interest on capital, etc.);
(d) Delivery delays;
(e) Risk of stock losses (wastage, obsolescence, etc.);
(f) Minimum ordering quantities imposed by the supplier;
(g) Purchase ordering costs (clerical, transportation, etc.); and
(h) Required service level to workers or customers.

14.2.5 Stock or Inventory Control Systems

The following are the stock control systems and each will be discussed in turn:
(a) Periodic Review System;
(b) Re-order Level System;
(c) Perpetual Inventory/Continuous Stock Taking;
(d) ABC Principles or Selective Approach; and
(e) Economic Order Quantity (EOQ).

14.2.6 Periodic Review System

Under this system, purchase orders are placed at fixed intervals of time and the quantity to be ordered on any occasion will be decided by reviewing the trend of demand for or usage of the item concerned. This should help avoid over-ordering, but if there should be an unexpected increase in demand, the stock of an item may be exhausted before the next regular ordering date.

It may be necessary, therefore, to hold a safety stock or margin to cover possible fluctuations in demand.

14.2.7 Stock Level Control (Re-order Level) System

This system involves deciding a level of stock holding at which new purchase orders should be placed. If stock falls to the re-order level, an order will be placed for fixed quantity of the stock. However, the re-order quantity must have been decided having regard to the normal delivery period, the rate of usage of stock, variations in delivery time and the minimum level of stock.

To provide a safety margin against unforeseen situations, a minimum level of stock holding will be fixed. If at anytime stock falls below the said level, the storekeeper will consider the need for special emergency order. This is the stock allowance to cover errors in forecasting the lead time or demand during the lead time and it is set so that management is warned when usage is above average and buffer stock is being used.

The re-order quantity is the replenishment ordered frequently but not always the Economic Order Quantity EOQ. This is to ensure that when goods are received, the stock holding will be restored to an amount sufficient to last for a reasonable period ahead. The re-order quantity is set by giving consideration to the rate of consumption; cost of holding stock against cost of buying; bulk discounts; obsolescence and deterioration risks and transportation cost. The upper figure in the diagram below is referred to as the maximum level. This is used as an indicator to management to show when stocks have risen too high. This is set so that management will be warned when demand is the minimum anticipated and consequently stock may rise above
maximum intended. This level is set after giving effect to: rate of consumption; risk of obsolescence; cost of storing above normal stocks; storage space availability, the re-order quantity and the time necessary to obtain the delivery of the materials.

![Diagram showing stock control levels](image)

**Figure 2: Stock Control Levels**

**ILLUSTRATION 14-4**

The data given below is to be used for calculating the following stock control levels.

(a) Re-order level  
(b) Minimum level  
(c) Maximum level and  
(d) Average level

Average usage 50 units per day  
Maximum usage 70 units per day  
Minimum usage 30 units per day  
Re-order period 11-13 days  
EOQ 1000 units

**SUGGESTED SOLUTION 14-4**

\[ \text{Reorder Level} = \text{Maximum Usage} \times \text{Maximum Reorder Period} \]
\[ = 70 \times 13 \]
\[ = 910 \text{ units} \]

Minimum Level = Re-order level - Average usage x Average reorder Period
\[ = 910 - (50 \times 12) \]
\[ = 910 - 600 \]
\[ = 310 \text{ units} \]
Maximum Level = Re-order Level + EOQ - (Minimum usage x Minimum reorder period)
= 910 + 1000 - (30 x 11)
= 1,580 units

Average Level = \( \frac{\text{Maximum Level} + \text{Minimum Level}}{2} \)
= \( \frac{1,580 + 310}{2} \) = 945 units

ILLUSTRATION 14-5

(a) Calculate three control levels for a stock control system having the following characteristics:

Average Usage 3000 units per week
Minimum Usage 2200 units per week
Maximum Usage 4200 units per week
Reorder Period 10 - 14 weeks
EOQ = 35,000 units

SUGGESTED SOLUTION 14-5

Reorder Level = Maximum Usage x Maximum Reorder Period
= 4200 x 14
= 58,800 units

Maximum Level = Reorder Level + EOQ - 
(Minimum usage x Minimum Lead Time/Reorder Period)
= 58,800 + 35,000 - (2,200 x 10)
= 93,800 - 22,000
= 71,800 units

Minimum Level = Reorder Level - 
(Average Usage x Average Reorder Period)
= 58,800 - (3,000 x 12)
= 58,800 - 36,000
= 22,800 units
14.2.8 Perpetual Inventory System/Continuous Stock Taking

The perpetual inventory system refers to a situation whereby after each issue or receipt the physical balance is calculated. The total of the balances represents the stock on hand, thus making for the avoidance of wholesale periodic stock taking. However, the continuous stock taking system may be adopted, and it is that which allows for the comparison or checking of the actual stock against what is maintained in the stock records on a continuous basis. The system is operated by checking a few items each day so that all items are checked two or three times a year, thus rendering the annual stock process a worthless assignment.

The procedures, however, are as follows:

(a) A small group of employees is assigned the job of stock check on a permanent basis. Sometimes, cost department staff may be utilized for control purposes.

(b) Items are checked on a daily basis to ensure:
   (i) Complete or full check of all items; and
   (ii) Emphasis is laid on fast moving stocks

(c) The balances on the store ledger card is not to be revealed to any staff authorized to check physical stock in the stores.

(d) At the end of each stock account period, the staff given the task of counting should report the physical units to the officer who assigned the job.

ILLUSTRATION 14-6

(a) Daily Consumption = 130-180 units
(b) Lead Time = 16 - 20 days
(c) EOQ = 4,800 units
   Holding cost per unit N 10

Required:
(a) Find the average stock level
(b) What is the total cost of the base stock per annum?
(c) Would your answer to (b) above differ, if the normal daily consumption is 160 units?

SUGGESTED SOLUTION 14-6

The average stock level cannot be ascertained except the following stock level are known: re-order level; maximum stock level; and minimum stock level. Hence, we calculate the above first, even though the question was silent on them.
Reorder Level = Maximum Usage x Maximum Lead Time
= 180 x 20
= 3,600 units

Maximum Stock Level
= ROL + EOQ - (Minimum Usage x Minimum Lead Time)
= 3,600 + 4,800 - (130 x 16)
= 8,400 - 2,080 = 6,320 units

Minimum Stock Level = ROL - (Average Usage x Average Lead Time)
= 3,600 - (155 x 18)
= 3,600 - 2,790 = 810 units

Average Stock Level = \( \frac{6,320 + 810}{2} \) = 3,565 units

(b) Cost of holding base stock = Qh
Q = Base stock = 810
H = Annual holding cost/unit = 10
Base stock annual holding cost = \( \text{N} 10 \times 810 = \text{N} 8,100 \)

(c) If the normal consumption is 160 units

Minimum Stock Level = ROL - (Normal Usage x Normal Lead Time)
= 3,600 - (160 x 18)
= 3,600 - 2,880 = 720 units

Therefore, total cost of base stock = \( \text{N} 720 \times \text{N} 10 = \text{N} 7,200 \)
Hence, the difference in cost = \( \text{N} (8,100 - 7,200) = \text{N} 900 \)

Any difference(s) between the recorded figure and physical stock count is/are immediately investigated. The typical causes of discrepancies are:

(a) Errors caused by incorrect recording and calculations, for example, using the wrong stock price;
(b) Incorrect coding causing the wrong stock to be issued and wrong card to be altered;
(c) Parts and materials returned to stores not documented;
(d) Shrinkages, pilferage, evaporation, wastages, etc; and
(e) Loss or non usage of goods received notes, materials requisition notes and other essential documentations.
Advantages

The following are the advantages of the perpetual inventory/continuous stock taking exercise:

(a) Production or sales stoppages are easily tracked;
(b) Likely errors are reduced by the usage of skilled staff;
(c) The process of investigation is accelerated;
(d) Staff morale is increased and standard raised; and
(e) Discrepancies and losses are revealed sooner than they would be, if stock taking were limited to an annual check.

14.2.9 ABC Selective or Principle Approach

Under this system, control of stock is maintained by classifying materials or items into expensive, inexpensive or a middle cost range because of the advantages of simplifying stores procedures without incurring unnecessarily high cost. The segregation of materials for selective stores control purposes may be done having the following in mind:

(a) Expensive and medium cost materials are subject to careful stores control procedures to reduce costs, that is, items of high values even though few in number are given priority to avoid a high loss; and

(b) Inexpensive materials can be stored in large quantities with a slow turnover period because the cost savings from careful stores control do not justify the administrative effort needed to carry out the controls. Large quantities of these items may be stored without increasing stores costs by any appreciable amount.

The selective method for stores control is at times referred to as the ABC method whereby materials are classified into A, B, and C groups according to their values to the organisation and it is better explained by the table and diagram below.

<table>
<thead>
<tr>
<th>Table 14.1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
14.2.10 Economic Order Quantity

Costs Associated with Inventory

Inventory control can be defined as the system used in a firm to control the firm’s capital outlay on stock. Typically, it involves the recording and monitoring of stock levels, forecasting future demands and deciding when and how many units to order.

However, the main purpose is to minimise, in total, the cost associated with stock, which are categorized into three groups, namely:

(a) Carrying Cost;
(b) Ordering Cost; and
(c) Stock-out Cost.

(a) Carrying Costs: These are the cost of holding stock in the store and may be calculated as a percentage of purchase prices of an items or materials. The examples are:

(i) Interest on capital invested in stock;
(ii) Storage charges (rent, lighting etc.);
(iii) Stores, staffing, equipment maintenance and running cost;
(iv) Material handling costs;
(v) Audit, stock taking, stock recording costs;
(vi) Insurance;
(vii) Deterioration and obsolescence; and
(viii) Pilferage, evaporation, etc.
(b) **Ordering Cost**: These are basically the costs of obtaining stocks and examples are:

(i) Transport costs;
(ii) Set up and tooling costs; and
(iii) Clerical costs.

(c) **Stock-out Cost**: These are costs of running out of stocks. Examples are:

(i) Lost contribution or profit through lost sales;
(ii) Loss of future sales because of lack of patronage by customers;
(iii) Cost of production stoppages caused by lack of work in progress and raw materials; and
(iv) Extra costs associated with urgent, often small quantity, replenishment orders.

### 14.2.11 Assumptions Underlying the Operation of the EOQ Model

The following are the assumptions underlying the operations of the EOQ model, namely:

(a) There is a known constant holding or carrying stock;
(b) There is a known constant stock ordering cost;
(c) There is a known constant price per unit;
(d) The rates of demand are known; and
(e) The replenishment of stock is made instantaneously.

It should be noted that all the assumptions mentioned may not be present in all situations. In most cases, EOQ focuses on the holding and ordering costs. Therefore, the EOQ can be explained to be a calculated re-order quantity which minimizes the balance of costs between carrying costs and ordering costs.

The cost of holding stock could be reduced to some extent if the average quantity of stock held could be reduced and this could be made possible by reducing the reorder quantity but the implication is frequent orders being placed.
14.2.12 Simple EOQ Model

The EOQ model can be determined by either of the two methods as shown below when there are no discounts:

(a) **Simple graphical method**

(b) **By formula** (Algebraic method and calculus)

(a) **Graphical Method**: The procedures to be followed if the graphical method is to be used are the following:

(i) Put up a graph showing on Y-axis the total annual cost of buying and holding stocks, and on the X-axis the selected range of possible order quantities.

(ii) Select a number of order quantities and determine for each of the following:

- The annual cost of buying which is determined by multiplying the cost per ordering (Co) by the number of orders that would be placed in a period (that is, the total annual demand divided by quantity ordered at each buying (D/Q). Thus, the ordering cost is Co x D/Q.
The annual cost of carrying stock which is determined by multiplying the annual cost of carrying one unit of stock by the average number of units held in stock (that is, dividing the opening stock and closing stock by 2). Thus, the annual carrying cost is \( \frac{1}{2}Q \times C_c \).

The total annual cost of ordering and carrying cost is determined by adding costs (a) and (b) above together.

(iii) Plot on a graph the total annual cost of ordering and holding or carrying stock against each selected order quantity and consequently rule a smooth curve through the identified points.

(iv) Determine the point at which the curve or line is at its minimum level and this is the point where it is advantageous to place an economic order since costs are at the minimum point.

The stated steps are depicted in Figure 14.4 as above.

(b) **Formula method (Algebraic and Calculus Methods)**

(i) **Algebraic Method:** For the EOQ to be determined, both ordering cost and the carrying cost must be at their minimum levels, thus, mathematically, the formula given will have to be equated to each other, that is:

\[
\frac{DC_o}{Q} = \frac{QC_c}{2}
\]

By cross multiplication

\[2DC_o = Q^2C_c\]

\[Q^2 = \frac{2DC}{Cc}\]

\[\text{EOQ} = \sqrt{\frac{2DC_o}{Cc}}\]

Where:

- \(Q\) = Economic Order quantity
- \(C_c\) = Carrying Cost per item per annum
- \(C_o\) = Ordering cost per order
- \(D\) = annual demand per annum
(ii) **Calculus:**
The Total Relevant Cost = Total Ordering Cost + Total Carrying Cost

\[
\frac{D\text{Co}}{Q} + \frac{QC\text{c}}{2}
\]

Differentiate total relevant cost with respect to \(Q\)

\[
\frac{d\text{TRC}}{dQ} = -\frac{D\text{Co}}{Q^2} + \frac{C\text{c}}{2}
\]

At the turning point \(\frac{d\text{TRC}}{dQ} = 0\)

\[
\frac{D\text{Co}}{Q} = \frac{C\text{c}}{2}
\]

\[
Q = \sqrt{\frac{2D\text{Co}}{C\text{c}}}
\]

The above formula was based on the fact that stock can be replenished on a constant basis.

The following illustrates the EOQ model for stock control purposes:

**ILLUSTRATION 14-7**

ALAYAKI Enterprises has an annual demand of 1000 units per month; the ordering cost is \₦350 per order, the units cost \₦8 each and it is estimated that carrying costs are 15% per annum of the purchase price. You are required to find the Economic Order Quantity.

**SUGGESTED SOLUTION 14-7**

By Formula: \(\text{EOQ} = \sqrt{\frac{2D\text{Co}}{C\text{c}}}\)

Where:

\(D = 1000 \times 12 = 12,000\) units

\(\text{Co} = \₦350\)

\(\text{Cc} = \₦8 \times 15\% = \₦1.2\)

\[\text{EOQ} = \sqrt{\frac{2 \times 12,000 \times 350}{1.2}} = 2,645\] units
ILLUSTRATION 14-8

The following data relate to components B9

Cost of raw material $10 per unit
Usage of raw material 100 units
Minimum re-order period 20 days
Maximum re-order period 30 days
Cost of ordering materials $400 per order
Carrying costs 10% per order
Assume that each year consists of 48 working weeks of 5 days per week

Required:
Calculate
(a) The order level
(b) The re-order quantity
(c) The maximum level
(d) The minimum level
(e) The average level.

(a) Reorder Level = Maximum Usage x Maximum Reorder Period
                = 100 x 30 = 300 units

(b) Reorder Quantity = \( \frac{2DC}{Cc} \)
                      = \( \frac{2 \times 400 \times (100 \times 485)}{10 \times 10\%} \)
                      = 4,382 units

EOQ = 4,382 units

(c) Maximum Level = Reorder Level + Reorder quantity - Minimum Usage x Minimum Reorder Period
                = 3000 + 4382 - (100 x 20)
                = 3000 + 4382 - 2000
                = 5382 units

(d) Minimum Level = Reorder Level - Average Usage x Average Reorder Period
                = 3000 - (100 x 25) = 500 units

(e) Average Level = \( \frac{\text{Maximum Level} + \text{Minimum Level}}{2} \)
                = \( \frac{5382 + 500}{2} \) = 2941 units
ILLUSTRATION 14-9

Ideato Motors, a car assembly plant buys batteries from an overseas supplier at N 20 per battery. Total annual requirement are 25,000 batteries at a rate of 100 per working day. The following cost data are available:

Desired annual return on stock investment N 2
Sundry carrying cost/unit per year 50k
Total carrying cost/unit per year N 2.50k
Cost of purchase order include clerical cost, stationery telephone N 50.

Required:

(i) Prepare in tabular form the total annual relevant cost for each of the following order sizes: 250, 500, 1,000, 2,000, 4,000 and 8,000.

(ii) What is the EOQ for batteries at Ideato Motors and why?

SUGGESTED SOLUTION 14-9

<table>
<thead>
<tr>
<th>Q No. of Orders</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>D/Q Average Inventory Q/2</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>12.5</td>
<td>6.25</td>
<td>3.128</td>
</tr>
<tr>
<td>Total Ordering Cost D x Q</td>
<td>500</td>
<td>250</td>
<td>1250</td>
<td>625</td>
<td>312.5</td>
<td>156.25</td>
</tr>
<tr>
<td>Total Carrying Cost Q x Cc 2</td>
<td>312.5</td>
<td>625</td>
<td>1250</td>
<td>2500</td>
<td>5000</td>
<td>10000</td>
</tr>
<tr>
<td>Total R.C</td>
<td>5312.5</td>
<td>312.5</td>
<td>2500</td>
<td>3.25</td>
<td>5312.5</td>
<td>10156.25</td>
</tr>
</tbody>
</table>

(ii) EOQ = 1000 units i.e. where the total relevant cost is least.

14.2.13 EOQ with Discounts

One of the major assumptions of the simple EOQ model is that the price is fixed and known with certainty. However, in a real-life situation, it is possible for the price to vary. This occurs when there are discounts resulting from bulk purchases. Whenever there is a discount, the simple EOQ formula will break down. The illustration on page 392 is used to determine EOQ whenever there is purchase discount.
ILLUSTRATION 14-10

A retailer has an annual demand for a certain non-perishable commodity of 1000 units. He buys from a wholesaler at a cost of ₦5 per unit and the cost of ordering and receiving delivery of a replenishment order is ₦25 each time. His stock holding cost are 25% of the average stock value per year.

Required:

(a) How many units should the retailer order per occasion and how often should he order this quantity to minimize the total relevant cost?

(b) What is the total stock cost?

(c) Suppose the wholesaler offers 5% discount on the purchase price per unit on orders between 300 and 1999. 10% discounts on orders of 2000 or more. Determine whether the retailer should take advantage of either of the discount offered.

SUGGESTED SOLUTION 14-10

(a) (i) \[
\sqrt{\frac{2DCo}{Cc}} = \frac{2 \times 1,000 \times 25}{0.25 \times 5} = 200 \text{ units}
\]

(ii) No. of orders = \(\frac{D}{Q} = \frac{1,000}{200} = 5 \text{ times}\)

(b) Total Stock Cost = Total Carrying Cost + Total Ordering Cost + Total Purchase Cost

\[
= \frac{QCc}{2} + Dcc + \text{Purchase}
\]

\[
= \frac{200 \times 1.25}{2} + \frac{1,000 \times 25}{200} + 1,000 \times 5
\]

= 125 + 125 + 5000

= ₦5,250

(c) With discount of 5%

\[
Q = \sqrt{\frac{2 \times 1000 \times 25}{25\% \times 4.75}} = \sqrt{\frac{50,000}{1.1875}} = 205 \text{ units} = \text{Not feasible}
\]

With discount of 10%

\[
Q = \sqrt{\frac{2 \times 1000 \times 25}{25\% \times 4.5}} = \sqrt{\frac{50,000}{1.125}} = 211 = \text{Not feasible}
\]
Recommendation:

He should not take advantage of the offer because the EOQ is below the given range. If he does, he will incur higher carrying cost.

ILLUSTRATION 14-11

The annual demand of a product by a company is 5000 units. Ordering costs are N100 and the basic unit price is N5 and carrying costs are 20% per annum.

Discount are available thus:

1200 - 1399 less 10%
1400 - 1499 less 15%
1500 - over less 20%

What is the economical quantity to order?

SUGGESTED SOLUTION 14-11

EOQ (without discount)

\[
EOQ = \sqrt{\frac{2DCo}{Cc}}
\]

\[
= \sqrt{\frac{2 \times 5000 \times 100}{5 \times 0.2}}
\]

\[
= 1,000 \text{ units}
\]

We need to calculate the total relevant cost of purchasing 1000 units, 1200 units, 1400 units and 1500 units before we can make a decision on which to order.

The total relevant stock cost = Total Ordering Cost + Total Carrying Cost at 1,000 units

Total Ordering Cost = \( \frac{DCo}{Q} \times \frac{5,000}{1,000} \times N100 = N500 \)

Total Carrying Cost = \( \frac{QCc}{2} \times \frac{1,000}{2} \times N1 = N500 \)

Where Q = EOR
Therefore, Total Relevant Stock Cost = \( \text{₦ 500} + \text{₦ 500} = \text{₦ 1,000} \)

At 1200 units Total Ordering Cost = \( \frac{5,000}{1,200} \times 100 = \text{₦ 416.67} \)

Total Carrying Cost = \( \frac{1,200}{2} \times 5 \times 0.2 \times 0.9 = \text{₦ 540} \)

Therefore, Total Relevant Cost = \( \text{₦ 416.67} + \text{₦ 540} = \text{₦ 956.67} \) units

At 1400 units Total Ordering Cost = \( \frac{5,000}{1,400} \times 100 = \text{₦ 357.14} \)

Total Carrying Cost = \( \frac{1,400}{2} \times 5 \times 0.2 \times 0.85 = \text{₦ 595} \)

Total Relevant Stock Cost = \( \text{₦ 357.14} + \text{₦ 595} = \text{₦ 952.14} \) at 1,500 units

At 1500 units Total Ordering Cost = \( \frac{5,000}{1,500} \times 100 = \text{₦ 333.33} \)

Total Carrying Cost = \( \frac{1,500}{2} \times 5 \times 0.8 = \text{₦ 560} \)

Therefore, Total Relevant Stock Cost = \( \text{₦ 333.33} + \text{₦ 600} = \text{₦ 933.33} \)

Decision:

Order in 1500 units because it gives the lowest total relevant stock cost of \( \text{₦ 933.33} \).

<table>
<thead>
<tr>
<th>UNITS</th>
<th>1,000</th>
<th>1,200</th>
<th>1,400</th>
<th>1,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Purchase Cost</td>
<td>₦ 25,500</td>
<td>₦ 22,500</td>
<td>₦ 21,250</td>
<td>₦ 20,000</td>
</tr>
<tr>
<td>Ordering Cost</td>
<td>₦ 500</td>
<td>₦ 416.67</td>
<td>₦ 357.14</td>
<td>₦ 333.33</td>
</tr>
<tr>
<td>Carrying Cost</td>
<td>₦ 500</td>
<td>₦ 540</td>
<td>₦ 595</td>
<td>₦ 600</td>
</tr>
<tr>
<td>Savings in Ordering</td>
<td>-</td>
<td>₦ 83.33</td>
<td>₦ 142.86</td>
<td>₦ 166.67</td>
</tr>
<tr>
<td>Additional Cost of Carrying</td>
<td>-</td>
<td>₦ 40</td>
<td>₦ 95</td>
<td>₦ 100</td>
</tr>
<tr>
<td>Savings as a result of discount</td>
<td>-</td>
<td>₦ 2,500</td>
<td>₦ 3,750</td>
<td>₦ 5,000</td>
</tr>
<tr>
<td>Net Gain</td>
<td>-</td>
<td>₦ 2,543.33</td>
<td>₦ 3,797.86</td>
<td>₦ 5,066.67</td>
</tr>
</tbody>
</table>

Decision:

Column 1500 gives the highest net gain of \( \text{₦ 5,066.67} \) if compared with the first scenario (when there are no purchase discounts).
14.2.14 EOQ with Gradual Replenishment

\[
\text{EOQ (with gradual replenishment)} = \sqrt{\frac{2DC_0}{Ce(1 - D/R)}}
\]

Where \( R \) = replenishment rate per annum.

**ILLUSTRATION 14-12**

A company uses 50,000 rings per annum which cost \( N10 \) each to purchase. The ordering and handling costs are \( N150 \) per order and carrying costs are 15% per annum. However, on purchasing its own machinery, the company now has the capacity to produce 250,000 rings per annum. You are required to calculate the EOQ (assuming that there is now a gradual replenishment of stock).

**SUGGESTED SOLUTION 14-12**

\[
= \sqrt{\frac{2 \times 150 \times 50,000}{1.5 \left(1 - \frac{50,000}{250,000}\right)}} = \sqrt{\frac{\sqrt{2 \times 150 \times 50000}}{1.5 - (1 - 0.2)}} = \sqrt{12,500,000} = 3,535 \text{ rings}
\]

14.2.15 Limitations of the EOQ Model

According to Harper (1982), the EOQ model suffers from the following set-backs:

(a) The fact that in practice, the total annual cost curve is relatively flat in the vicinity of the EOQ, means that quite significant divergences from that quantity will result in only minor cost increases. The EOQ, then, is by no means a critical figure.

(b) The actual optimum order quantity, is in fact, often much more crucially dependent on the storage space and facilities available, work load of purchase office, economics of delivery and overall convenience of all involved in the purchase such that, it is only a potential savings of a few naira.
(c) The cost of purchasing and holding stocks is often difficult to quantify with any accuracy. Consequently, even when the EOQ has been calculated, there is little certainty that the result is particularly accurate.

(d) Charging prices or usage rates in theory requires recomputation of the EOQ, with the consequential need to alter all the relevant records in the purchase office and stores office. If interest rates change, then the order quantities and records of all materials bought and stocked will need to be changed.

14.3 PRODUCT MIX WITH MULTIPLE CONSTRAINTS (LINEAR PROGRAMMING)

14.3.1 Definition

The technique used in the allocation of resources where more than one key factor or constraint is involved is referred to as “Linear Programming.” It is a method of solving equations and can be programmed for the computer so that difficult and multi-constraint problems will show how scarce resources in a firm can best be utilised. It is a procedure to optimise the value of some objectives, for example, maximise profits or minimise costs when the factors involved (for example, labour or machine hours) are subject to some constraints.

14.3.2 Assumptions of LP

The basic assumptions underlying the operation of the technique are:

(a) **Certainty:** It is believed that all relevant information relating to a problem situation are known, for example, the resources available.

(b) **Linearity:** It is believed that there is a proportional relationship between the resources utilised and the contribution or the cost incurred.

(c) **Non-Negativity:** There is no negative output that will be produced, that is, at worst we achieve zero level of production.

(d) **Single-Objective:** There is an assumption of only one economic objective, that is, maximisation of profit or minimisation of costs.

(e) **Divisibility:** It is generally believed that fractional output could be produced, that is, all the variables are assumed to be completely divisible.
14.3.3 Uses of Linear Programming

The specific uses of the Linear programming technique are:

(a) It can be used in determining the optimal product mix;
(b) It is an effective method of solving capital rationing problems;
(c) It can be used to plan the production activities effectively;
(d) It is an effective aid to financial modeling; and
(e) It can assist in solving transportation and assignment problems.

14.3.4 Methods of Linear Programming

Three main methods of solving linear programming problem are:

(a) Graphical solution method.
(b) Algebraic or Simultaneous Solution method.
(c) Simplex Solution method.

(a) **Graphical Solution Method**: It is simple but is very limiting in nature where the variables are more than 2 unless 3 dimensional graphs are used, it could be cumbersome. The feasible region on the graph will help to determine the optimal solution as in illustrations 14.13 and 14.14 below.

(b) **Algebraic or Simultaneous Solution Method**: It will handle more than 2 variables and explore all the values and bring out an optimal value for satisfying the objective function (see illustration 14.15 below).

(c) **Simplex Solution Method**: It is an algorithmic method in the sense that certain steps will be given and followed to the end till the optimal solution is arrived at (see illustrations 14.16 and 14.17 for details of procedures to be followed).

14.3.5 Formulating a Linear Programming Problem

In order to formulate a Linear programming problem, the following are the steps involved:

(i) Determine the objective function.
(ii) Formulate the constraint.
(iii) Formulate the non-negativity constraint.
ILLUSTRATION 14-13

The Okiki Farm Ltd. manufactures two models of garden cutters: "Opeke" and the "Opaka" in a two stage process involving casting and machining. When preparing the 2003 budget, it was found that the following weekly limitations on capacity existed:

Foundry hours available 480
Machining hours available 600

Each "Opaka" takes two hours in the foundry and four hours in the machine shop whereas an "Opeke" takes three hours in each. In addition, the material required for the "Opeke" was in short supply and only sufficient material for 140 units per week could be guaranteed for the year.

If the profit contribution from "Opeke" is N8 and the "Opaka" is N6, formulate the optimum production schedule and the weekly contribution using the linear programming model.

<table>
<thead>
<tr>
<th>OPEKE</th>
<th>OPAKA</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundry hours</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Machine hours</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Direct material</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Contribution</td>
<td>N8</td>
<td>N6</td>
</tr>
</tbody>
</table>

Formulation: Let B represents Opeke and R represents Opaka
Maximum weekly contribution: \(8B + 6R\)
Subject to the following constraints:

\[
\begin{align*}
3B + 2R &\leq 480 & \text{- Foundry hours} \\
3B + 4R &\leq 600 & \text{- Machine hours} \\
B &\leq 140 & \text{- Direct material} \\
B, R &\geq 0 & \text{- Non negativity}
\end{align*}
\]

ILLUSTRATION 14-14

A manufacturer wishes to produce 100 tons of a product containing at least 50% factor of A and 30% factor of B. He can use two ingredients, X costing N20 per ton, which will yield 60% of A and 20% of B and Y costing N40 per ton which will yield 40% of A and 50% of B.

Required:
Formulate the programme for the expected mix of X and Y that is needed to yield the minimum material cost of production and state what the objective function should be.
SUGGESTED SOLUTION 14-14

Let X represent tons of ingredients X and Y tons of ingredient Y.
Objective function: Minimize 20X + 40Y
Subject to: 

- 0.6X + 0.4Y ≥ 50  factor A constraint
- 0.2X + 0.5Y ≥ 30  factor B constraint
- X + Y ≥ 100  production constraint
- X, Y ≥ 0  Non negativity constraint

ILLUSTRATION 14-15

Abiola farms uses two crop yielding ingredients (Vim and Moon) on its farm in order to enhance its production capacity.

The local agricultural centre has advised Abiola Farm to spend at least 4,800kg of a special nitrogen fertilizer ingredient and at least 5,000kg of a special phosphate fertilizer ingredient in order to increase his crops. Neither ingredient is available in pure form.

A dealer has offered 100kg bags of Vim at N1 each. Vim contains the equivalent of 20kg of nitrogen and 80kg of phosphate. Moon is available in 100kg bags at N3 each, it contains the equivalent of 75kg of nitrogen and 25kg of phosphate.

Required:

Express the relationships as inequalities. How many bags of Vim and Moon should Abiola Farms buy in order to obtain the required fertilizer at minimum cost. Solve graphically.

SUGGESTED SOLUTION 14-15

Let Vim be represented by V and Moon represented by M
Objective function: Minimize Cost V + 3M
Subject to: 

- 20V + 75M ≥ 4800  .......... (1)
- 80V + 25M ≥ 5000  .......... (2)
- V, M ≥ 0

In equation 1; 20V + 75M = 4800
- V = 0, M = 64
- V = 240, M = 0

In equation 2; 80V + 25M = 5000
- V = 0, M = 200
- V = 62.5, M = 0
The graph is now plotted as below:

![Graph Image]

**Figure 11.5: LP graph**

<table>
<thead>
<tr>
<th>Points</th>
<th>V</th>
<th>M</th>
<th>Cost</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>240</td>
<td>0</td>
<td>240 + 3(0)</td>
<td>240</td>
</tr>
<tr>
<td>B</td>
<td>46.36</td>
<td>51.64</td>
<td>46.36 + 3(51.64)</td>
<td>201.28</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>200</td>
<td>0 + 3(200)</td>
<td>600</td>
</tr>
</tbody>
</table>

The objective point is Point B where we have the lowest cost of ₦201.28 when the firm will have to buy 46.36kg of Vim and 51.64kg of Moom.

**ILLUSTRATION 14-16**

For Agbogunleri Ltd, the following data are relevant to its products, Lot and Pot:

<table>
<thead>
<tr>
<th>Per Units</th>
<th>LOT</th>
<th>POT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>₦200.00</td>
<td>₦240.00</td>
</tr>
<tr>
<td>Cost:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct materials</td>
<td>₦45.00</td>
<td>₦50.00</td>
</tr>
<tr>
<td>Direct wages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dept 1</td>
<td>₦16.00</td>
<td>₦20.00</td>
</tr>
<tr>
<td>Dept 2</td>
<td>₦22.50</td>
<td>₦13.50</td>
</tr>
<tr>
<td>Dept 3</td>
<td>₦10.00</td>
<td>₦30.00</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>₦6.50</td>
<td>₦11.50</td>
</tr>
</tbody>
</table>

Fixed overhead is budgeted at ₦275,000 per annum. Relevant data for each department are:
<table>
<thead>
<tr>
<th>Employees</th>
<th>Number</th>
<th>Hours per Employee</th>
<th>Wages rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dept 1</td>
<td>20</td>
<td>40</td>
<td>2.00</td>
</tr>
<tr>
<td>Dept 2</td>
<td>15</td>
<td>40</td>
<td>2.25</td>
</tr>
<tr>
<td>Dept 3</td>
<td>18</td>
<td>40</td>
<td>2.50</td>
</tr>
</tbody>
</table>

In the present environment, it is not possible to engage any more employees. You are required to formulate the linear programming equation and show on a graph the mix of products which will maximize the contribution of the company. What is the resulting profit?

**SUGGESTED SOLUTION 14-16**

<table>
<thead>
<tr>
<th></th>
<th>LOT</th>
<th>POT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price</td>
<td>200.00</td>
<td>240.00</td>
</tr>
<tr>
<td>Less: variable cost:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct material</td>
<td>45.00</td>
<td>50.00</td>
</tr>
<tr>
<td>Direct wages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dept 1</td>
<td>16.00</td>
<td>20.00</td>
</tr>
<tr>
<td>Dept 2</td>
<td>22.50</td>
<td>13.50</td>
</tr>
<tr>
<td>Dept 3</td>
<td>10.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>6.50</td>
<td>11.50</td>
</tr>
<tr>
<td>Contribution</td>
<td>(110.00)</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>LOT</th>
<th>POT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution</td>
<td>100</td>
<td>115</td>
</tr>
<tr>
<td>Direct labour hours:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dept 1</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>Dept 2</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Dept 3</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

Formulation: Let L represent Lot and P represent Pot
Maximum contribution: 100L + 115P

Subject to the following constraints:

8L + 10P ≤ 800 .......... (1)
10L + 6P ≤ 600 .......... (2)
4L + 12P ≤ 720 .......... (3)
L, P ≥ 0 non negativitity

In equation (1) 8L + 10P = 800
When L = 0, P = 80
When P = 0, L = 100

In equation (2), 10L + 6P = 600
When \( L = 0 \), \( P = 100 \)
When \( P = 0 \), \( L = 60 \)

In equation (3), \( 4L + 12P = 720 \)
When \( L = 0 \), \( P = 60 \)
When \( P = 0 \), \( L = 180 \)

The graph for the mix of products is then depicted as below:

<table>
<thead>
<tr>
<th>POINTS</th>
<th>L</th>
<th>P</th>
<th>( 100L + 11P )</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100(0) + 115(0)</td>
<td>= 0</td>
</tr>
<tr>
<td>A</td>
<td>60</td>
<td>0</td>
<td>100(60) + 115(0)</td>
<td>= 6,000</td>
</tr>
<tr>
<td>*B</td>
<td>30</td>
<td>50</td>
<td>100(30) + 1150(50)</td>
<td>= 8,750</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>60</td>
<td>100(0) + 115(60)</td>
<td>= 6,900</td>
</tr>
</tbody>
</table>
The company should produce 30 units of Lot and 50 units of Pot to realise ₦8,750 contribution per week.

Note *: The number of units of Lot and Pot to be produced can also be derived by using the simultaneous equation based on the feasible region thus:

\[ 4L + 12P = 720 \] \hspace{1cm} (1)
\[ 10L + 6P = 600 \] \hspace{1cm} (2)

Substituting for \( L \), multiply the equation (2) by 2 and deduction from equation (1)

\[ 4L + 12P = 720 \]
\[ 20L + 12P = 1200 \]
\[ -16L = -480 \]
\[ L = 480 = 30 \]
\[ 16 \]

Substituting for \( P \) in equation (1)

\[ 4L + 12P = 720 \]
\[ 4(30) + 12P = 720 \]
\[ 12P = 720 - 120 \]
\[ L = 600 = 50 \]
\[ 12 \]

14.3.6 Shadow Price
It can be defined as the amount by which the profit of a company will increase if an additional unit of scarce resources is made available that is, it is the maximum amount which a company is prepared to pay for the use of an additional unit of a constraint. Generally, only binding constraints have shadow price, while the shadow price of non-binding constraints is zero. Binding constraints form part of the feasible region and the resources are fully utilised at that optimal level.

14.3.7 Usefulness of shadow price
(a) It is the extra profit that may be earned for having additional units of a constraint;
(b) It can be used to determine the maximum amount which a company is willing to pay for a scarce resource; and
(c) It will generally indicate the effect of unit change of the constraints, that is, it provides a measure of the sensitivity of the resources.

ILLUSTRATION 14-17
A company manufacturers for sale, two products Pako and Papo from three raw materials, Rix, Rex and Rax which are in short supply. The usage of three raw materials per product is as follows:
Raw material per unit

<table>
<thead>
<tr>
<th></th>
<th>Pako</th>
<th>Papo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rix</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Rex</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Rax</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

The supply of each raw material is limited to Rix = 240, Rex = 120 and Rax = 200. The contribution per product is N100 for Pako and N160 for Papo.

**Required:**

(a) Formulate the linear programming problem and determine graphically the optimal solution.
(b) At the optimal solution, determine the shadow price of each material.
(c) Assuming it is possible to increase the supply of Rex at the rate of N12 per unit should the company increase the supply and if so, by how much units?

**SUGGESTED SOLUTION 14-18**

Let P1 represents Pako and P2 represents Papo
Maximize contribution: 100P1 + 160P2
Subject to the following constraints:

\[
\begin{align*}
6P1 + 2P2 & \leq 240 \quad \text{Rix (Equation 1)} \\
2P1 + 2P2 & \leq 120 \quad \text{Rex (Equation 2)} \\
2P1 + 4P2 & \leq 200 \quad \text{Rax (Equation 3)} \\
P1, P2 & \geq 0
\end{align*}
\]

In equation 1; \(6P1 + 2P2 = 240\)
When \(P1 = 0, P2 = 120\)
\(P2 = 0, P1 = 40\)

In equation 2; \(2P1 + 2P2 = 120\)
When \(P1 = 0, P2 = 60\)
When \(P2 = 0, P1 = 60\)

In equation 3; \(2P1 + 4P2 = 200\)
When \(P1 = 0, P2 = 50\)
\(P2 = 0, P1 = 100\)

The optimal solution can be derived graphically as below:
The solution is that the company should produce 20 units of Pako and 40 units of Papo to derive a maximum contribution of $8,400.

(b) To determine the shadow price, test that the available resources have been fully utilized at the recommended production mix, thus:

<table>
<thead>
<tr>
<th>Resource</th>
<th>20P1 + 40P2</th>
<th>Raw Material Consumed</th>
<th>Raw Material Available</th>
<th>Excess</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rix</td>
<td>20 (6) + 40 (2) = 200</td>
<td>240</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Rex</td>
<td>20 (2) + 40 (2) = 120</td>
<td>120</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Rax</td>
<td>20 (2) + 40 (4) = 200</td>
<td>200</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

There are no excess stock of Rex and Rax, therefore, shadow prices exist in them.

Test the equation at the maximum point

Equation 1. Rix - 6P1 + 2P2 = 40

= 240 - [6(20) + 2(40)] = 40
= 240 - (120 + 80) = 40

Therefore, no shadow price exists.
Equation 2. \[ \text{Rex} \cdot 2P1 + 2P2 = 120 \]
\[ = 2(20) + 2(40) = 120 \]
\[ 40 + 80 = 120 \]
\[ 120 = 120 \]
Therefore, shadow price exists.

Equation 3. \[ \text{Rax} \cdot 2P1 + 4P2 = 200 \]
\[ = 2(20) + 4(40) = 200 \]
\[ 40 + 160 = 200 \]
\[ 200 = 200 \]
Therefore, shadow price exists.

Therefore, the relevant equations are:
\[ 2P1 + 2P2 = 120 \quad \ldots \ldots \quad (1) \]
\[ 2P1 + 4P2 = 200 \quad \ldots \ldots \quad (2) \]

Based on the principle of shadow price, if the available units of Rex is increased by one unit, and equation (2) held constant, then equation (2) is multiplied by -1 and the new equations are:

\[ 2P1 + 2P2 = 121 \quad \ldots \ldots \quad (1) \]
\[ 2P1 + 4P2 = 200 \quad \ldots \ldots \quad (2) \]
\[ -2P2 = -79 \]

Therefore, \[ P2 = \frac{79}{2} = 39.5 \]

Substitute the value of P2, that is, 39.5 into equation (1) which is being sensitized. This will give the value of P1 as 21 units.

Substituting for P in new equation (1) above
\[ 2P1 + 2(39.5) = 121 \]
\[ 2P1 = 121 - 79 \]
Maximization Objective: \[ 100P1 + 160P2 \]
Then based on the new units to be produced of P1 and P2 the new contribution can be determined thus:
\[ 100 (21) + 160 (39.5) \]
\[ 2100 + 6320 = N8420 \]

Maximization objective: \[ 100P1 + 1 < 160P2 \]
Comparing the old contribution and new contribution, we thus have the shadow price (which is the additional profit made as result of using an additional units of Rex).

New contribution \[ N8,420 \]
Old contribution \[ N8,400 \]
Shadow price of P1 \[ 20 \]
For additional units of Rex, we are ready to pay ₦20.
On the other hand, if the units of Rex is increased by 1 and equation 1 held constant, and if equation (2) is multiplied by -1, then the new equations are:

\[
\begin{align*}
2P1 + 2P2 &= 120 \quad \text{............... (1)} \\
-2P1 - 4P2 &= 201 \quad \text{............... (2)} \\
-2P2 &= -81
\end{align*}
\]

Therefore, \( P2 = \frac{81}{2} = 40.5 \)
Substituting for \( P1 \) in equation (2) which is being sensitized, we have:
\[
2P1 + 4(40.5) = 201
\]
\[
P1 = 201 - 162 = 39
\]
\[
\frac{39}{2} = 19.5
\]

Maximisation objective: \[
\frac{100P1 + 160P2}{100(19.5) + 160(40.5)} =\frac{1950 + 6480}{8430}
\]

To derive the shadow price, the following is done thus:
New contribution ₦8,430
Old contribution ₦8,400
Shadow price of \( P2 = \frac{30}{30} \)

14.3.8 Simplex Method

This involves algorithms and the following procedures or steps are to be taken in order to formulate the tableau for the purpose of determining the optimal solution:

(a) Formulate the objective function.
(b) Formulate the non negativity constraints.
(c) Formulate the constraints.
(d) Get rid of inequality signs in constraints by introduction of slack variables.
(e) Set up the initial simplex tableau.
(f) Locate the pivot column in the tableau set up in the initial simplex tableau.
(g) The pivot column is the one that houses the least element on the objective function row if you are maximising and the maximum value on the objectives function row if you are minimising.
(h) Locate the pivot row by dividing each position element of the pivot column into the corresponding constant value of the last column. Select the row with the least quotient. This is the pivot row. The element in the pivot row and the pivot column is the pivot element.

(i) The pivot element is then turned to unity by dividing through all the elements in the pivot column by the pivot element.

(j) Using a procedure to obtain zeros in the pivot column other than the pivot element, by adding suitable products of the pivot row to the remaining ones i.e. we use pivot row to eliminate all other rows.

(k) If a negative number remains in the objective function row, go to step (f) and start all over if maximising. If none of the element in the objectives function row are negative, the optimum solution has been found.

On the other hand, if minimising and one of the elements in the objectives function row is still negative, then the optimal solution has not been arrived at. If all the elements in the objective function row are zero or positive, then the solution has been found.

The examples below are used to illustrate the equation of the simplex method of solving linear programming problems.

**ILLUSTRATION 14-19**

Given the following information, use the simplex method in arriving at the optimal solution:

Maximise P: 8x1 + 6x2

Subject to: 
4x1 + 2x2 ≤ 60
2x1 + 4x1 ≤ 48
x1, x2 > 0

**SUGGESTED SOLUTION 14-19**

Introduce the slack variable and the equation becomes:

4x1 + 2x2 + S1 = 60
2x1 + 4x2 + S1 = 48
P = 8x1 + 6x2 + 0S1 + 0S2

Therefore, P - 8x1 - 6x2 - 0S1 - 0S2 = 0

<table>
<thead>
<tr>
<th></th>
<th>x1</th>
<th>x2</th>
<th>S1</th>
<th>S2</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>(4)</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>60</td>
<td>T2</td>
</tr>
<tr>
<td>T1</td>
<td>2</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>48</td>
<td>NR1 = R1 + 4</td>
</tr>
<tr>
<td></td>
<td>-8</td>
<td>-6</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>NR2 = R2 + 0</td>
</tr>
</tbody>
</table>

The pivot column is x1

The optimum solution is P = 360, x1 = 5, x2 = 0.
The pivot row is that with 15 (1st row) that is, (60/4).
The pivot element is 4.

\[
\begin{array}{cccccc}
1 & 1/2 & 1/4 & 0 & 0 & 15 \\
2 & 4 & 0 & 1 & 0 & 48 \\
-8 & -6 & 0 & 0 & 1 & 0 \\
\end{array}
\]

\[
NR_2 = R_2 + 2R_1 \\
NR_3 = R_3 + 8R_1
\]

\[
\begin{array}{cccccc}
1 & 1/2 & 1/4 & 0 & 0 & 15 \\
0 & 3 & -1/2 & 1 & 0 & 18 \\
-2 & 2 & 0 & 1 & 120 \\
\end{array}
\]

\[
NR_2 = R_2 - 3 \\
NR_3 = R_3 + 0
\]

Since we still have a negative in the objective function row, we have to go back to step (f), the pivot column is \(x\) and the pivot row is that containing 3.

\[
\begin{array}{cccccc}
1 & 1/2 & 1/4 & 0 & 0 & 15 \\
0 & 1 & -1/6 & 1/3 & 0 & 6 \\
-2 & 2 & 0 & 1 & 120 \\
\end{array}
\]

\[
NR_1 = R_1 + 1/2R_2 \\
NR_3 = R_3 + 8R_1
\]

\[
\begin{array}{cccccc}
1 & 0 & 1/3 & -1/6 & 0 & 12 \\
0 & 1 & -1/6 & 1/3 & 0 & 6 \\
0 & 0 & 5/3 & 2/3 & 1 & 132 \\
\end{array}
\]

Proof: \( P = 8x1 + 6x2 \)
\[
\begin{align*}
x1 &= 12 \\
x2 &= 6
\end{align*}
\]

Therefore, \( P = 8(12) + 6(6) = 96 + 36 = 132 \)

**ILLUSTRATION 14-20**

Given the following information, determine the optimal solution by using the linear programming technique.

Minimize \( Z: \)
\[
4x1 + 3x2
\]
Subject to:
\[
\begin{align*}
2x1 + 4x2 & \geq 16 \\
3x1 + 2x2 & \geq 12 \\
x1, x2 & \geq 0
\end{align*}
\]
SUGGESTED SOLUTION 14-20

Introduce the slack variables and the equation becomes:

\[
\begin{align*}
2x_1 + 4x_2 &\geq S_1 = 16 \\
3x_1 + 2x_2 &\geq S_2 = 12 \\
4x_1 + 3x_2 - z &\geq 0
\end{align*}
\]

<table>
<thead>
<tr>
<th>x1</th>
<th>x2</th>
<th>S1</th>
<th>S2</th>
<th>Z</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>16</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>0</td>
</tr>
</tbody>
</table>

\[ T_1 \]

The pivot column is x1
The pivot row is the second row
The pivot element is 3

\[
\begin{align*}
x_1 & \quad x_2 & \quad S_1 & \quad S_2 & \quad Z & \quad C \\
2 & \quad 4 & \quad 1 & \quad 0 & \quad 0 & \quad 16 \\
1 & \quad 2/3 & \quad 0 & \quad 1/3 & \quad 0 & \quad 4 \\
4 & \quad 3 & \quad 2 & \quad 0 & \quad -1 & \quad 0
\end{align*}
\]

\[ T_2 \]

\[ NR_2 = R_2 / 3 \]
\[ NR_3 = R_3 + 0 \]

Back to step (f) obtain pivot element which is now 8/3. We now try to make 8/3 unity by multiplying throughout by 3/8.

\[
\begin{align*}
x_1 & \quad x_2 & \quad S_1 & \quad S_2 & \quad Z & \quad C \\
0 & \quad 1 & \quad 3/8 & \quad -1/4 & \quad 0 & \quad 3 \\
1 & \quad 2/3 & \quad 0 & \quad 1/3 & \quad 0 & \quad 4 \\
0 & \quad 1/3 & \quad 0 & \quad -4/3 & \quad -1 & \quad -16
\end{align*}
\]

\[ T_3 \]

\[ NR_2 = R_2 / 3R_1 \]
\[ NR_3 = R_3 - 1/3R_1 \]

\[
\begin{align*}
x_1 & \quad x_2 & \quad S_1 & \quad S_2 & \quad Z & \quad C \\
0 & \quad 1 & \quad 3/8 & \quad -1/4 & \quad 0 & \quad 3
\end{align*}
\]

\[ T_4 \]

\[ NR_2 = R_2 / 3R_1 \]
\[ NR_3 = R_3 - 1/3R_1 \]

<table>
<thead>
<tr>
<th>x1</th>
<th>x2</th>
<th>S1</th>
<th>S2</th>
<th>Z</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>-1/4</td>
<td>1/2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>-9/8</td>
<td>-15/12</td>
<td>-1</td>
<td>-17</td>
</tr>
</tbody>
</table>

\[ T_5 \]

\[ \text{Proof: } Z = 4x_1 + 3x_2 \]
\[ x_1 = 2 \]
\[ x_2 = 3 \]

Therefore, \[ Z = 4(2) + 3(3) = 8 + 9 = 17 \]
14.3.9 MARKOV ANALYSIS

Markov analysis is a technique specially designed to deal with the probabilities of future occurrences by analysing presently known probabilities. The technique assumes that all system starts with an initial state or condition.

According to Trueman RG (1981) the "Markov process is a stochastic process which has the property that the probability of a transition from a given state to any future state depend only on the present state and not on the manner in which it was reached.

A stochastic process is a time dependent event, guided or governed by some probability laws. The 'states' of such a system change in some probabilistic fashion at fixed or random intervals in time. Markov chain is one of such processes.

APPLICATION OF MARKOV ANALYSIS

The technique can be used in:

(a) Sales and Marketing Management:
   (i) Number of outlets; and
   (ii) Brand switching behaviour.

(b) Operations Management
   (i) Personnel Management;
   (ii) Aggregate scheduling; and
   (iii) Management of Finance.

(c) Business analysis
   (i) Market share analysis; and
   (ii) Bad debt prediction.

UNDERLINING ASSUMPTIONS OF MARKOV CHAINS

(a) The probability of changing states / and outcomes remain constant over time.

(b) Limited or finite number of states.

(c) Size and make up of the system do not change during the analysis.

(d) Future state(s) can be predicted from the previous state(s) and the Matrix of Transition Probability. This implies that the probability of next outcome depends on the outcome immediately preceding it.

(e) It is assumed that states are both collectively exhaustive (i.e. all the possible states of a process can be listed and are mutually exclusive (i.e. a system can only be in one state at any point in time).
TYPES OF MARKOV CHAINS

(a) **An Ergodic Markov Chain.** It describes the process in which it is possible to go from one state to any other state. This transition can be made in one or more steps but there must be a link between them. In an ergodic Markov Chain, \( X \) is non-zero and less than one.

(b) **A Regular Markov Chain.** Is one in which the transition matrix \( P \) is such that for some powers of \( n \), \( P^n \) has non-0 elements. Zero means impossible movements i.e. there is no movement from one step to another.

(c) **Absorbing Markov Chain.** A Markov chain is said to be absorbing if: (i) it has at least one absorbing state and (ii) it is possible to go from every none absorbing state to at least one absorbing state in one or more steps

TYPES OF MARKOV STATES

(a) **Absorbing Markov State.** This is a state that cannot be left once entered. That is, there is 0 probability of leaving it (impossible to leave). Hence, the process either stops completely or it is restarted all over again. Examples are: Retirement, Resignation, death etc.

(b) **Transient State.** A state is transient if the probability of its not returning back to that state is 1. It is the same as non-recurrent state.

(c) **Recurrent State** A state is recurrent if the probability that the process will eventually return back to that state after leaving it is 1.

14.4 SUMMARY AND CONCLUSIONS

Cost prediction especially those relating to direct labour costs should allow for the effects of learning process which states that as a new part or process is carried out, experience and skills are gained, productivity increases and there is a reduction of time taken per unit.

Manufacturing inventory can be conveniently categorised into raw materials, work in progress, finished goods and consumable stocks and they are held for precautionary, transactionary and speculative reasons with the attendant costs of holding, ordering and any stock out.

The various methods for controlling stocks are re-order level, periodic review system and economic order quantity.

The overall objective of inventory control is to maintain stock at a level, which minimises total stock costs.
Linear programming technique is a resource allocation technique which provides a valuable extension to cost-volume-profit-analysis. The assumptions thereof are: linearity, single objective function, non-negativity and divisibility.

Linear programming problems can be solved by using any of the following methods: graphical, simultaneous equation and simplex method.

The major limitations of Linear Programming techniques are: the assumptions of linearity, certainty and continuity.

The shadow price of a scarce resource is the opportunity cost of the constraint and is a valuable by - product of the simplex method.

*(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)*

14.5 **REVISION QUESTIONS**

14.5.1 **MULTIPLE CHOICE QUESTIONS**

1. Bogu Plc has recently developed a new product. The nature of Bogu plc work is repetitive and it is usual for their to be an 80% learning curve effect when a new product is developed. The time taken for the first unit was 22 minutes.

   Assuming that an 80% learning effect applies, the time to be taken for the fourth unit is nearest to
   A 9.91 minutes
   B 9.97 minutes
   C 14.08 minutes
   D 15.45 minutes
   E 17.60 minutes.

   Use the below data to answer questions 2 and 3
   A domestic appliance retailer with multiple outlets stocks a popular toaster known as the Autocycle 2000, for which the following information is available
   Average sales 75 per day
   Maximum sales 95 per day
   Minimum sales 50 per day
   Lead time 12 - 18 days
   Re-order quantity 1,750

2. Based on the above, at what level of stock would a replenishment order be issued?
   A 1050
   B 1330
   C 1710
   D 1750
   E 1760.
3 Based on the data above, what is the maximum level of stock possible?
A 1750
B 2860
C 3460
D 5210
E 5310.

4 Tunde Limited mixes four raw materials to produce a plastic. Material W costs \( N\) 40 per kg. Material X costs \( N\)112 per kg, Material Y costs \( N\)90 per kg, and Material Z costs \( N\)260 per kg. Each of the materials contribute some essential quality to the plastic and it is required to use the least cost mix.

The objective function therefore is:
A \[ 40x1 + 120x2 + 80x3 + 260x4 \]
B \[ 40x1 + 80x2 + 120x3 + 260x4 \]
C \[ 40x1 + 260x2 + 120x3 + 50x4 \]
D \[ 40x1 + 120x2 + 90x3 + 260x4 \]
E \[ 40x1 + 100x2 + 90x3 + 260x4 \].

5 ALHASSAN BILIAMINU Plc uses the economic order quantity formula (EOQ) to establish its optimal re-order quantity for its single raw material. The following data relates to the stock costs:

- Purchase price \( N\)15 per item
- Carriage costs \( N\)50 per order
- Ordering costs \( N\)5 per order
- Storage cost 10% of purchase price plus \( N\)0.20 unit per annum.

Annual demand 4000 units.

What is the EOQ to the nearest whole unit?

A 153 units
B 170 units
C 485 units
D 509 units
E 500 units.

14.5.2 SHORT ANSWER QUESTIONS
1 A mathematical technique concerned with the allocation of scarce resources is called -----------

2 In the pricing model, the increase in the value of the objective function which would be achieved if one unit of the resources is available is called ----

3 That linear programming refers to the quantification of an objective and usually takes the formal maximizing profits or minimizing costs is called --------

4 When can graphical solution method be used in linear programming?

5 What is a slack variable?

(Refer to Suggested Solution in Appendix I, page 443)
15

CURRENT TRENDS IN MANAGEMENT ACCOUNTING

15.0 LEARNING OBJECTIVES

After studying this chapter, readers should be able to understand the:
- Issues in Advanced Manufacturing Technology (AMT) and relationship with management accounting;
- Concept of Total Quality Management (TQM);
- Relevance of AMT to Activity-Based Costing (ABC);
- Issues which relate to Throughput Accounting;
- Usage of Backflush Accounting and principles of Target Costing;
- Use of physical measures to carry-out performance evaluation; life-cycle costing and the stages involved in a product’s life cycle (PLC); tear-down Analysis, Value Engineering and Functional Analysis;
- Aim of Kaizen Costing and different types of Environmental Cost;
- Various elements of Strategic Management Accounting; and
- Balanced scorecard and the associated benefits thereof.

15.1 WHAT IS ADVANCED MANUFACTURING TECHNOLOGY (AMT)?

Advanced Manufacturing Technology (AMT) is an umbrella word used to capture automated production technology, computer assisted design and manufacturing systems (CAD/CAM), flexible manufacturing systems (FMS), robotics, total quality control (TQC), advances in production management including materials requirement and manufacturing resources planning systems (MRP), just-in-time (JIT) systems, etc., which are considered to be the new developments in the area of management accounting due to technological advancement.

Based on the above, the traditional management accounting systems have been found to be inadequate as basis for evaluating performances in companies that have adopted the AMT. This view is supported by Kaplan (1996) when he said that "traditional management accounting produces simply the wrong measures."
They move the company in the wrong direction, reward managers for damaging the business and provide no incentive for improvement. The best we can do is to switch them off, just stop doing them!

15.2 BENEFITS OF AMT

The benefits of AMT:

(a) Assisting companies to function effectively in the technologically and fast growing economies and global markets;
(b) Ensuring that consumers derive better satisfaction from super-quality goods that are made available at cheap rates;
(c) Encouraging companies to cope with short product life cycles which are enhanced by flexibility and innovation in production activities;
(d) Abilities to sustain cost reduction programme and ensure that variety of goods are supplied; and
(e) The desire to minimise set-up times and costs as well as stock usage which are required for sustaining flexibility in production activities is achieved.

15.3 COMPUTER-AIDED DESIGN (CAD)

This is a good part/component design and testing using a computer. The designer, the programmer and the database engineers come together so that more choices and designs can be looked at as a way of having activities carried out at the least cost. The basic function involved here is putting the CAD database to test in order to ascertain standard parts and systems that ensure the minimisation of production parts, stock and simplifies product design.

15.4 COMPUTER-AIDED MANUFACTURING (CAM)

This is an umbrella word depicting the application of computers for the programming and control of production equipments which includes robots, machines operated automatically and those machines that operate automatically by computers. The benefits of CAM include:

(a) Enhances efforts in carrying out series of operation and production of various components;
(b) Effective monitoring of production efforts;
(c) Minimises set-up times and costs;
(d) Ensures quality on constant basis; and
(e) Jobs are machine intensive/highly automated.
15.5 FLEXIBLE MANUFACTURING SYSTEM (FMS)

This is a system that ensures a linkage of computer controlled machines to ensure effective handling and transfer of parts from one location to another, principally to give effect to the production of similar parts in a more flexible manner.

Even where the ultimate is to integrate manufacturing efforts by the use of computers, the human element is still of paramount importance.

15.6 TOTAL QUALITY CONTROL (TQC)

Under the conventional management accounting practice, functions and costs associated with bad quality units and addressed by factoring into standard costs and process costs, 'normal' allowances in percentages for scrap, waste and defects, the normal loss is kept within the set limits no matter the output involved. Consequently, no problem is reported.

However, based on modern trends, quality is a function of the design and not the inspection. Therefore, TQC is a matter to be considered at every point of activity, especially commencing with when the idea for the product was muted.

TQC is seen to be functional with the following activities in place; product design, production engineering, control charts, Just-in-time systems and inspection of goods inwards and outwards.

With the effective installation of TQC, the following, among others will happen:

(a) Decrease in defects;
(b) Scrapping;
(c) Reworking;
(d) Warranty; and
(e) Service expenses resulting in lower costs due to higher quality.

15.7 TOTAL QUALITY MANAGEMENT (TQM)

Total quality management has to do with ensuring that there is a spirit of defined culture of quality improvement in quality maintenance in every aspect of an organisation whether in terms of function and units. Of relevance is the recognition of three key elements: customers, products and employees.

In Nigeria, organisations can be recognised under Standard Organization of Nigeria (SON), if they comply with the required quality standards throughout the companies. SON's recognition applies to service organisations as well as production companies and there are various businesses that have received the recognition. These include: government agencies, accountants, shipping companies, paints, food and beverage companies.
15.8 MANAGEMENT ACCOUNTING AND AMT

Under 15.1 above, it was asserted that the traditional management accounting is deficient. The issues involved are discussed below:

The main problem areas as identified by Lucey (2003) are:

(a) **Absorption costing**

In the AMT environment, the application of overhead absorption basis of direct labour hours or machine hours in determining product costs is considered inadequate because of time lag or inconsistency in decision making efforts.

(b) **Cost Behaviour**

The classification of costs as fixed or variable does not make for the effective recognition of overheads, especially where costs are related to production volume, even though labour costs are not significant in relation to total costs.

(c) **Standard Costing**

The traditional control techniques of standard costing and variance analysis have been considered inadequate in the AMT and JIT environments because they are not at par with the consistent improvement belief, in the AMT situation and that the variances lose their significance under the latter situation. For example, material usage variance is not relevant where quantity is involved because JIT does not allow for excess material as what is required is what is purchased.

(d) **Short-term Financial Measures**

Traditional management accounting focuses on short-term financial issues which are related to industrial events or costs, whereas AMT addresses readily available non-cash issues such as those concerning machine failures, defective items, etc.

(e) **Cost accounting Methods**

Cost accounting is basically concerned with the determination of production processes, by methodically focusing on the movement of stocks of raw materials to the final stage of having the finished products. However, with the advent of JIT, the cumbersome processes
no longer exist as stocks are at almost ‘nil’ level and production processes are carried out in small batch lots on a continuous basis. The cost accounting procedures and methods are now by no small means made simple to operate and results more effectively achieved.

15.9 THROUGHPUT ACCOUNTING (TA)

Throughput Accounting is a management accounting system of determining the rate at which capacity is achieved especially when costs are related to the throughput time, that is, the rate at which products and/or services can be made available to meet consumer’s demand.

Throughput accounting is defined as:

“A management accounting system which focuses on ways by which the maximum return per unit of bottleneck activity can be achieved.”

Throughput Accounting (TA) is based on the following three concepts:

(a) All factory costs, except material costs are assumed to be fixed costs, especially in the short-term. Factory costs and indirect labour costs constitute total factory costs (TFC);

(b) One of the principles on which JIT is based is that if there are no orders there should be no production since the stock level is supposed to be ‘nil.’ The whole essence of this is to ensure that there is no idle capacity except for the activity which has bottleneck at the moment; and

(c) Efforts are to be geared towards increasing the rate of production to meet consumers’ demand, and earn more profits. There is also the need for key resources or capacity factors to be utilised for contribution to be effectively measured.

Using TA, product returns can be determined, using the following formula:

\[
\text{Return per factory hour} = \frac{\text{Sales Price} - \text{Material Cost}}{\text{Time on key resource (i.e. the bottleneck)}}
\]

Product costs are calculated thus:

\[
\text{Cost per factory hour} = \frac{\text{Total factory cost (TFC)}}{\text{Total available on the key resources}}
\]
Therefore, the TA ratio is calculated thus:

\[
\text{TA ratio} = \frac{\text{Return per factory hour (or Minute)}}{\text{Cost per factory Hour (or Minute)}}
\]

A ratio of 1 and above is ideal, but anything short of this will result in loss of funds. The decision will then be the withdrawal of the product from the market.

The TA ratio can be computed by comparing the total return with the total fixed costs. This is a ‘total’ concept.

\[
\text{Primary} = \frac{\text{Return from ‘total’ throughput (that is, sales – material costs)}}{\text{TFC (that is, all costs other than materials costs)}}
\]

It should be noted that since a bottleneck is a key factor that limits the production function or activity, the issue of how to treat overheads involved at a point in time should be related to the actual period involved in terms of the key resource, and not the period related to the utilized portion of the key resources which may be caused by factors which are not related to any key resource, for example, poor quality production inputs.

The computation can be made, using the following formula:

\[
\text{Throughput cost} = \left( \frac{\text{Standard minutes of the throughput usage of bottleneck resource}}{\text{Budget TFC cost per minute of bottleneck resource}} \right) \times \text{Budget TFC cost per minute of bottleneck resource}
\]

From the foregoing, efficiency percentage can be calculated thus:

\[
\text{Efficiency} \% = \frac{\text{Throughput cost}}{\text{Actual TFC}} \times 100\%
\]

Labour efficiency can be measured as:

\[
\text{Labour Efficiency} \% = \frac{\text{Throughput cost}}{\text{Actual total labour cost}} \times 100\%
\]
ILLUSTRATION 15-1

A key resource (bottleneck) of facility Z is available for 15,650 minutes per period.

Budgeted factory costs and data for two products, A and B, are shown as below:

<table>
<thead>
<tr>
<th>Product</th>
<th>Selling Price/unit</th>
<th>Material Cost/unit</th>
<th>Time in facility Z Mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14 N</td>
<td>9 N</td>
<td>2</td>
</tr>
<tr>
<td>B</td>
<td>14 N</td>
<td>8 N</td>
<td>4</td>
</tr>
</tbody>
</table>

Budgeted factory costs per week:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct labour</td>
<td>10,000 N</td>
</tr>
<tr>
<td>Indirect labour</td>
<td>5,000 N</td>
</tr>
<tr>
<td>Lighting</td>
<td>700 N</td>
</tr>
<tr>
<td>Depreciation</td>
<td>9,000 N</td>
</tr>
<tr>
<td>Space costs</td>
<td>3,200 N</td>
</tr>
<tr>
<td>Maintenance</td>
<td>1,400 N</td>
</tr>
<tr>
<td>Administration</td>
<td>2,000 N</td>
</tr>
</tbody>
</table>

Calculate:

(a) Total Factory Costs (TFC)
(b) Cost per Factory Minute
(c) Return per Factory Minute for both products
(d) Throughput activity ratios for both products

SUGGESTED SOLUTION 15-1

(a) Total Factory Costs = Total of all costs except materials
   = 10,000 + 5,000 + 700 + 9,000 + 3,200 + 1,400 + 2,000
   = 31,300 N

(b) Cost per factory minute = \[ \frac{\text{Total Factory Costs}}{\text{Total Minutes in bottleneck}} \]
   = \[ \frac{31,300}{15,560} \]
   = 2 N per minute
(c) Return per minute of products

<table>
<thead>
<tr>
<th>Products</th>
<th>Selling Price/Unit</th>
<th>Material Cost/Unit</th>
<th>Time in Facility (Units)</th>
<th>Return (Unit)</th>
<th>Return Per minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14</td>
<td>9</td>
<td>2</td>
<td>(14-9)=5</td>
<td>5/2 = 2.50</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>8</td>
<td>4</td>
<td>(14-8)=6</td>
<td>6/4 = 1.50</td>
</tr>
</tbody>
</table>

**Tutorial:**
Product 'A', records the ratio of 1.25 as against that of 'B' of 0.75. It should therefore be picked in preference to 'B' as 'A' earns more than 1 ratio also.

**ILLUSTRATION 15-2**

Assume the data in illustration 15-1 above. During a week actual production was 6,000 units of Product A and 700 units of Product B. Actual factory costs were N31,300.

(a) Calculate:
(i) Standard minutes of throughput
(ii) Throughput cost for the week
(iii) Efficiency percentage

(b) State the possible reason(s) for the efficiency percentage calculated.

**SUGGESTED SOLUTION 15-2**

(a) (i) Standard minutes of throughput for the week:

\[ = (6,000 \times 2) + (700 \times 4) = 14,800 \text{ minutes} \]

(ii) Throughput cost for the week:

\[ = 14,800 \times N2 \text{ per min (from Illustration 15-1)} \]

\[ = N29,600 \]

(iii) Efficiency % = \[ \frac{\text{Throughput Cost}}{\text{Actual TFC}} \times 100 \]

\[ = \frac{29,600}{31,300} \times 100 = 94.57\% \]

The bottleneck resource of facility Z is available for only 15,650 minutes per
week but produced 14,800 standard minutes. The shortfall in time utilisation of 850 minutes could have been due to any of the following developments:

(i) The presence of a ‘wandering’ bottle which caused facility Z to be under-utilised.
(ii) Outright inefficiency in facility Z

Tutorial:
The Throughput Accounting (TA) Ratio Technique shares some similarities with the conventional contribution margin approach in that both focus on limiting key resources. However, the two concepts may be compared and contrasted, as follows:

(a) In Throughput Accounting (TA) ‘return’ on performance is measured as sales minus material costs. With marginal costing approach, the performance measurement criterion is achieved by deducting the variable cost of labour, material and overhead from sales, to obtain the contribution margin.

(b) Under Throughput Accounting, all costs, except materials, are regarded as ‘fixed’ in the short-run and recognised for the purpose of computing total factory costs. Marginal costing, on the other hand, takes cognisance of only variable costs.

Throughput Accounting, although a criterion which embraces ‘short-run’ perspective only is very appropriate in ‘Just-In-Time’ environment. It enhances management ability in identifying key resources which are required for profit making particularly in the reduction of stock pile and ‘waiting time’ of customers.

15.10 BACKFLUSH ACCOUNTING

According to the Chartered Institute of Management Accountants (U.K), Backflush Accounting is defined as a method of costing, associated with JIT production systems, which applies cost to the output of a process. Costs do not reflect the flow of products through the manufacturing process. They are attached to output produced (finished goods stock and cost of sales), on the assumption that such back flushed costs are a realistic measure of the actual costs incurred.

In effect, a single account is maintained for both the raw materials and work-in-progress items, whereby the standard cost of the raw material in the finished goods is credited to a single account already created. Furthermore, the processing costs are not applied to the work-in-progress.
ILLUSTRATION 15-3

The following shows the transactions of Bisi Ltd, in a given period:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchases of raw materials</td>
<td>510,000</td>
</tr>
<tr>
<td>Processing costs</td>
<td>411,600</td>
</tr>
</tbody>
</table>

Qty. (in Units)

| Production            | 9,800   |
| Sales                 | 9,700   |

There were no opening stocks of raw materials, WIP or finished goods. The standard cost per unit is N93 (N51 materials + N42 processing cost). There was no closing WIP at the end of the period.

Journalize the entries on backflush accounting, using a raw materials in progress (RIP) account.

SUGGESTED SOLUTION 15-3

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIP account</td>
<td>510,000</td>
</tr>
<tr>
<td>Creditors</td>
<td>510,000</td>
</tr>
<tr>
<td>Being the cost of raw materials Bought on credit</td>
<td></td>
</tr>
<tr>
<td>Finished Goods Stock (N93x9,800)</td>
<td>911,400</td>
</tr>
<tr>
<td>RIP a/c</td>
<td>499,800</td>
</tr>
<tr>
<td>Processing cost control a/c</td>
<td>411,600</td>
</tr>
<tr>
<td>Being the cost of production of 9,800 units</td>
<td></td>
</tr>
<tr>
<td>Cost of sales</td>
<td>902,100</td>
</tr>
<tr>
<td>Finished Goods Stock</td>
<td>902,100</td>
</tr>
<tr>
<td>Being the cost of sales of 9,700 units at N93 each</td>
<td></td>
</tr>
</tbody>
</table>

At the end of the period there will be two separate stock balances:

<table>
<thead>
<tr>
<th></th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIP account (N510,000 - 499,800)</td>
<td>10,200</td>
</tr>
<tr>
<td>Finished Goods (100 N93 per unit)</td>
<td>9,300</td>
</tr>
</tbody>
</table>

15.11 ADVANTAGES OF BACKFLUSH ACCOUNTING

(a) It is very simple to operate. Work-in-progress is not accounted for separately;

(b) The accounting entries are very few and documentation is not rigorous; and

(c) It does not allow for the piling-up of inventory, since doing so is not of importance to the managers.
15.12 **TARGET COSTING**

A target cost is defined as a product cost estimate derived by subtracting a desired or target profit margin from a competitive market price. This may be less than the planned initial product cost but will be expected to be achieved by the time the product reaches the mature production stage: Lucey (2003).

In order to adopt Target Costing, the following are the steps to be taken:

(a) Ascertain the target selling price at which demand are likely to be made.

(b) Derive the target cost by subtracting the target profit margin from the target selling price.

(c) Forecast the likely actual cost for the product.

(d) Ensure that the estimated cost is equal to the target cost.

Target costing entails the adoption of team spirit which ensures that the designers, engineers, purchasers, production, selling and distribution as well as the management accounting staff are involved in order to attain the quality level required for realising the target cost. If the target cost cannot be attained, then the new item or goods contemplated should not be considered.

The technique is adopted at the design and planning stage, with the designers, especially those using the ‘tear-down analysis’, value engineering and functional analysis to attain the target cost.

Tear-Down Analysis has to do with the determination of openings for increasing the value of products and/or reducing costs by putting to test a competitor’s product, so as to get at the competitive edge that can be introduced into the product.

Value Engineering on the other hand, is used to determine the elements that could have effects on the costs of a product, such that measures can be taken to enhance product design and reduce unwanted activities which add to product costs, to the detriment of high demand.

Functional Analysis is a variation of Value Engineering. It is used to determine product activities, associated costs and value added to the consumers. In the CIMA terminology, it is “an analysis of the relationships which exist between product functions, their perceived value to the customer and the cost of provision”.
15.13 PERFORMANCE EVALUATION IN AN AMT ENVIRONMENT

The conventional performance evaluation basis such as variances (material, labour, overhead cost) can no longer meet up with the requirements of the technological advancement in the global world for reasons which include the following:

(a) Inability to assess important elements of performance;
(b) Inadequate use of standard costing; and
(c) Delays in reporting mechanism.

Consequently, to overcome these short comings, physical and non-financial measures have been put in place in order to enhance improvement and monitoring. According to Lucey (2003), such measures can be appreciated as tabulated under the various countries of the United Kingdom, United States of America and Japan, thus:

<table>
<thead>
<tr>
<th>Europe</th>
<th>United States</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Outgoing quality</td>
<td>Incoming quality</td>
<td>Manufacturing lead times</td>
</tr>
<tr>
<td>(b) Unit manufacturing costs</td>
<td>Inventory accuracy</td>
<td>Direct labour productivity</td>
</tr>
<tr>
<td>(c) Unit material cost</td>
<td>Direct labour productivity</td>
<td>WIP turnover</td>
</tr>
<tr>
<td>(d) Overhead costs</td>
<td>Manufacturing lead times</td>
<td>Incoming quality</td>
</tr>
<tr>
<td>(e) On-time deliveries</td>
<td>Vendor lead times</td>
<td>Vendor lead times</td>
</tr>
<tr>
<td>(f) Incoming quality</td>
<td>Set-up times</td>
<td>Indirect productivity</td>
</tr>
<tr>
<td>(g) Direct labour productivity</td>
<td>WIP turnover</td>
<td>Material yield</td>
</tr>
</tbody>
</table>

Examples of performance measurements are listed as follows:

(i) Manufacturing cycle efficiency =

\[
\text{Processing time} = \frac{\text{Processing time} + \text{waiting time} + \text{transport time inspection time}}{
\text{Machine down time}} = \frac{\text{Total machine hours}}{
\]

Ideally the above ratio should be 1. Progress in moving towards this should be monitored. This is a useful summary ratio for a JIT factory or line as it relates value added time to non-value added time.

(ii) Machine availability

\[
\text{Machine availability} = \frac{\text{Machine down time}}{\text{Total machine hours}}
\]

This is useful in monitoring machine availability, usage and efficiency.
(iii) In-coming quality: \[ \text{Reject parts (number, weights as appropriate)} \]
\[ \text{Purchase parts} \]

This technique is used to monitor the quality of existing and new suppliers. Customer satisfaction is the ultimate measure of product/service quality. This can be measured in a variety of ways including the following:

\[
\frac{\text{Customer rejects/returns}}{\text{Total Sales}}
\]

Percentage of sales which are repeat sales to existing customers is computed as follows:

\[
\text{Delivery performance} = \frac{\text{Late Delivery}}{\text{ Deliveries on Schedule}}
\]

Applied to sales, this provides a measure of the efficiency of production and production scheduling. Applied to purchasing, it monitors supplier reliability.

In addition to ratios, many AMT performance measures are expressed in real terms; such as hours, minutes, quantities, weights and so on. The trends in these can be followed easily and have real and immediate meaning for everybody associated with production.

Examples include:

- Process times;
- Set-up times;
- Distance parts/materials travel;
- Number of on time deliveries; and
- Number of lost machine time.

15.14 LIFE - CYCLE COSTING

Life cycle costing or terotechnology can be defined as, “the maintenance of physical asset cost records over the entire asset lines, so that decision concerning the acquisition, use or disposal of the assets can be made in a way that achieves the optimum asset usage at the lowest possible cost to the entity. This term may be applied to the profiting of cost over a product’s life, including the pre-production stage (terotechnology), and to both company and industry life cycle” (CIMA).
Even though the above definition is applicable to assets that are physical, there is a need to reflect the concept in relation to manufactured goods and services rendered.

The prevalent costs associated with product life-cycle of an asset, product or service may include the following:

(a) Acquisition costs - Such as set-up costs, research and development costs, production etc., if they are produced by the company. However, where they are bought, the costs will include purchase costs, freight charges, installation costs, etc.

(b) Operating costs - Such as maintenance costs, lighting costs, spare components, casts storage costs, staff costs, safety regulation costs etc.

(c) Disposal costs - Such as scrap costs.

The product life cycles are as depicted in figure 15.5 below. Thus, one can talk about the stages as being planning/design stage, production stage and the service and abandonment stage. This goes to show that more costs are incurred at the first stage as well as the last stage of abandonment where activities are considered to be heavy.

If life cycle costs are to be minimised, then, the issues of utilisation, maintenance and disposal should be properly addressed in terms of technical, engineering and production viability and exposure.

![Diagram](image)

Figure 15.5 product life-cycle phases: relationship between costs committed and cost incurred
ILLUSTRATION 15.4

Kogbodoku Nigeria Limited, with a 10% cost of capital, is considering the purchase of two fertilizer machines: Lexure machine and deluxe machine. Both can produce the same component at identical rates per working hour and the relevant data on the machine, are as follows

(i) Capital cost

<table>
<thead>
<tr>
<th>Machine</th>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>₦38,000</td>
<td>₦480,000</td>
</tr>
</tbody>
</table>

(ii) Operating cost per working hours

<table>
<thead>
<tr>
<th>Category</th>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>₦9</td>
<td>₦15</td>
</tr>
<tr>
<td>Consumables</td>
<td>₦18</td>
<td>₦24</td>
</tr>
<tr>
<td>Variables overheads</td>
<td>₦18</td>
<td>₦21</td>
</tr>
</tbody>
</table>

(iii) Maintenance costs

<table>
<thead>
<tr>
<th>Service interval</th>
<th>36 pa.</th>
<th>30 pa.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of services</td>
<td>₦3,000</td>
<td>₦2,400</td>
</tr>
<tr>
<td>Random breakdowns</td>
<td>9 p.a.</td>
<td>9 p.a.</td>
</tr>
<tr>
<td>Cost of breakdowns</td>
<td>₦6,000</td>
<td>₦9,000</td>
</tr>
</tbody>
</table>

(iv) Expected availability

| (Working hours per annum) | 4,500 HRS     | 6,000 HRS     |

(v) Contribution from production per hour

<table>
<thead>
<tr>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>₦150</td>
</tr>
</tbody>
</table>

(vi) Expected life

<table>
<thead>
<tr>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>5 years</td>
</tr>
</tbody>
</table>

(vi) Net salvage value at the end of year 5

<table>
<thead>
<tr>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>₦30,000</td>
</tr>
</tbody>
</table>

Required:

Determine the machine to be bought with reasons.

SUGGESTED SOLUTION 15-4

<table>
<thead>
<tr>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross contribution</td>
<td>₦150</td>
</tr>
<tr>
<td>Less: operating costs</td>
<td>₦45</td>
</tr>
<tr>
<td>Contribution per hour</td>
<td>₦105</td>
</tr>
<tr>
<td>Hours available</td>
<td>4,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lexure machine</th>
<th>Deluxe machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total contribution per annum</td>
<td>₦472,500</td>
</tr>
<tr>
<td>less: maintenance cost: service</td>
<td>(₦108,000)</td>
</tr>
<tr>
<td></td>
<td>(₦54,000)</td>
</tr>
<tr>
<td>Net contribution per annum</td>
<td>₦310,500</td>
</tr>
</tbody>
</table>
15.15 **KAIZEN COSTING**

This is a costing method adopted whenever the issues of cost reduction and management are to be addressed by a company. It involves the enhancement of production activities by little increases in costs rather than substantial increases.

Basically, Kaizen costing is to minimise the cost of parts and goods at a predetermined rate, whereby each factory is allocated target cost reduction rate which is used in relation to past year’s actual costs to ascertain the target cost reduction.

Kaizen costing is workers’ friendly because their understanding of the enhancement of production processes and customer welfare are conditions for the reduction of costs.

Therefore, significant characteristic of Kaizen costing is that employees have the duty of enhancing processes and reduce costs.

15.16 **BENCHMARKING**

Benchmarking is defined as:
“The establishment, through data gathering, of targets and comparators, through whose use relative levels of performance (and particularly areas of underperformance) can be identified. By the adoption of identified best practices, it is hoped that performance will improve”. (CIMA)

Therefore, benchmarking has to do with the comparison of a company with other companies, especially where they are leaders by making use of certain indicators that are financial and non-financial.

CIMA suggests that there are various types of benchmarking:

(a) Internal benchmarking - a method of comparing one operating unit or function with another within the same industry;

(b) Functional benchmarking - a method in which internal functions are compared with those of the best external practitioners of those functions, regardless of the industry they are in (also known as operational benchmarking or generic benchmarking);

(c) Competitive benchmarking - a method in which information is gathered about direct competitors, through techniques such as reverse engineering; and
(d) Strategic benchmarking - a type of competitive benchmarking aimed at strategic action and organizational change.

15.17 ENVIRONMENTAL COST MANAGEMENT

Environmental cost management has evolved as a result of the need for companies to adopt different methods of assessing, summarising and ascertaining environmental costs. All of these are important because environmental costs can be enormous for some industrial organisations; legal condition may involve substantial times for inability to conform to the rules and regulations in the past years; the public requires that organisations work towards being environmentally compliant especially if the issues of social responsibility and high volume of sales of goods are to be enhanced.

Epstein and Roy (1997) stated that, ‘companies cannot identify their total environmental costs, and do not recognise that they can be controlled and reduced’. Therefore, the required association between environmental costs and the respective activities, processes and products can be determined.

From the foregoing, environmental costs should be gathered by using different cost pools and effect, based on the classifications used to find out the products or processes that caused the costs using the Activity Based Costing principles. The issue here, is to ensure that the pollution of the environment can be managed more easily by redesigning the process especially where the causes and the types of environmental costs are made available to the managers.

In order to address the issue of costs incurred as a result of the existence of bad environmental quality procedures, Hansen and Mendoga (1999) have advocated that an environmental cost report should be produced at regular intervals, based on the concepts of a cost of quality report to indicate the total environmental costs to the organisation associated with the creation, detection, remedy and prevention of environmental degradation. They have also classified the environmental costs into four as follows:

(a) Environmental prevention costs: Being the costs of processes involved to avoid the wastes in production which could bring about pollution of the environment. The costs that may be involved include certification for meeting international and national standards, staff training, design and plan to minimise pollution, product recycling etc.

(b) Environmental evaluation costs: These are the costs associated with ensuring that companies production functions and goods comply with laws and local regulations and procedures. The associated costs include verification of goods and production functions to determine compliance with rules, environmental audits and carrying out of pollution tests.
(c) **Environmental internal failure costs:** These are the costs of carrying out production functions that have been finalised but are yet to be released to the environment especially those that involve the elimination or reduction of wastes to the extent of meeting up with legal standards. Good examples include the costs of having scraps reworked and disposal of acidic items that are injurious to human health.

(d) **Environmental external failure costs:** These are costs of functions carried out after polluting the environment with wastes. Examples include the costs of reducing degradation of the soil, ensuring the reduction of the spread of oil-spillages, fumigation to reduce bacteria effects, etc.

With the effective classification of the costs, the environmental cost report should be framed in such a manner that each class of costs is denoted as a function of turnover (or operation costs) in order to ensure that comparisons with past periods, other companies and subsidiaries of the same company are made possible.

Nonetheless, the Environmental Cost Management Report is more meaningful than the conventional accounting reporting system for various reasons:

(a) It ensures the division of costs and ascertain that they are not of significance which calls for the minimisation of those cost elements.

(b) It enhances the basis for determining the healthy position of the company.

(c) The classification of costs as above helps in enhancing the outlook of the company towards the management of costs.

(d) It ensures effective assessment of the environment and allows everyone involved to be more informed about the activities that are carried out.

(e) It allows for progress to be evaluated in real terms because the focus is the same within the company.

The main drawback of the environmental cost reports is that they only show or relay the costs that were basically incurred by the company alone without giving effect to those created by the company. However, the society is made to bear the burden of reducing the life span of creatures within the ecosystems as a result of releasing solid wastes to the environment.

The above issues can be addressed by carrying out the environmental effects of goods and this can be done by adopting the life cycle costing technique earlier explained in this chapter and this can be nipped in the bud at the planning and design phase where the great percentage of the environmental costs would have been incurred rather than at the production phase.
15.18 STRATEGIC MANAGEMENT ACCOUNTING (SMA)

What is strategic management accounting?

Innes (1998) defines strategic management accounting as the “provision of information to support the strategic decisions in organisations. Strategic decisions usually involve the longer-term, having a significant effect on the organisation and, although they may have an internal element, they also have an external element”. This definition affirms that strategic management accounting can be used to provide information on mixing of products, initiation and abandonment issues. Cooper and Kaplan (1988) are also of the view that 'strategic accounting techniques are designed to support the overall competitive strategy of the organization principally-by using information technology to develop more refined products and service costs.

Of relevance here, is the fact that target costing, life cycle costing techniques and activity based costing are all related to strategic management accounting when current trends of management are involved.

Strategic Management Accounting is the provision and analysis of financial information on the firm’s product markets, competitors' costs and cost structures, the monitoring of the enterprise's strategies and those of its competitors in these markets over a number of periods.

The Chartered Institute of Management Accountants (CIMA) defines Strategic Management Accounting as: “a form of management accounting in which emphasis is placed on information which relates to factors external to the firm, as well as non-financial information and internally generated information.”

The lack of consensus on what constitutes strategic management accounting motivated, Lord (1996) to review literature on the topic. He identified several strands that have been used to characterize strategic management accounting. They include:

(a) The extension of traditional management accounting's internal focus to include external information about competitors.

(b) The relationship between the strategic position chosen by a firm and the expected emphasis on management accounting (that is, accounting in relation to strategic positioning).

(c) Gaining competitive advantage by analysing ways to decrease costs and/or enhance the differentiation of a firm's products, through exploiting linkages in the value chain and optimising cost driver.

Based on the survey carried out by Gulding (2000), the following represent
the twelve (12) areas of strategic management accounting practices:

(a) Quality costing which entails the adoption of quality reports.
(b) Life cycle costing which has to do with the forecasting and accumulation of costs over a product's life cycle with respect to the various stages involved and effects of profits earned on every stage concerned.
(c) Target costing which focuses on the product and cost reduction strategies especially at the planning and design stage.
(d) Monitoring of competitors strategic marketing position in the industry in terms of sales volume, share of the market, unit costs and sales turnover.
(e) Pricing strategy as it relates to price elasticity, exposure, reaction to competitors price, growth in the market etc.
(f) Evaluation of competitors result in order to determine the strength in terms of the competitors key resources which can be ascertained by having a look at the published financial statements.
(g) Determination of competitors basis for costing such as evaluation of facilities, technological advancement, economies of scale through ex-staff, dealers, inspection, substantive buyers, etc.
(h) Strategic costing procedures evolved in order to ensure competitive advantages as a result of adopting strategic and selling information put in place by the management.
(i) Value-chain costing which ensures that costs are directly related to function needed to design, buy, manufacture, sell, and make service and goods available at the right time, place and cost.
(j) Brand value assessment which entails the valuation of brand power elements which includes: leadership; consistency; market trend; support; and guide related to past brand profits.
(k) Brand value forecasting - whereby managerial efforts in relation to the direct utilization of resources to promote brand position is based on brand value for which management is seen to be responsible.
(l) Attribute costing with emphasis on the relatedness of the various characteristics of relevance, timeliness, cost effectiveness etc. to the processes, products and services which are required to enhance cost reduction opportunities throughout the entire production functions.

In a nutshell, it was discovered that the three competitors' strategies (d, f and g above) and pricing strategy are rated as being easily adopted. Furthermore, it was also asserted that the term is not popular in organisations and practicing accountants have not really valued it as a concept.
15.19 THE BALANCED SCORECARD

In the words of Drury (2004), “the need to integrate financial and non-financial measures of performance and identify key performance measures that link measurements to strategy led to the emergence of the balanced score card - an integrated set of performance measures derived from the company’s strategy that gives top management a fast but comprehensive view of the organisational unit that is a division/strategic business unit.”

The balanced scorecard was devised by Kaplan and Norton (1992) and refined in later publications by Kaplan and Norton, (1993; 1996; and 2001). Therefore, the following discussion is a summary of Kaplan and Norton’s writings on this topic.

The balanced scorecard philosophy assumes that an organisation’s vision and strategy is best achieved when the organisation is viewed from the following four perspectives:

(a) Customer perspective (How do customers see us?);
(b) Internal business process perspective (What must we excel at?);
(c) Learning and growth perspective (Can we continue to improve and create value?); and
(d) Financial perspective (How do shareholders see us?)

The balanced scorecard is a strategic management technique for measuring and disseminating the attainment of the mission and strategy of a company. In order to give effect to the balanced score card, the main reasons for the basis should be put together so that they can be transformed into particular evaluation system whereby one or more reasons can be advanced with various evaluation bases associated with each reason. However, there is a need to reduce the number of basis in order to avoid excess information content.

The balanced scorecard could be measured from two angles, thus;

(a) Lagging measures which are the financial results based on past financial action detailing the financial effects on decisions as they occur which are usually after the decisions might have been made; and

(b) Leading measures are those that are related to future financial results which are non-financial in nature especially as they relate to process within an enterprise as well as the learning perception.
Kaplan and Norton (1996) describe how innovative companies are using the measurement focus of the scorecard to accomplish the following critical management processes:

(a) Clarifying and translating vision and strategy into specific strategic objectives and identifying the critical drivers of the strategic objectives;

(b) Communicating and linking strategic objectives and measures. Ideally, once all the employees understand the high level objectives and measures, they should establish local objectives that support the business unit’s global strategy;

(c) Plan, set-targets and align strategic initiatives. Such targets should be over a 3-5 year period broken down on a yearly basis so that progression targets can be set for assessing the progress that is being made towards achieving the longer-term targets; and

Enhancing strategic feedback and learning so that managers can monitor and adjust the implementation of their strategy, and, if necessary, make fundamental changes to the strategy itself.

15.19.1 Advantages and Drawbacks of the Balanced Scorecard Technique:

Advantages of Balance Scorecard

(a) It ensures that the various competitive objectives of a company which include reduction of lead time, enhancement of quality, promotion of team spirit, consumer consciousness, etc are reflected in a single report such that the various perceptions of company results are reflected;

(b) It is used to transform the firm’s strategic objectives into understandable means of evaluation systems used to develop the main objectives for the perspective and ensuring that these objectives are turned to particular evaluation systems;

(c) It assists managers to determine whether enhancement in one perspective is at the detriment of another one; and

(d) It enhances the ability to link performance measures with strategic business units through effective communication as well as formulation and implementation of corporate strategy.
Drawbacks of Balance Scored Card
(a) The drawbacks include the cause and effect relationships which are assumed despite their being empirically or theoretically deficient and not clear in meaning. The empirical studies that have been undertaken have failed to provide evidence on the underlying linkage between non-financial data and future financial performance (American Accounting Association Financial Accounting Standards Committee, 2002); and

(b) Another shortcoming is that the perspectives in which it is based may not be all that can be used to assess its impact especially where the staff perspective and public perspective are not recognised.

It should be realised that perspectives must be limited, even though there is a need to meet various demands.

15.20 SUMMARY AND CONCLUSIONS

Advanced Manufacturing Technology (AMT) is altering the way manufacturing takes place and the manner it is organised. It consists of Computer Aided Design and Manufacture, Flexible Manufacturing Systems and also included: Material Requirement Planning (MRP) and Just-In-Time (JIT) systems.

Of relevance here also are Total Quality Control (TQC); Activity Based Costing; Target Costing; Life-Cycle or Tetrotechnology Costing; Kaizen Costing; Backflush Costing; Throughput Costing, Strategic Management Accounting and Balanced Scorecard techniques of managing processes, products and manufacturing efforts in the modern day era.

The traditional management accounting when compared with the current trends management is deficient in the areas of absorption costing methods, cost behaviour analysis, standard costing and the pre-occupation with short-term financial measures.

(Refer to Comprehensive Questions and Suggested Solutions in Appendix II, Page 457)
15.21 REVISION QUESTION

15.21.1 MULTIPLE CHOICE QUESTIONS

1. The objectives of JIT are achieved by:
   (a) Controlling costs
   (b) Improvising delivery performance
   (c) Improving quality
   (d) Efficiency and effectiveness of operations
   (e) All of the above.

2. A withdrawal Kamban specifies
   (a) How much should be produced to replace inventory
   (b) The number of parts that should be withdrawn and used to manufacture one unit
   (c) When customers should be notified to pick up orders
   (d) When suppliers should be informed to deliver more parts
   (e) That only quality products should be produced.

3. Which of the following is the primary objective of Total Quality Management (TQM)?
   (a) Improving the profit of the company.
   (b) Meeting management goals
   (c) Meeting shareholders’ dividend goals.
   (d) Meeting budgetary targets.
   (e) Satisfying customer requirement.

4. Which of these is NOT a key element of a Material Requirement Planning?
   (a) Master production schedule
   (b) Stockout schedule
   (c) Bill of material file
   (d) Inventory report
   (e) Lead time of all items

5. Life Cycle Costing tracks an accumulates the actual costs from the beginning to the end of a
   (__________)
   (a) Period
   (b) Product
   (c) Process
   (d) Posting
   (e) Pricing

6. ABC and ABM stands for:
   (a) Activity Based Concept and Activity Based Management
   (b) Actual Budget Concept and Activity Based Manager
   (c) Activity Based Costing and Activity Based Management
   (d) Activity Based Costing and Activity Based Manager
   (e) Advanced Business Concept and Action Based Manager
### 15.21.2 SHORT ANSWER QUESTIONS

1. The provision and analysis of financial information on the firm's product markets and competitors' costs structures and the monitoring of the enterprises strategies and those of its competitors in these market over a number of period is known as _______

2. What is a Manufacturing Cycle Efficiency?

3. Explain the differences between lag measures and lead measures.

4. State two benefits attributed to the balanced scorecard approach.

5. A term used to describe a situation where all business functions are involved in a process of continuous quality improvement is known as -

6. Distinguish between Target costing and Kaizen costing.

7. The examination of competitor's product in order to identify opportunities for product improvement and/or cost reduction is called _______

8. "A management accounting system which focuses on ways by which the maximum return per unit of bottleneck activity can be achieved" is known as _______


*(Refer to Suggested Solution in Appendix I, page 443)*
APPENDICES
APPENDIX 1

SUGGESTED SOLUTIONS TO REVISION QUESTIONS

CHAPTER 1
MULTIPLE CHOICE QUESTIONS

1. C
2. B
3. B
4. D
5. A

SHORT ANSWER QUESTIONS

1. Management Accounting
2. Financial Accounting
3. Cost Accounting
4. Management Accounting differs from Financial Accounting in the following ways:
   (a) Rules and regulations;
   (b) Focus on individual part;
   (c) Time focus; and
   (d) Report frequency.
5. User of accounting information are:
   (a) Government;
   (b) Public;
   (c) Employees and Trade Union;
   (d) Research Institute; and
   (d) Bankers / creditors.
6. Goal congruence means that the management accounting should encourage all employees, including management staff to act in a fashion, which contributes to the overall objectives of the organisation.
7. The following techniques are used by management accounting: standard costing, budgeting and budgetary control, absorption costing and marginal costing.
8. Sub-objectives of an organisation are:
   (a) Maximization of sales revenue or achieving target level of sales, subject to a minimum profit constraint;
   (b) Long-run growth; and
   (c) Maintaining or increasing market share.

CHAPTER 2
MULTIPLE CHOICE QUESTIONS

1. D
2. A
3. E
SHORT ANSWER QUESTIONS

1. Planning, control
2. Vertical or horizontal
3. Tactical information
4. False
5. Strategic information

CHAPTER 3

MULTIPLE CHOICE QUESTIONS

1. C
2. D
3. B
4. A
5. B
6. C
7. B

SHORT ANSWER QUESTIONS

1. Non-linear/curvilinear variable cost
2. Variables, fixed and mixed (or semi variables)
3. Regression analysis
4. Range method
5. Mixed cost

CHAPTER 4

MULTIPLE CHOICE QUESTIONS

1. C
2. B
3. D
4. E
5. E

SHORT ANSWER QUESTIONS

1. Cost control
2. Cost reduction
3. Objectives of method study to:
   (a) Eliminate unnecessary work;
   (b) Improve working conditions; and
   (c) Improve operators performance by reducing fatigue
4. Value engineering
5. Value analysis
6. Work study
CHAPTER 5

MULTIPLE CHOICE QUESTIONS
1. E
   \[
   \text{BEP} = \frac{60,000}{0.40} = \text{₦150,000}
   \]

   \[
   = \frac{150,000}{20} = \text{₦7,500 units}
   \]

2. A
   Break-even point in sales value
   \[
   = \text{Fixed costs (profit volume ratio)}
   = \frac{\text{₦76,800}}{0.40} = \text{₦192,000}
   \]
   Actual sales \(224,000\)
   Margin of safety \((224,000 - 192,000)\) = \( \text{₦32,000} \)
   Margin of safety in units \(2,000 \text{ units} \ (32,000 \div 16)\)

3. C
   Break-even point (units) = \(5,220 \cdot (19.575\% \times 5,220)\)
   = 4198 units
   Fixed costs = contribution at the break-even point
   = \(4,198 \times \text{₦42} \times 40\%\)
   = \( \text{₦70,526} \)

4. B
   \[
   \begin{array}{ll}
   \text{High} & 3,000 & 12,900 \\
   \text{Low} & 2,000 & 11,100
   \end{array}
   \]
   \[
   \begin{array}{ll}
   1,000 & 1,800 = \text{₦1.80} \\
   \text{Total cost High} & 12,900 \\
   \text{Total variable cost 3000 x 1.8} & 5,400 \\
   & 7,500
   \end{array}
   \]
   Cost of 4000 units = \( \text{₦7,500} + (1.8 \times 4,000) = \text{₦14,700} \)

5. A

SHORT ANSWER QUESTIONS
1. Differential cost are the differences between costs and revenues for the corresponding items under such alternative being considered.

2. Formula for break-even point in units
   \[
   \text{BEP (units)} = \frac{\text{Fixed cost}}{\text{Contribution per unit}}
   \]

   \[
   \text{BEP (in value)} = \frac{\text{Fixed cost}}{\text{Profit / Volume Ratio}}
   \]
3. A relevant cost is a future cash flow arising as a direct consequence of a decision.

4. Product A Variable cost = N240,000 (300,000 x .8)
   Product B Variable cost = N40,000 (80,000 x .5)

5. An opportunity cost can be defined as the value of the next best alternative i.e. the net receipts forgone by not accepting the best available alternative.

CHAPTER 6

MULTIPLE CHOICE QUESTIONS

1. C
2. D
3. D
4. E
5. B

SHORT ANSWER QUESTIONS

1. Marginal Pricing or the variable cost pricing is the application of cost-volume-profit analysis to pricing decisions. Using marginal pricing the firm sets prices so as to maximize contribution towards fixed cost and profit.

2. Factors to be considered on pricing decision are:
   (a) The market in which the firm operates;
   (b) The firm's objectives;
   (c) The demand for the firm's product;
   (d) The elasticity of demand for the product; and
   (e) The cost structures of the firm and the product.

3. The disadvantages of cost-plus-systems are:
   (a) The system do not take demand explicitly into account and assume that prices are solely related; and
   (b) Cost-plus is a long run pricing concept which tasks flexibility in dealing with short-run pricing where the interaction of volume, price and profit are all important.

4. Full cost pricing, sometimes known as absorption cost pricing, uses conventional cost accounting principles to establish the total cost for a product to which is added a mark-up (say 10%) to arrive at a selling price.

5. Price discrimination is a situation where different prices are charged for the same product e.g. Football match, cinema.

6. Demand Orientated pricing is a price a customer wish to pay for a product due to one reason or other.

7. Minimum price

8. Loss leader
CHAPTER 7

MULTIPLE CHOICE QUESTIONS

1. D

2. C

3. D

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow N</th>
<th>DF</th>
<th>PV N</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-1,000,000</td>
<td>1.000</td>
<td>-1,000,000</td>
</tr>
<tr>
<td>1</td>
<td>+600,000</td>
<td>0.9091</td>
<td>+545,460</td>
</tr>
<tr>
<td>2</td>
<td>+400,000</td>
<td>0.8264</td>
<td>+330,560</td>
</tr>
<tr>
<td>3</td>
<td>+1,000,000</td>
<td>0.7513</td>
<td>+751,300</td>
</tr>
</tbody>
</table>

NPV 627,320

4. A. Sales Volume
   BEP 7200
   Annual sales 7800

Sensitivity of sales Volume $\frac{600}{7800} \times \frac{100}{1} = 7.7\%$

5. B. Cost of capital = 26.2\% 

SHORT ANSWER QUESTIONS

1. Standard Deviation formula is $\frac{1}{n} \sum (x - \bar{x})^2 P$
   Where $A_x$ are the profit level of observation
   $\bar{x}$ is the expected or mean value
   $P$ is the probability of each outcome
   $n$ is the total number of possibilities
   is the summation of all possible observations.

2. Sensitivity Analysis

3. Project A Coefficient of Variation

$$\frac{3500}{6000} \times \frac{100}{1} = 58\%$$

Project B Coefficient of Variation

$$\frac{4500}{12500} \times \frac{100}{1} = 36\%$$

4. (a) Risks occur where it is not known what the future outcome will be but where the various possible may be expected with some degree of confidence; and

(b) Uncertainty occurs where the future outcome cannot be predicted with any degree of confidence from a knowledge of past or existing events, so that no probability estimates are available.
5. Sales 10,000 0.3 3000
20,000 0.4 8,000
50,000 0.2 10,000
100,000 0.1 10,000
31,000 units
Sales 31,000 x N20 = 620,000
Variable cost 31,000 x N6 = 186,000
Total contribution 434,000

CHAPTER 8

MULTIPLE CHOICE QUESTIONS

1. A
   IRR = 15% + 3,664 / (3,664 + 21,451) x (20% - 15%)
   = 15.75%

2. A
   Annuity factor 9.954
   = (9.954 x N300) = N2986.2
   = 2986 x 0.9426
   = N2816

3. A

4. C

5. D
   PV of cost = PV of benefits
   400 = 500
   400 (1 + r) = 500
   1 + r = 1.25
   r = 25%

SHORT ANSWER QUESTIONS

1. Capital rationing is a situation in which a company does not have sufficient fund to execute available investment projects. Under this situation, a company has projects with positive NPVs whose combined outlays exceed all available finance to the company for same period.

2. Profitability index is a concept based on the contribution per limiting factor approach. It is actually a benefit/cost analysis of projects. It can be measured as the ratio of NPV or in some cases, Gross Present Value (GPV) of a project to the outlay required for the project during the year of restriction.

3. Factors to be considered in abandonment project decision are:
   (a) Availability of spare parts and ease of maintenance;
   (b) Changes in technology or obsolescence;
   (c) Changes in taxation rate; and
   (d) Off balance sheet financing.
4. Internal Rate of Return (IRR) is the discount rate which gives zero NPV and can be found graphically or by linear interpolation.

5. Cost of capital.

CHAPTER 9

SHORT ANSWER QUESTIONS

1. Planning can be defined as the establishment of objectives, and the formulation, evaluation and selection of the policies, strategies, tactics and action required to achieve these objectives.

2. The following are short-comings of corporate planning:
   (a) The process may absorb a considerable amount of management time and in volume a lot of bureaucracy;
   (b) It may lead to the formulation of unrealistic objectives, which may act as a disincentive to the employees; and
   (c) It may make the organisation in flexible and less capable of responding to changes.

3. Short-term tactical planning can be defined as “Planning the utilization of resources to achieve specific objectives in the most effective and efficient way”.

4. Programmed decisions are relatively structured decisions within a clearly defined area. Non-programmed decisions are decisions for which decision rules and procedures cannot be devised.

5. SWOT Analysis is the appraisal stage in planning - [i.e. strengths, weaknesses, opportunities and threats].

6. Model

7. Open loop systems are where no feedback exists and control is external to the system and not an internal part of it. A close loop system is no where output measurement is fed back so that appropriate adjustments are made to the input side of the system.

8. Corporate planning or long range planning.

9. (a) Corporate planning exposes weaknesses in the organization’s information system and forces improvements to be made; and
   (b) Goal congruence by middle and senior management may be improved.

CHAPTER 10

MULTIPLE CHOICE QUESTIONS

1. B

2. A
sales 120,000
closing stock 6,500
126,500
Less: Opening stock 18,000
Production 113,500 / 2 = 57,750 units

3. D
4. A
5. C

SHORT ANSWER QUESTIONS

1. Master budget consisting of a budgeted profit and loss account, a balance sheet and a cash flow statement.

2. Stages in the budgeting process:
   (a) Communicating details of budget policy and guidelines to those people responsible for the preparation of budgets;
   (b) Determining the factor that restricts output; and
   (c) Preparation of the sales budget.

3. Function of budgets:
   (a) Planning annual operations.
   (b) Co-ordinating the activities of the various parts of the organization.
   (c) Communicating plans to the various responsibility centre managers.
   (d) Motivating managers.

4. Planning programming and Budgeting involves preparation of a long term plan that clearly establishes the objectives that the organization aims to achieve.

5. Discretionary costs are costs which management has some discretion as to the amount it will budget for the particular activity e.g. advertising, research and development etc. Cost that has no optimum relationship between inputs (as measured by the cash) and outputs.

CHAPTER 11

MULTIPLE CHOICE QUESTIONS

1. A
2. C
3. D
4. A
5. C
6. D
A favourable labour efficiency variances indicates that actual hours used were less than the standard hours produced. The favourable variance was N7800.
Therefore the standard hours produced were 18700 (17500 + 7800 / 6.50).

7. B
Volume Variance
SR (BQ - AQ)
N5 (20,000 - 19500)
N2500 A

8. C
Actual quantity (6800 x 0.85) + N544 ÷ 5800 = 0.93k

9. D
Standard price per unit = \[
\frac{N46,248}{11.280}
\]
= N4.10
Adverse variance Quantity
\[
\frac{492}{4.10} = 120 \text{ units}
\]
Actual usage 11.280
Adverse Quantity 120
11,160 units

10. B, A.
Material price variances
\[
\text{AQ (SP - AP)}
\]
26,400 (N343,200 - 336,600)
N6600 F
Labour Rate Variance
\[
\text{AH (SR - AR)}
\]
40,200 (160,800 - 168,840)
N8040 A

SHORT ANSWER QUESTIONS

1. (a) Material mix variance arises when the mix of materials used differs from the predetermined mix included in the calculation of the standard cost of an operation; and
(b) Material yield variance arises because there is a difference between the standard outputs for a given level of inputs and the actual output attained.

2. The formula for calculating sales margin mix variance is standard margin (actual sales quantity - actual sales quantity in budgeted proportion)

3. Ex-Ante = this is the first target set
Ex-Post = this is the later situation during the year or immediately which were not foreseen during the first target.

4. Material price variance = AQ (SP - AP)
= 19000 (11 -10)
= N19000A

DR stores ledger control account 19,000
DR material price variance 19,000
CR creditors control account 19,000
5. Avoidance planning variance and unavoidable planning.
6. Idle time.
7. Attainable and level.
8. True
9. Variable spending/exp var and var. production efficiency
10. Variance control chart

CHAPTER 12

MULTIPLE CHOICE QUESTIONS

1. C
2. B
3. B
4. D
5. B

<table>
<thead>
<tr>
<th>Year</th>
<th>Cashflow</th>
<th>DF</th>
<th>PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-50,000</td>
<td>1.000</td>
<td>-50,000</td>
</tr>
<tr>
<td>1-4</td>
<td>+17,350</td>
<td>3.1698</td>
<td>+54,996</td>
</tr>
</tbody>
</table>

NPV +4,996

6. C
Residual profit in year 1
Depreciation p.a. = \( \frac{50,000}{4} = \text{N} 12,500 \)
- Income 17,350
- Depreciation 12,500
- Interest in investment (10% of N50,000) 5000 (150)

7. C
8. A

9. E Profit (N60,000) less imputed cost (N28,000)

SHORT ANSWER QUESTIONS

1. Objectives of decentralization are

(i) Incentive
(ii) Training
2. 
(a) Profit centers - managers are accountable for both revenues and costs.
(b) Investment center - managers are responsible for both sales revenues and costs, in addition have responsibility to make working capital investment decisions.

3. 
(a) Accounting Rate of return;
(b) Pay-back period;
(c) Net Present value; and
(d) Internal rate of return.

4. 
Residual Income (RI)
Divisional Net income after tax
Imported interest
RI
ROI or ROCE Divisional Net income
Average Investment
ROI

<table>
<thead>
<tr>
<th></th>
<th>Divisional Net income after tax</th>
<th>N900,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imported interest</td>
<td>800,000</td>
<td></td>
</tr>
<tr>
<td>RI</td>
<td>100,000</td>
<td></td>
</tr>
<tr>
<td>ROI or ROCE Divisional Net income</td>
<td>N900,000</td>
<td></td>
</tr>
<tr>
<td>Average Investment</td>
<td>10,000,000</td>
<td></td>
</tr>
<tr>
<td>ROI</td>
<td>900,000</td>
<td></td>
</tr>
</tbody>
</table>

\[
\text{ROI} \times 100 = \frac{900,000}{10,000,000} \times 100 = 9\%
\]

5. Value for money audit (VFM) can be defined as an investigation into whether proper arrangement have been made for securing economy, efficiency, and effectiveness in the use of resources.

CHAPTER 13

MULTIPLE CHOICE QUESTIONS

1. B

2. B

3. D

<table>
<thead>
<tr>
<th></th>
<th>Net income</th>
<th>N50,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Return 12%</td>
<td>42,000</td>
<td></td>
</tr>
<tr>
<td>ROCE</td>
<td>12,000</td>
<td></td>
</tr>
</tbody>
</table>

4. C

\[
\text{Residual Income} = \frac{50,000}{350,000} \times 100 = 14\%
\]

5. E

SHORT ANSWER QUESTIONS

1. Objectives of transfer pricing:
(a) To motivate managers;
(b) To provide an incentive for managers to make decisions consistent with the firm’s goals; and
(c) To provide a basis for fairly rewarding the managers.
2. This means that the equilibrium transfer price would be the marginal cost of the selling division for that output level at which this marginal cost equals the buying division's marginal revenue product from the use of the resource or item transferred.

3. The negotiation price method involves a negotiation process and sometimes arbitration between units to determine the transfer price.

4. Dual Price - where there are numerous conflicts between two units, i.e. standard full cost might be used as the transfer price for the buyer, while market price be used for the seller. The difference between the two prices is accumulated at the firm level.

5. Advantages of market transfer price:
   (a) It helps to preserve unit autonomy;
   (b) It provides incentive for the selling unit to be competitive; and
   (c) Has arm's length desire by taxing authority.

CHAPTER 14

1. C
   Unit produced   Minutes
   1              22
   2              17.6
   4              14.08

2. C
   Re-order level = Max. Usage x Min. Lead Time
   = 95 x 18 = 1710

3. B
   Maximum stock level = Re-order level + Re-order Quantity - (Min. Usage x Min. Lead Time)
   = 1710 + 1750 - (50 x 12)
   = 2860

4. D

5. D
   \[ EOQ = \frac{2DO}{H} \]
   \[ = \frac{2 \times 55 \times 4000}{(15 \times 0.1) + 0.2} \]
   \[ = 509 \text{ units} \]


7. Shadow price.

8. Objective function.

9. The graphical method can be used with two products.
10. Slack variables are added to a linear programming problem to account for any constraint that is unused at the point of optimality.

CHAPTER 15

MULTIPLE CHOICE QUESTIONS

1. E
2. B
3. D
4. A
5. B
6. C

SHORT ANSWER QUESTIONS

1. Strategic management accounting.

2. Manufacturing cycle efficiency (MCE) is the elimination of those manufacturing time which are non value added activities such as inspection time, wait time and move time, only processing time adds value

\[
\text{MCE} = \frac{\text{Processing Time}}{\text{Processing Time} + \text{Inspection Time} + \text{Wait Time} + \text{Move Time}}
\]

3. The balanced scorecard consists of two types of performance measures:
   (a) Lagging measures are the financial (outcome) measures within the financial perspective that are the results of past actions; and
   (b) Leading measure are the drivers of future financial performance. These are the non-financial measures relating to the customer, internal business process and learning and growth perspectives.

4. Benefits of Scorecard
   (a) The scorecard brings together in a single report four different perspective on a company's performance that relate to many of the disparable elements of the company's competitive agenda.
   (b) The scorecard helps managers to consider all the important operational measures together.

5. Total Quality Management (TQM)

6. The main differences between Target Costing and Kaizen Costing
   (i) Target costing is applied during the design stage whereas kaizen costing is applied during the manufacturing stage; and
   (ii) With target costing, the focus is on the product and cost reduction are achieved primarily through product design, whereas kaizen costing focuses on the production processes and cost reductions are derived primarily through the increased efficiency of the productive process.

7. Reverse Engineering.

8. Throughput Accounting.
9. Advanced Manufacturing Technology (AMT) is a general expression encompassing Automated production technology, Computer assisted design and manufacturing, (CAD/CAM), Flexible manufacturing system (FMS), robotics, Total Quality Control (TQC), advances in production management including materials requirements and Manufacturing Resources Planning systems (MRP), Just-in-Time (JIT) systems, etc.
APPENDIX II

COMPREHENSIVE QUESTIONS AND SUGGESTED SOLUTIONS

1. In the broadest sense, all accounting is management accounting. All financial and cost information generated by accountants are of some interest to management. In practice, however, management accounting differs from financial accounting (John Sizer, “An Insight into Management Accounting”).

Required:
(a) Define Management Accounting.
(b) Discuss the major differences between Management Accounting and Financial Accounting.

Suggested Solution

1. (a) Management Accounting is defined as the process of identification, measurement, accumulation, analysis, preparation, interpretation and communication of financial information used by management to plan, evaluate and control within an organization and to ensure appropriate use of and accountability for its resources.

(b) Major differences between management accounting and the financial accounting are in the following areas:
   (i) Legal requirement;
   (ii) Focus on individual parts or segments of the business;
   (iii) Generally accepted accounting principles;
   (iv) Time dimension; and
   (v) Report Frequency.

2. Jide Ltd uses a special material in the manufacturing of her products which she order from outside supplier. The appropriate data are:

   Demand = 1,000 per annum
   Ordering cost = ₦70 per order
   Carrying cost = 20% of item price
   Basic item price = ₦5 per material

   The company is offered the following discounts on the basic price:
   For order quantities
   400 - 799 less 2%
   800 - 1599 less 4%
   1600 and over less 5%

   You are required to establish the most economic quantity to order.

Suggested Solution

2. This problem can be answered using the following procedure:

   (a) Calculate the EOQ using the basic price
(b) Compare the savings from the lower price and ordering costs and the extra stockholding costs at each discount point (that is, 400 and 800) with the costs associated with the basic EOQ, thus

\[
\text{Basic EOQ} = \sqrt{\frac{2 \times 1000 \times 20}{50 \times 0.2}} = 200 \text{ units}
\]

Based on this EOQ, the various costs and savings comparisons are given in the table below:

<table>
<thead>
<tr>
<th>Order Quantity</th>
<th>200 (EOQ)</th>
<th>400</th>
<th>800</th>
<th>1600</th>
<th>Line No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount</td>
<td>-</td>
<td>2%</td>
<td>4%</td>
<td>5%</td>
<td>1</td>
</tr>
<tr>
<td>Average No. of Order</td>
<td>5</td>
<td>2.5</td>
<td>1.25</td>
<td>0.625</td>
<td>2</td>
</tr>
<tr>
<td>Average No. Of Order</td>
<td>-</td>
<td>2.5</td>
<td>3.75</td>
<td>4.375</td>
<td>3</td>
</tr>
<tr>
<td>Order Cost Savings p.a</td>
<td>-</td>
<td>2 (5 x 20) N50</td>
<td>(3.75 x 20) N75</td>
<td>4.375 x 4 N87.50</td>
<td>4</td>
</tr>
<tr>
<td>Price saving per Item per Annum</td>
<td>-</td>
<td>20k (1000 x 20k) N200</td>
<td>40k (1000 x 20k) N400</td>
<td>50k (2000 x 50k) N500</td>
<td>5</td>
</tr>
<tr>
<td>Stockholding Cost p.a</td>
<td>(100 x 5 x 5 0.2) = N100</td>
<td>(200 x 4.9 x 0.2) = N1.96</td>
<td>(400 x 4.75 x 0.2) = N384</td>
<td>(800 x 4.75 x 0.2) = N760</td>
<td>7</td>
</tr>
<tr>
<td>Additional Cost Incurred by Order Quantity</td>
<td>-</td>
<td>(N196 - N1000) = N96</td>
<td>(N384 - N100) = N284</td>
<td>(N760 - N100) = N660</td>
<td>8</td>
</tr>
<tr>
<td>NET GAIN/LOSS</td>
<td>-</td>
<td>N154</td>
<td>N191</td>
<td>(N72.50)</td>
<td>9</td>
</tr>
</tbody>
</table>

From the table, the most economical order quantity is 800 units, thereby gaining the 4% discount.

Notes:

a. Line 2 is demand of 1000 order quantity 200 = 5 times.

b. Line 7 is the cost of carrying the average stock, that is, order quantity x cost per item x carrying cost %

c. Line 9 is Line 6 minus Line 8

3. Sammy Manufacturing Company makes a product called "SUNNCY". Some of the manufacturing expenses are easily identified as fixed or directly variable with production. The Cost Accountant of the company is confronted with the problem of preparing a flexible budget for the coming year and wishes to determine the fixed and variable element of the mixed factory overhead.

The following details are provided for the first 10 months of the year.
Month | No. of units produced (x) | Mixed factory overhead (y)
--- | --- | ---
1 | 1,500 | 800
2 | 2,000 | 1,000
3 | 3,000 | 1,350
4 | 2,500 | 1,250
5 | 3,000 | 1,300
6 | 2,500 | 1,200
7 | 3,500 | 1,400
8 | 3,000 | 1,250
9 | 2,500 | 1,150
10 | 1,500 | 800
 | 25,000 | 11,500

(a) Determine the fixed and variable elements of the mixed factory overhead using:

(i) The high and low method; and

(ii) The method of least squares.

(b) Differentiate between correlation coefficient (r) and coefficient of determination.

**SUGGESTED SOLUTION**

3. (a) (i) High and Low Method:

<table>
<thead>
<tr>
<th></th>
<th>x units</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>3500</td>
<td>1,400</td>
</tr>
<tr>
<td>Low</td>
<td>1500</td>
<td>800</td>
</tr>
<tr>
<td>Difference</td>
<td>2000</td>
<td>600</td>
</tr>
</tbody>
</table>

Variable rate: \( \frac{1,400 - 800}{2000} = \frac{0.30}{unit} \)

Fixed element:

<table>
<thead>
<tr>
<th></th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mixed overhead</td>
<td>1,400</td>
<td>800</td>
</tr>
</tbody>
</table>
| Variance (N0.30/unit) | 1,050 | 450
| | 350 | 350 |

Therefore, the formula is \(800 + 0.30 \times \text{unit} \)

(ii) Since the number are voluminous, we will use the alternative formula for b, that is:

\[
b = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sum (x - \bar{x})^2}
\]
\[
\begin{array}{ccccccc}
    y & x & y - \bar{y} & (x - \bar{x}) & (y - \bar{y})(x - \bar{x}) & (x - \bar{x})^2 \\
1.500 & N800 & -1.000 & -350 & 350,000 & 1,000,000 \\
2.000 & 1.000 & -500 & -150 & 75,000 & 250,000 \\
3.000 & 1.350 & 500 & 200 & 100,000 & 250,000 \\
2.500 & 1.250 & 0 & 100 & 0 & 0 \\
3.000 & 1.300 & 500 & 150 & 75,000 & 250,000 \\
2.500 & 1.200 & 0 & 50 & 0 & 0 \\
3.500 & 1.400 & 100 & 250 & 250,000 & 1,000,000 \\
3.000 & 1.250 & 500 & 100 & 50,000 & 250,000 \\
2.500 & 1.15 & 0 & 0 & 0 & 0 \\
1.500 & 800 & -1.000 & -350 & 350,000 & 1,000,000 \\
25.000 & & & & & 1,250,000 & 4,000,000 \\
\end{array}
\]

Therefore, \[ b = \frac{1,250,000}{4,000,000} = \text{N0.3125} \]

\[ a = \text{N11,500} - (\text{N0.3125} \times 25,000) \]

\[ = 1150 - 781.25 = \text{N368.75} \]

Thus, the cost formula is N368.75 fixed, plus N0.3125 per unit, that is, N368.75 + 0.3125 (x)

(b) The correlation coefficient \( r \) measures the degree of correlation between \( y \) and \( x \). The range of values it takes on is between -1 and +1. While the coefficient of determination, designated \( r^2 \) (read as \( r \)-squared), tells us how good the estimated regression is.

In order words, it is a measure of "goodness of fit" in the regression. Therefore the higher the \( r^2 \) the more confidence we can have in our estimated cost for units.

4. The summarized profit and loss statement for Ronke Plc for the last year is as follows:

\[
\begin{array}{ccc}
\text{N'000} & \text{N'000} \\
\text{Sales (50,000 units)} & & 1,000 \\
\text{Direct materials} & 350 & \\
\text{Direct wages} & 200 & \\
\text{Fixed production overhead} & 200 & \\
\text{Variable production overhead} & 50 & \\
\text{Administration overhead} & 180 & \\
\text{Selling and distribution overhead} & 120 & \\
\hline
\text{Profit/ (loss)} & & 1,100 \\
\hline
\end{array}
\]

At a recent board meeting, the directors discussed the year's results, following which the Chairman asked for suggestions to improve the situation.

You are required as the Management Accountant to evaluate the following alternative proposals and to comment briefly on each:

(a) Reduce selling price by 10%, which it is estimated would increase sales volume by 30%.

(b) Increase direct wage rates from \text{N4} to \text{N5} per hour, as part of a productivity/pay
deal. It is hoped that this would increase production and sales by 20%, but advertising costs would increase by N50,000.

(c) Increase sales by additional advertising of N300,000, with an increase selling price of 20%, setting a profit margin of 10%.

**SUGGESTED SOLUTION**

4. (a) A 10% decrease in selling price will decrease the selling price by N2 per unit and the revised unit contribution will be N6 = (N18 - 12)

| Revised total contribution (65,000 x N6) | N390,000 |
| Less fixed costs | N500,000 |
| Profit / (Loss) | (N110,000) |

The estimated loss is worse than last year and the proposal is therefore not recommended.

(b) Wages will increase by 25% that is, from N200,000 to N250,000 causing output to increase by 20% 

| Sales | N1,200,000 |
| Direct materials and variable | |
| Overheads | 480,000 |
| Direct wages | 250,000 |
| Contribution | 730,000 |
| Less fixed costs | 550,000 |
| Profit / (Loss) | (N80,000) |

This represents an improvement of N20,000 on last year's loss of N100,000

(c) Revised selling price = N24

Let X = Revised sales volume

Therefore sales revenue less (variable costs + fixed costs) = Profit

24X less (12X + 800,000) = 0.1 (24X)

Therefore 9.6X = 800,000

Therefore X = 83,333 units

Clearly, this proposal is preferable since it is the only proposal to yield a profit. However, the probability of increasing sales volume by approximately 67% plus the risk involved from increasing fixed costs by N300,000 must be considered.

5. Dotun Limited manufactures one standard product and operates a system of variance accounting using a fixed budget. As Assistant Management Accountant, you are responsible for preparing the monthly operating statements. Data from the budget, the standard product cost and actual data for the month ended 31 October 2004, are:

Budgeted and standard cost data:
Budgeted sales and production for the month: 10,000 units
Standard cost for each unit of product:
Direct material: Millet 10kg at $100 per kg
Corn 5kg at $500 per kg
Direct wages: 5 hours at $300 per hour

Fixed production overhead is absorbed at 20% of direct wages.
Budgeted sales price has been calculated to give a profit of 20% of sales price.

Actual data for month ended 31 October 2004:
Production: 9,500kg units sold at a price of 10% higher than that budgeted.

Direct materials consumed:
Millet 96,000 kg at $120 per kg
Corn 48,000 kg at $470 per kg
Direct wages incurred 46,000 hours at $320 per hour.
Fixed production overhead incurred $29,000,000

Using the data given, you are required to prepare the operating statement for the month ended 31 October to show the budgeted profit; the variances for direct materials, direct wages, overhead and sales, each analysed into causes and actual profit.

SUGGESTED SOLUTION

5. WORKING

STANDARD COST SHEET

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Cost per Unit</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millet</td>
<td>10kg</td>
<td>$100</td>
<td>$1,000</td>
</tr>
<tr>
<td>Corn</td>
<td>5kg</td>
<td>$500</td>
<td>$2,500</td>
</tr>
<tr>
<td>Labour</td>
<td>5 hours</td>
<td>$300</td>
<td>$1,500</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$5,000</td>
</tr>
</tbody>
</table>

ACTUAL RESULT

Sales ($10,000 x 1.10) = (11,000 x 9,500) = $104,500,000
Less: Actual cost of production
Material Millet = (96,000 x 120) = $11,520,000
Corn = (48,000 x 470) = $22,560,000
Labour = (46,000 hrs x 320) = $14,720,000
Total cost = $48,800,000
Contribution = $55,700,000
Less: Fixed Production Overhead = $29,000,000
Actual profit = $26,700,000

VARIANCES

Material cost variance: (SC - AC)
Material Millet SC = 9,500 x 10kg x $100 = $9,500,000
AC = 11,520,000
Variance = $20,200,000 (A)

Material Price Variance: AQ (SP - AP)
96,000 (100 - 120) = $1,020,000 (A)

Material Usage Variance: SP (SQ - AQ)
100 (95,000 - 96,000) = $100,000 (A)
Material cost variance (SC - AC)
\[
\begin{align*}
SC &= 9,500 \times 5 \text{kg} \times \text{N}500 = 23,750,000 \\
AC &= 22,560,000 \\
\text{Material Price Variance AQ (SP - AP)} &= 48,000 (\text{N}500 - 470) = 1,440,000 \text{ F} \\
\text{Material Usage Variance SP (SQ - AQ)} &= 500 (47,500 - 48,000) = 250,000 \text{ A}
\end{align*}
\]

Labour cost variance (SC - AC)
\[
\begin{align*}
SC &= 9,500 \times 5 \text{HOURS} \times \text{N}300 = 4,250,000 \\
AC &= 46,000 \text{HOURS} \times \text{N}320 = 14,720,000 \\
\text{Labour Rate Variance AH (SR - AR)} &= 46,000 (300 - 320) = 920,000 \text{ A} \\
\text{Labour Volume Variance SR (SH - AH)} &= 300 (47,500 - 46,000) = 450,000 \text{ F}
\end{align*}
\]

Fixed Overhead Cost Variance (SC - AC)
\[
\begin{align*}
SC &= 9,500 \times 5 \text{hours} \times \text{N}600 = 28,500,000 \\
AC &= 29,000,000 \\
\text{Fixed Overhead Expenditure Variance (BFO - AFO)} &= 10,000 \times 5 \text{hours} \times \text{N}600 = 30,000,000 \\
\text{AFO} &= 29,000,000 \\
\text{Fixed Overhead Volume Variance SR (BH - SH)} &= 600 (50,000 - 47,500) = 1,500,000 \text{ A}
\end{align*}
\]

Sales Margin Price Variance AQ (SSP - ASP)
\[
\begin{align*}
9,500 (10,000 - 11,000) &= 9,500,000 \text{ F}
\end{align*}
\]

Sales Margin Volume Variance
Std. Margin (BSQ - ASQ)
\[
\begin{align*}
2,000 (10,000 - 9,500) &= 1,000,000 \text{ A}
\end{align*}
\]

* BQS = Budgeted Quantity sales
AQ = Actual Quantity Sales

\[
\begin{align*}
\text{OPERATING STATEMENT} \\
\text{Budgeted Profit (10,000 x 2,000)} &= \text{N}20,000,000 \\
\text{Sales Margin Price Variance} &= 9,500,000 \text{ F} \\
\text{Sales Volume Variance} &= 1,000,000 \text{ A} \\
\text{Total} &= 8,500,000 \text{ F} \\
\text{COST VARIANCES} \\
\text{Material aspirin Price Variance} &= 1,920,000 \\
\text{Material aspirin Usage Variance} &= 100,000 \\
\text{Material lactose Price Variance} &= 1,440,000 \\
\text{Material lactose Usage Variance} &= 250,000
\end{align*}
\]
Labour Rate Variance 920,000
Labour Volume Variance 450,000
Fixed Overhead Expenditure Variance 1,000,000
Fixed Overhead Volume Variance 1,500,000

Actual Profit 4,690,000 2,890,000 1,800,000A 26,700,000

Note:
(i) SQ = Standard Quantity (the actual production at standard specification that is, 9,500 x 10 = 95,000kg
(ii) SC = Standard Cost (the actual production at standard specification multiply by Standard unit price of material)
that is, 9,500 x 10 x ₦100 = ₦950,000
(iii) Std = Standard Hour (Actual production at standard hours specified, that is, 9,500 x 5 = 47,500 hours)
(iv) BH = Budgeted Hours (Budgeted Quantity at standard specified).
(v) BFO = Budgeted Fixed Overhead Cost = (Budgeted quantity at standard hours specified multiply by standard hourly rate. 100,000 x 5 hrs x ₦600 = ₦30,000,000).
(vi) AFO = Actual Fixed Overhead Cost.

6. You have just been employed as a Management Accountant in Ilori Laboratories Limited. You are required to write a report to the Managing Director describing the design and installation of a management accounting system in the company.

SUGGESTED SOLUTION

INTERNAL MEMORANDUM

6. From: Management Accountant Date:
To: Managing Director
Subject: REPORT ON DESIGN AND INSTALLATION OF A MANAGEMENT ACCOUNTING SYSTEM
A management accounting system is an important part or sub-system within the information system of a business. The aim of the management accounting system is to collect financial and operating data about business activities, comparing these results against set targets and highlighting any deviations from the business plan. The information produced will also be used to assess the performance of the individual manager.

The design and installation of a management accounting system can be divided into eight stages as follows:
Stage 1: Defining the functions of the business;
Stage 2: Defining information requirements of management;
Stage 3: Preparing the chart of accounts;
Stage 4: Designing the recording system for the collection of data;
Stage 5: Explaining the system to management;
Stage 6: Preparing the budgets;
Stage 7: Implementing the system; and
Stage 8: Post-implementation review.

7. The management of Wâte Limited feel that standard costing and variance analysis have little to offer in the reporting of some of the activities of their firm. "Although, we produce a range of fairly standardized products" states the Accountant of Wâte Limited, "prices of many of our raw materials are apt to change suddenly and comparison of actual prices with pre-determined are often unrealistic, standard price is of little use. For some of our products, we can utilize one of several equally suitable raw materials and we always plan to utilize the raw material which will, in our opinion, lead to the cheapest total production costs. However, we are frequently caught out by price changes and the material actually used often proves, after the event, to have been more expensive than the alternative which was originally rejected.

For example, consider the experience over the accounting period of two of our products, Beombiony and Malaquiney. To produce a Beombiony, we can use either 5kg of aspirin or 5kg of lactose. We planned to use aspirin as it appeared it would be the cheaper of the two and our plans were based on a cost of aspirin of N 3 per kg. Due to market movements, the actual prices changes and if we had purchased efficiently, the costs would have been:

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost per kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material aspirin</td>
<td>N 4.50</td>
</tr>
<tr>
<td>Material lactose</td>
<td>N 4.00</td>
</tr>
</tbody>
</table>

Production of Beombiony was 2,000 units and usage of aspirin amounted to 10,800kg at a total cost of N 51,840.

A Malaquiney uses only one raw material, cafeine, but again, the price of this can change rapidly. It was thought that cafeine would cost N 30 per tonne but in fact, we only paid N 25 per tonne and if we had purchased correctly, the cost would have been less as it was freely available at only N 23 per tonne. It usually takes 1.5 tonnes of cafeine to produce 1 Malaquiney but our production of 500 Malaquiney used only 700 tonnes of cafeine. So you can see that with our particular circumstances, the traditional approach to variance analysis is of little use and we don't use it for materials, although, we do use it for reporting on labour and variable overhead costs."

**Required:**

(a) Analyse the material variances for both Beombiony and Malaquiney, utilizing:

(i) Traditional variance analysis; and

(ii) An approach which distinguishes between planning and operational variances.

(b) Write brief notes which:

(i) Explains the approach to variance analysis and distinguishes between planning and operational variances;

(ii) Indicates the extent to which this approach is useful for firms in general and for Wâte Limited in particular; and

(iii) Highlight the main difficulty in the application of this approach.
**SUGGESTED SOLUTION**

7. **VISION**

(a) (i) Traditional variance analysis:

- **Material Aspirin**
  - Production should use [x 5kg]
  - 2,000 Beconim should use [x 5kg]
  - and did use 10,000 kg
  - Material aspirin usage variance 800 kg [A]
  - x N3 per kg N2,400 [A]

- **Material Caffeine**
  - 10,800 kg of aspirin should cost [x N3]
  - but did cost 32,400
  - Material aspirin price variance: 51,840
  - 500 Malaquine should use [x 1.5 tonnes]
  - and did use 750 tonnes of caffeine
  - Material caffeine usage variance 700 tonnes
  - aspirin N30 per tonne N1,500 [F]

- **700 tonnes of caffeine should cost [x N30]**
  - but did cost [x N25] 21,000
  - Material caffeine price variance N3,500 [F]

<table>
<thead>
<tr>
<th>Summary</th>
<th>Material aspirin Variances</th>
<th>Material malaria Variances</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage variance</td>
<td>2,400 [A]</td>
<td>1,500 [F]</td>
<td>900 [A]</td>
</tr>
<tr>
<td></td>
<td>N21,840</td>
<td>N5,000</td>
<td>N16,840 [A]</td>
</tr>
</tbody>
</table>

(ii) Planning and Operational Variances:

- **Beconim**:
  - ex-post standard, given the choice of material Aspirin instead of lactose was:
  - 5kg at N4.50 per kg

- 10,800 kg of aspirin should have cost [x 4.5]
- but did cost 48,600
- Usage variance for Aspirin = 800 kg [A] x N4.5
- = [Operational variance] N3,600 [A]

The planning variance is:

- Ex ante standard [using aspirin] 2,000 units x 5kg x N3 = 30,000
- Ex post standard [using aspirin] 2,000 units x 5kg x N4.5 = 45,000
- Planning variance N1.50 [A] per kg, or N15,000 [A]

**Note:** The variance is adverse because the ex-ante standard was too optimistic, over stating the profits by understanding the realistic cost.

Since a perfect substitute, Material lactose is available, there is a possibly avoidable planning variance:

- Ex ante standard [aspirin] 2,000 units x 5kg x N3 = N30,000
- Possible standard [lactose] 2,000 units x 5kg x N4 = N40,000
- Possibly avoidable planning variance [N1 [A] per kg N10,000 [A]

---

[466]
Ex post standard [using aspirin] 2,000 units x 5kg x N4.50
\((45,000 - 40,000) = \) N5,000 [A]
Unavoidable planning variance
N15,000 [A]

Malaquine: The ex-post realistic is 1.5 tonnes of caffeine at N23 = N34.50

700 tonnes of caffeine should cost \( \times 23 \) 16,100
did cost \( \times 25 \) 17,500
Material aspirin price variance [operational variance] 1,400 [A]
Material caffeine usage variance = 50 tonnes \( [F] \times N23 = O/variance \) 1,150 [F]

Planning Variance:

Ex ante standard 500 units aspirin 1.5 tonnes x N30 per tonne= N22,500
Ex post standard 500 units aspirin 1.5 tonnes x N23 per tonne = N17,250
Total planning variance \( \{N7 \} \) per tonne \( [F] \) or \( \{N7.250 \] [F]

<table>
<thead>
<tr>
<th>Summary:</th>
<th>Material aspirin/lactose</th>
<th>Material caffeine</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage variance</td>
<td>3,600 [A]</td>
<td>1,150 [F]</td>
<td>2,450 [A]</td>
</tr>
</tbody>
</table>

Planning variances:

Unavoidable 10,000 [A] - -
Possibly avoidable 5,000 [A] - -


[b] (i) The distinction between planning and operational variances is a development of the opportunity cost approach to variance analysis. Denski argued that more helpful and meaningful information will be provided for management control decisions if variances are reported using an ex post standard, i.e. a standard which in hindsight should have been used, when the actual standard used [or the budget] is unrealistic for the conditions which actually prevailed. Thus, when it is realized in retrospect that the planned standard is inaccurate, a more realistic [ex post] standard should be used to calculate operational variances. The final reconciliation between budgeted and actual profit would then be made a planning variance, which measures the extent to which the budget targets are at fault because the standard used [ex ante] was incorrect. [A planning variance is similar to a budget revision variance].

(ii) The opportunity cost approach may be useful to companies by indicating more clearly the actual loss sustained by faults which gave a rise to the particular variances. There is an attempt to equate variance with the amount of profit or loss sustained, which traditional variances often fail to do. For example:
Traditional absorption costing variances for sales volume and production volume do not show the true effect of the variations from budget on company profitability;

When a standard is incorrect, traditionally variances will mislead managers about the true costs incurred in the case of Wilson Limited the error in the ex-ante standard price of materials aspirin and caffeine mean that traditional variances would have reported a misleading variance to the purchasing department for price, and a mis-valuation of the usage variance would report the cost of the adverse usage of materials aspirin and favourable usage of caffeine incorrectly.

Planning and operational variances attempt to indicate constructively:

(a) What the real cost of variances should be;
(b) Which of these variances might have been controllable by better management performance and which were unavoidable; and
(c) The effect on financial targets of a failure to construct realistic standards.

The approach is only different from traditional variance analysis, however, when the x-post and ex-ante standards are different.

(iii) The main difficulty with the approach is deciding in retrospect what the realistic standard should have been. Unless, readily available yardstick is used, the selection of an ex-post standard might be subjective and designed to provide a cover-up of responsibility rather than to reveal constructive control information.

8. Iwoye Division (A) and Oru Division (B) are two manufacturing divisions of Ijebu Plc. Both of these divisions make a single standardised product. A makes product Isu and B makes product Jerry. Every unit of Jerry requires one unit of Isu. The required input of Isu is normally purchased from division A but it is sometimes purchased from an outside source.

The following table gives details of selling price and the cost of each product:

<table>
<thead>
<tr>
<th></th>
<th>Product Isu</th>
<th>Product Jerry</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Established selling price</strong></td>
<td>₦30</td>
<td>₦50</td>
</tr>
<tr>
<td><strong>Variable costs:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct material</td>
<td>(8)</td>
<td>(5)</td>
</tr>
<tr>
<td>Transfer from A</td>
<td>-</td>
<td>(30)</td>
</tr>
<tr>
<td>Direct labour</td>
<td>(5)</td>
<td>(3)</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>(2)</td>
<td>(2)</td>
</tr>
<tr>
<td>Profit</td>
<td>(15)</td>
<td>(10)</td>
</tr>
<tr>
<td><strong>Divisional fixed cost (per annum)</strong></td>
<td>₦500,000</td>
<td>₦225,000</td>
</tr>
<tr>
<td><strong>Annual outside demand with current selling prices (units)</strong></td>
<td>125,000</td>
<td>25,000</td>
</tr>
</tbody>
</table>
Capacity of plant (units) 130,000 30,000
Investment in division ₦6,625,000 ₦1,250,000

Division B is currently achieving a rate of return well below the target set by the central office. Its manager blames this situation on the high transfer price of product Isu. Division A charges division B for the transfer of Isu at the outside supply price of ₦30. The manager of division A claims that this is appropriate since this is the price determined by market forces. The manager of division B has consistently argued that intra group transfers should be charged at a lower price based on the cost of the producing division plus a ‘reasonable’ mark-up.

The board of Ijebu Plc is concerned about B’s low rate of return and the divisional manager has been asked to submit proposal for improving the situation. The board has now received a report from B’s manager in which he asks the board to intervene to reduce the transfer price charged for product Isu. The manager of division B also informs the board that he is considering the possibility of opening a branch office in rented premises in a nearby town, which should enlarge the market for product Jerry by 5,000 units per year at the existing price. He estimates that the branch office establishment costs would be ₦50,000 per annum.

You have been asked to write a report advising the board on the response that it should make to the plans and proposals put forward by the manager of Division B. Incorporate in your report, a calculation of the rates of returns currently being earned on the capital employed by each division and the changes to these that should follow from an implementation of any proposals that you would recommend.

SUGGESTED SOLUTION

8. Schedule 1 Present Rate of Return

<table>
<thead>
<tr>
<th>Divisions</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales/Production in units</td>
<td>125,000</td>
<td>25,000</td>
</tr>
<tr>
<td>₦’000</td>
<td>₦’000</td>
<td></td>
</tr>
<tr>
<td>Sales/Revenue</td>
<td>3,000</td>
<td>(50 x 25,000)</td>
</tr>
<tr>
<td>Transfers(25 x 30)</td>
<td>750</td>
<td>-</td>
</tr>
<tr>
<td>Less Variable Cost:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transfer to B (25 x 30)</td>
<td>-</td>
<td>750</td>
</tr>
<tr>
<td>Other Variable Costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A(15 x 125)</td>
<td>1,875</td>
<td>250</td>
</tr>
<tr>
<td>B(40-30 x 25)</td>
<td>1,875</td>
<td>250</td>
</tr>
<tr>
<td>Less Fixed Costs</td>
<td>500</td>
<td>225</td>
</tr>
<tr>
<td>Net Profit</td>
<td>1,375</td>
<td>25</td>
</tr>
<tr>
<td>Total Investment</td>
<td>6,625</td>
<td>1,250</td>
</tr>
<tr>
<td>Return on Investment %</td>
<td>20.75%</td>
<td>2%</td>
</tr>
</tbody>
</table>

The present return is as shown in schedule 1 above for Division B when transfer price is at market price.

9. Kweku Ltd. manufactures a single product. The company’s fixed cost amount to ₦2,550 per week and it is estimated that its variable cost per unit is given by the expression 1.6
+ 0.04Q, where Q is the quantity (in units) produced and sold.

The Marketing manager considers that there is a linear relationship between the quantity demanded and selling price per unit such that each time selling price is increased by 30 kobo, the quantity demanded will fall by one unit and vice-versa for decreases in selling price. The current selling price is N51.60 and the resultant demand is 60 units per week.

Kweku aims to maximise its profits.

You are required to calculate:

(a) The weekly profit or loss achieved at the current level of output and sales.

(b) The optimum selling price per unit of output and the resultant profit.

SUGGESTED SOLUTION

9   (a) Profit Statement

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Revenue (60 x 51.6)</td>
<td>3,096</td>
<td>3,096</td>
</tr>
<tr>
<td>Less: Cost of Sales:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable Cost (1.6 + 0.04(60))</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>2,550</td>
<td>2,550</td>
</tr>
<tr>
<td></td>
<td>2,790</td>
<td>2,790</td>
</tr>
<tr>
<td></td>
<td>306</td>
<td>306</td>
</tr>
</tbody>
</table>

b) Calculation of Optimum Output

MR = MC

69.6 - 0.6Q = 1.6 + 0.08Q

0.08Q + 0.6Q = 69.6 - 1.6

0.68Q = 68

Therefore, Q = 100 units

Calculation of Optimum Selling Price Per Unit

P = 69.6 - 0.3Q

= 69.6 - 0.3(100)

= N39.60

Profit Statement

<table>
<thead>
<tr>
<th></th>
<th>₦</th>
<th>₦</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales Revenue (39.6 x 100)</td>
<td>3,960</td>
<td>3,960</td>
</tr>
<tr>
<td>Less Cost:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Variable Cost [1.6 + 0.04 (100)]</td>
<td>560</td>
<td>560</td>
</tr>
<tr>
<td>Fixed Cost</td>
<td>2,550</td>
<td>2,550</td>
</tr>
<tr>
<td>Profit</td>
<td>3,110</td>
<td>850</td>
</tr>
</tbody>
</table>
Workings:

Profit is maximised, when MR=MC

Calculation of Marginal Cost (MC)

\[
\text{Total Cost} \quad = \quad \text{TVC} \quad + \quad \text{FC} \\
\quad = \quad (1.6 \quad + \quad 0.04Q)Q \quad + \quad 2,550 \\
\quad = \quad 1.6Q \quad + \quad 0.04Q^2 \quad + \quad 2,550 \\
\frac{dT\text{C}}{dQ} = 1.6 \quad + \quad 0.08Q
\]

Marginal Revenue \quad = \quad TR = P \times Q

Calculation of the Demand Function

At price N 51.6, demand is 60 units
At price zero, Q will be \( \frac{60 \text{ units} \quad + \quad 51.6}{0.3} \) \( = \) \( \frac{60 + 172}{0.3} = 232 \) units

Therefore, at what price would demand be reduced to zero?

\( P = 51.60 \quad + \quad (60 \times 0.3) = \quad N69.6 \)

\[
\frac{P}{Q} = 69.6 \quad - \quad 69.6 \\
\Rightarrow \frac{P}{Q} = 69.6 - 0.3Q
\]

Calculation of Marginal Revenue

\[
TR = P \times Q = (69.6 - 0.3Q) \times Q = 69.6Q - 0.3Q^2 \\
\frac{dTR}{dQ} = 69.6 - 0.6Q
\]

Therefore, \( MR = 69.6 - 0.6Q \)

10. (a) List the key factors to be considered in pricing decisions.

(b) Degema Nigeria Plc is planning to introduce a new product, which is expected to have a fairly short selling life. The company has carried out an extensive market survey and has produced the following assessment of the relationship between selling price and likely demand.

<table>
<thead>
<tr>
<th>Price (N)</th>
<th>48</th>
<th>44</th>
<th>40</th>
<th>36</th>
<th>34</th>
<th>32</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity ('000)</td>
<td>10</td>
<td>20</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>250</td>
<td>350</td>
</tr>
</tbody>
</table>

Factory capacity for this product is limited to 150,000 units.
Fixed costs for the product are projected at N800,000 and variable cost at N28 per unit.
(i) Calculate the optimum price that will maximise income and the forecast profit at that level.

(ii) It is estimated that the use of radio advertisement in the promotional campaign will add N800,000 to fixed cost and lead to an alteration in the selling price/demand relationship as follows:

<table>
<thead>
<tr>
<th>Price (N)</th>
<th>Quantity ('000)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48</td>
</tr>
<tr>
<td>N</td>
<td>60</td>
</tr>
</tbody>
</table>

Determine whether or not the use of radio advertisement would alter the conclusion you reached in (b)(i) above on the viability of the product. The factory capacity is still limited to 150,000 units.

**SUGGESTED SOLUTION**

10. **DEHEMA NIGERIA PLC**

(a) Key factors to consider in pricing decisions are:

(i) The firm’s objectives
(ii) The market in which the firm operates
(iii) Demand for the firm’s product
(iv) Elasticity of demand for the product
(v) Cost structure of the firm and the product
(vi) Competition
(vii) The product
(viii) The relative position of the firm. (Market share)
(ix) Level of activity
(x) Government restrictions or legislation
(xi) Inflation
(xii) The availability of substitutes
(xiii) Capacity utilization
(xiv) The industry

(b) (i) **COMPUTATION OF OPTIMUM PRICE**

Given data - Factory Capacity = 150,000 units

Fixed costs = N800,000

Variable Costs = N28.00 per unit

<table>
<thead>
<tr>
<th>Quantity (Units)</th>
<th>SELLING VARIABLE COST</th>
<th>CONTRIBUTION PER UNIT</th>
<th>TOTAL CONTRIBUTION</th>
<th>FIXED COST</th>
<th>PROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000</td>
<td>48</td>
<td>28</td>
<td>20</td>
<td>200,000</td>
<td>800,000</td>
</tr>
<tr>
<td>20,000</td>
<td>44</td>
<td>28</td>
<td>16</td>
<td>320,000</td>
<td>800,000</td>
</tr>
<tr>
<td>50,000</td>
<td>40</td>
<td>28</td>
<td>12</td>
<td>600,000</td>
<td>800,000</td>
</tr>
<tr>
<td>100,000</td>
<td>36</td>
<td>28</td>
<td>8</td>
<td>800,000</td>
<td>800,000</td>
</tr>
<tr>
<td>150,000</td>
<td>34</td>
<td>28</td>
<td>6</td>
<td>900,000</td>
<td>800,000</td>
</tr>
<tr>
<td>250,000</td>
<td>32</td>
<td>28</td>
<td>4</td>
<td>1,000,000</td>
<td>800,000</td>
</tr>
<tr>
<td>350,000</td>
<td>30</td>
<td>28</td>
<td>2</td>
<td>700,000</td>
<td>1,600,000</td>
</tr>
</tbody>
</table>

No capacity to Produce above 150,000 units.
Conclusion

The optimum price is ₦34.00 and the optimum quantity is 150,000 units which is the maximum capacity and which results in a profit of ₦100,000

(ii) COMPUTATION OF OPTIMUM PRICE WITH RADIO ADVERTISMENT

With radio advertising, capacity 150,000 units, ₦800,000 fixed costs and ₦28,000 variable costs, the result will be as follows:

<table>
<thead>
<tr>
<th>QUANTITY (UNITS)</th>
<th>CONTRIBUTION</th>
<th>TOTAL CONTRIBUTION</th>
<th>FIXED COST</th>
<th>NET PROFIT OR (LOSS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SP - VC = C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60,000</td>
<td>48 28 20</td>
<td>1,200,000</td>
<td>1,600,000</td>
<td>(400,000)</td>
</tr>
<tr>
<td>120,000</td>
<td>44 28 16</td>
<td>1,920,000</td>
<td>1,600,000</td>
<td>320,000</td>
</tr>
</tbody>
</table>

No capacity to produce above 150,000 units

Conclusion

Based on the schedule above, optimum is at 120,000 units resulting in a profit of ₦320,000. The ratio promotion may be undertaken.

11.(a) (i) Briefly explain the meaning of ‘transfer pricing.’
(ii) State any two methods of ‘transfer pricing’ and one advantage and disadvantage of each.

11.(b) Independent Power Authority is a parastatal in BUKURU State of Nigeria. The organisation has two divisions, namely: Generation and Distribution. The Generation division transfers all its output to the Distribution division which later transfers the product to consumers. Cost and revenue at various levels of the capacity are as follows.

**OUTPUT**

<table>
<thead>
<tr>
<th>Megawatts</th>
<th>Costs</th>
<th>Revenue</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,000</td>
<td>6,000</td>
<td>29,500</td>
<td>23,500</td>
</tr>
<tr>
<td>7,000</td>
<td>7,000</td>
<td>32,500</td>
<td>25,500</td>
</tr>
<tr>
<td>8,000</td>
<td>8,400</td>
<td>35,300</td>
<td>26,900</td>
</tr>
<tr>
<td>9,000</td>
<td>10,000</td>
<td>37,800</td>
<td>27,800</td>
</tr>
<tr>
<td>10,000</td>
<td>12,000</td>
<td>40,000</td>
<td>28,000</td>
</tr>
<tr>
<td>11,000</td>
<td>14,500</td>
<td>42,000</td>
<td>27,500</td>
</tr>
<tr>
<td>12,000</td>
<td>18,000</td>
<td>43,500</td>
<td>25,500</td>
</tr>
</tbody>
</table>

The output, costs revenue and profit above show that the Authority's profits are maximised at 10,000 megawatts, after which diminishing returns set in.

The authority has decided to select a ‘transfer price’, so as to assist in establishing the Generation and Distribution divisions as profit centres.
**Required:**

(i) Determine a ‘transfer price’ that will motivate the Chief Executives of Generation and Distribution divisions to produce just 10,000 megawatts.

(ii) State the assumptions used in fixing the ‘transfer price’

(iii) Prepare a statement showing the optimum profit.

**Suggested Solution**

11.(a) (i) ‘Transfer price’ is the amount charged when one division (within an organisation) sells goods/services to another division. This means that a transfer price usually represents an internal pricing policy of any organisation.

A ‘transfer price’ will therefore affect the profit measurement for both the selling and buying divisions.

A high ‘transfer price’ will result in high profit for the selling division and low profit for the buying division and vice versa.

(ii) **Methods of Transfer Pricing**

<table>
<thead>
<tr>
<th>Method(s)</th>
<th>Advantage(s)</th>
<th>Disadvantage(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost - based</td>
<td>Transfers the cost of goods/services alone to the buying division.</td>
<td>Makes planning difficult for buying department because costs cannot be known in advance.</td>
</tr>
<tr>
<td></td>
<td>It facilitates effective cost information system.</td>
<td>Supply department lacks the incentive to control its costs.</td>
</tr>
<tr>
<td></td>
<td>It is easy to understand and convenient to use.</td>
<td>Disguises cost behaviour pattern.</td>
</tr>
<tr>
<td>Cost - plus decision</td>
<td>It motivates divisional managers because it allows for an element of profit to the division.</td>
<td>May lead to faulty decision as company fixed costs may be taken as variable costs by the buying division.</td>
</tr>
<tr>
<td></td>
<td>It assists managers to absorb total costs of production.</td>
<td>May lead to rigid allocation of absorption of fixed overhead.</td>
</tr>
<tr>
<td>Market - Based</td>
<td>It is consistent with responsibility accounting concept of Profit and Investment centers.</td>
<td>It is prone to market fluctuation and may not be readily available for goods/services transferred internally.</td>
</tr>
<tr>
<td></td>
<td>It helps to show the contribution of each division to total Company profit or it enhances the quality of performance evaluation.</td>
<td>It complicates the process of stock valuation (SAS4) especially the need to eliminate unrealized profit on stock.</td>
</tr>
</tbody>
</table>
It gives the producing division the option to produce for either internal or external market i.e. autonomy of division. A domineering divisional manager may sacrifice corporate objective for personal/divisional objective.

**Negotiated**

Divisional managers are involve in the negotiation thus enhancing cordiality/friendship. Can lead to division and competition between participating managers thus undermining unity.

Social and political skills can be translated into good divisional performance by managers. Time and effort mat be wasted without adding directly to company profit.

**Arbitrary**

Eliminate the time of effort wasted during bargaining. Transfer price may not motivate either the transferor or transferee division.

---

**(b) (i)**

**DETERMINATION OF ‘TRANSFER PRICE’ THAT WILL MOTIVATE THE CHIEF EXECUTIVES OF GENERATION AND DISTRIBUTION DIVISIONS TO PRODUCE JUST 10,000 MEGA WATTS**

**INDEPENDENT POWER AUTHORITY**

**STATEMENT OF INCREMENTAL COSTS AND REVENUES**

<table>
<thead>
<tr>
<th>OUTPUT (MEGAWATTS)</th>
<th>GENERATION DIVISION INCREMENTAL COSTS</th>
<th>INCREMENTAL REVENUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7,000</td>
<td>1,000</td>
<td>3,000</td>
</tr>
<tr>
<td>8,000</td>
<td>1,400</td>
<td>2,800</td>
</tr>
<tr>
<td>9,000</td>
<td>1,600</td>
<td>2,500</td>
</tr>
<tr>
<td>*10,000</td>
<td>*2,000</td>
<td>*2,200</td>
</tr>
<tr>
<td>11,000</td>
<td>2,500</td>
<td>2,000</td>
</tr>
<tr>
<td>12,000</td>
<td>3,500</td>
<td>1,500</td>
</tr>
</tbody>
</table>

*N.B.:* From the above statement of incremental costs and revenues, it is evident that the Generating Division will continue to produce more than 10,000 megawatts of electricity if the ‘transfer price’ exceeds the incremental costs of production. Therefore, a transfer price of, at least, ₦2,000 per megawatt, that is, ₦2,000,000/1000, is required to persuade the CEO of Generating Division to produce as much as 10,000 megawatts. The required transfer price will be between ₦2,000 and ₦2,500.

On the other hand, the Distribution Division will continue to receive more megawatts from the Generation Division if the incremental revenues earned exceed the transfer costs from Generation Division. To demand 10,000 megawatts, the transfer price to the Distribution Division must be less than ₦2,200 per megawatt. The required transfer price will thus be between ₦2,000 and ₦2,200.
Hence, Transfer price  = \( \frac{2000 + 2200}{2} \)
= \( \mathbf{2,100} \) per megawatt.

(ii) **ASSUMPTIONS USED IN FIXING THE TRANSFER PRICE**

(a) that the Generation Division is considered as a cost centre.
(b) that the Generation Division cannot sell or is unable to sell to an outsider.
(c) that the overall profit of Independent Power Authority is considered supreme.

(iii) **STATEMENT OF OPTIMUM PROFIT DIVISIONS**

<table>
<thead>
<tr>
<th></th>
<th>GENERATION</th>
<th>DISTRIBUTION</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \mathbf{\text{'000}} )</td>
<td>( \mathbf{\text{'000}} )</td>
<td>( \mathbf{\text{'000}} )</td>
</tr>
<tr>
<td>Sales/Net Revenue</td>
<td>21,000</td>
<td>40,000</td>
<td>61,000</td>
</tr>
<tr>
<td>Less: Costs/(Transfer Price)</td>
<td>12,000</td>
<td>21,000</td>
<td>33,000</td>
</tr>
<tr>
<td>OPTIMUM PROFIT</td>
<td>9,000</td>
<td>19,000</td>
<td>28,000</td>
</tr>
</tbody>
</table>

Note: The average 'transfer price' of \( \mathbf{2,100} \) per megawatt is the sales price of Generation Division that yielded \( \mathbf{2,100,000} \) and it is the amount that should be transferred to the Distribution Division as costs.

12. On 1 July 2004, Damilare acquired the goodwill of a dress shop for \( \mathbf{8,000} \). He also acquired the lease of a locked-up shop for a premium of \( \mathbf{3,000} \). He arranged for the rental of \( \mathbf{1,500} \) p.a. to be paid six-monthly in advance from his private bank account. Damilare has asked you to help him to prepare budgets for the next nine months and has provided you with the following information:

(1) Gross sales are budgeted as follows:

July \( \mathbf{10,000} \)  
August \( \mathbf{14,000} \)  
September \( \mathbf{12,600} \)  
October \( \mathbf{18,800} \)  
November \( \mathbf{21,000} \)  
December \( \mathbf{29,400} \)  
January \( \mathbf{21,000} \)  
February \( \mathbf{16,400} \)  
March \( \mathbf{18,800} \)  
April \( \mathbf{25,200} \)  
May \( \mathbf{19,400} \)  
June \( \mathbf{22,000} \)

(2) Damilare paid \( \mathbf{20,000} \) for stock in 1 July 1994 and intends thereafter to ensure that at the end of each month he has sufficient stock for the following three months sales.

(3) All sales are on credit terms. Credit sales are settled at the end of the month after the end of sale. A 3% settlement discount is available for complying with these terms.

(4) Damilare anticipates that 50% of his customers will not take advantage of the discount and settle one month later.

(5) Damilare must pay his suppliers in the month of purchase.

(6) Wages will be \( \mathbf{500} \) per month including \( \mathbf{200} \) for Damilare.
(7) General expenses will be ₦100 per month; half of these will be paid one month in arrears.

(8) Rates for the shop are ₦1,800 for the year to 31 March 2004. Damilare share will be paid in September 2003.

(9) Damilare anticipates that his gross profit will be 30%.

You are required to prepare:

(a) A monthly cash flow forecast for the nine months period ending on 31 March 2004;

(b) A forecast trading account for the period; and

(c) A budgeted balance sheet as at 31 March 2004. Ignore depreciation.

**SUGGESTED SOLUTION**

<table>
<thead>
<tr>
<th>12.</th>
<th>DAMILARE LIMITED - CASH FLOW FORECAST FOR THE PERIOD 31ST MARCH, 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>JULY</td>
</tr>
<tr>
<td>RECEIPTS</td>
<td>₦</td>
</tr>
<tr>
<td>Sales</td>
<td>Prior month (48.5%)</td>
</tr>
<tr>
<td>Pre-prior month (50%)</td>
<td>-</td>
</tr>
<tr>
<td>Purchases (W1)</td>
<td>39,130</td>
</tr>
<tr>
<td>Premium</td>
<td>3,000</td>
</tr>
<tr>
<td>Goodwill</td>
<td>8,000</td>
</tr>
<tr>
<td>Wages</td>
<td>300</td>
</tr>
<tr>
<td>Drawings</td>
<td>200</td>
</tr>
<tr>
<td>Sundry Expenses</td>
<td>50</td>
</tr>
<tr>
<td>Rates</td>
<td>1,350</td>
</tr>
<tr>
<td>Net flow</td>
<td>50,680</td>
</tr>
<tr>
<td>b/f</td>
<td>(50,680)</td>
</tr>
<tr>
<td>c/f</td>
<td>(50,680)</td>
</tr>
</tbody>
</table>

July month end stocks to be 0.7(14,500 + 12,600 + 18,800) = 32,130

- Purchases | 20,000 |
- Sales | 0.7 (10,000) | (7,000) |
- Additional purchase | 19,130 |
- Closing Balance | ₦32,130 |

August to be 0.7(12,600 + 18,800 + 21,000) = 36,680

- Opening stocks | (32,130) |
- Cost of sales [0.7 (14,500)] | 10,150 |
- Cash flow | 14,700 |

477
b. TRADING AND PROFIT AND LOSS BUDGET
FOR THE 9 MONTHS TO 31 MARCH 2004

<table>
<thead>
<tr>
<th></th>
<th>£</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>162,500</td>
<td></td>
</tr>
<tr>
<td>Less cost of sales (70%)</td>
<td>113,750</td>
<td></td>
</tr>
<tr>
<td>Gross profit</td>
<td>48,750</td>
<td></td>
</tr>
<tr>
<td>Less: Wages</td>
<td>2,700</td>
<td></td>
</tr>
<tr>
<td>Rates</td>
<td>1,350</td>
<td></td>
</tr>
<tr>
<td>Rent</td>
<td>1,125</td>
<td></td>
</tr>
<tr>
<td>Discount Allowed (W2)</td>
<td>2,156</td>
<td></td>
</tr>
<tr>
<td>General Expense</td>
<td>900</td>
<td>8,231</td>
</tr>
<tr>
<td>Net profit</td>
<td>40,519</td>
<td></td>
</tr>
</tbody>
</table>

(W2)

Sales 162,500 or sales 162,500
Cash flow 133,344 Less March 18,800 not yet due

29,156 143,700

Debtors
February (8,200) Half @ 3% N2,156
March (18,800)
Discount N2,156

c. BALANCE SHEET

<table>
<thead>
<tr>
<th></th>
<th>£</th>
<th>£</th>
<th>£</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Assets at cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goodwill</td>
<td>8,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premium on lease</td>
<td>3,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Current Assets:
Stock (0.7 x (25,200 + 19,400 + 22,000) 46,620
Debtors (8,200 + 18,800) 27,000
Rent Prepaid 375 73,995

Current liabilities:
Bank overdraft 44,726
Creditors(general) 50 (44,776)

29,219 40,219

Capital
Introduced(Rent for 12 months paid privately) 1,500
Net profit for the period 40,519 42,019
Less: Drawing 1,800 40,219
APPENDIX III

CASE STUDY

CASE STUDY 1

AJANLEKOKO BANK PLC

Nichodemus is an ambitious young executive just appointed as Executive Director (Finance) of Ajanlekoko Bank Plc, a small bank. The bank has just signed a memorandum of understanding (MOU) with three other banks to fulfill the requirements of CBN. His intention is to ensure that the bank plays a leading role in the enlarged group that would emerge at the end of the exercise and also in 3 years’ time, with its share price standing high. As a consequence, he is particularly desirous that the reported profits of the group should be as high as possible in the third and final years.

As part of the MOU, Ajanlekoko is to raise ₦5 billion by public offer and the directors are considering three ways of using the fund. Three projects (X, Y, Z) are being considered, each involving the immediate purchase of equipment costing ₦5 billion.

The projects are mutually exclusive, and the equipment for each project will have a useful life equal to that of the project with no scrap value. Nichodemus favours project Z because it is expected to show the highest net cash flow in the third year.

However, he does not wish to reveal his real reasons for favouring project Z, and so in his report to the Chief Executive Officer, he recommends Project Z because it shows the highest IRR. The following summary is taken from his report:

<table>
<thead>
<tr>
<th>Year/Project</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>IRR%</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>-5,000</td>
<td>1,500</td>
<td>1,600</td>
<td>1,450</td>
<td>1,600</td>
<td>1,900</td>
<td>2,300</td>
<td>2,600</td>
<td>-</td>
<td>27.93</td>
</tr>
<tr>
<td>Y</td>
<td>-5,000</td>
<td>570</td>
<td>1,500</td>
<td>3,000</td>
<td>3,700</td>
<td>2,300</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>26.81</td>
</tr>
<tr>
<td>Z</td>
<td>-5,000</td>
<td>3,000</td>
<td>2,100</td>
<td>3,500</td>
<td>580</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>34.63</td>
</tr>
</tbody>
</table>

The Chief Executive Officer of the bank is accustomed to projects being appraised in terms of Payback Period and Accounting Rate of Return, and he is consequently suspicious of the use of Internal Rate of Return as a method of project selection. Accordingly, the Chief Executive Officer has asked for an independent report on the choice of project. The bank's cost of capital is 20% and a policy of straight-line depreciation is used to write-off the cost of equipment in the financial statements.

Required:

(a) Advise the Chief Executive Officer on the project likely to be favoured by the shareholders of Ajanlekoko Bank Plc. Support your answer with relevant computations.

(b) Fear of natural disaster and unstable government economic policies generally threaten the viability of projects at this time. Adduce three other techniques, which can be used to mitigate the effect of this uncertainty.

(ICAL PE II, MAY 2005)
SOLUTIONS TO CASE STUDY 1

AJANLEKOKO BANK PLC

(a) To be able to advise the CEO on the preferred project likely to be favoured by the ordinary shareholders of the bank, the ranking of the result based on the various appraisal methods would be necessary as follows:

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>IRR</th>
<th>PBP</th>
<th>ARR</th>
<th>NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Y</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Z</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

An examination of the characteristics of the above methods in relation to public offer of N5b share of Ajanleko Bank Plc is crucial.

Internal Rate Return (IRR) - This has the following flaws which make it cumbersome and less qualified under this circumstance:

- Multiple rates of return can occur when a project has unconventional cash flows;
- It is assumed that the Cash-inflows are re-invested at the IRR and not cost of capital;
- It is not possible to rank mutually exclusive projects using IRR.

Payback Period (PBP) - This has the following shortcomings:

- Ignores cash flow outside the PBP;
- It also ignores the timing of cash flows within the PBP;
- This method is only interested in recovering the initial investment quickly.

Accounting Rate of Return (ARR)

- Ignores the timing cash flows.

Net Present Value (NPV)

Is believed to be the correct evaluation procedure as it considers the time value of money using the company's cost of capital. A positive NPV from an investment indicates increase in the market value of the shareholders' funds.

For this reason NPV method would be favoured by the ordinary shareholders and project Z that has highest positive NPV should be undertaken.

(b) Other techniques which can be used to mitigate the effect of uncertainty in project appraisal include:

(i) Sensitivity Analysis;
(ii) Standard Deviation;
(iii) Risk Premium;
(iv) Profitability Index;
(v) Coefficient Variation;
(vi) Utility and Certainty Equivalent;
(vii) Probability Theory; and
(viii) Decision Tree.
Workings:
- IRR already given in the question as 27.93% and 34.63% for X, Y and Z respectively.
  This is ranked as 2:3:1 in favour of Project Z.
- PBP
  Project X = 3 yrs + 450/1,600 = 3.28 yrs.
  Y = 2 yrs + 2,930/3,000 = 2.98 yrs.
  Z = 1 yr + 2,000/2,100 = 1.95 yrs.
  This is ranked as 3:2:1 in favour of Project Z.
- ARR = \(\frac{(\text{Average Profit/Average Investment} \times 100)}{\text{Year}}\)
  Project X = \(\frac{1,136}{2,500} \times 100 = 45.44\%\)
  Y = \(\frac{1,214}{2,500} \times 100 = 48.56\%\)
  Z = \(\frac{1,045}{2,500} \times 100 = 41.80\%\)
  This is ranked as 2:1:3 in favour of Project Y.
- NPV
  Project X = \(\left((1,500 \times 0.833) + (1,600 \times 0.694) + (1,450 \times 0.579) + (1,600 \times 0.482)\right)
  Project Y = \(\left((570 \times 0.833) + (1,500 \times 0.694) + (3,000 \times 0.579) + (3,700 \times 0.482) + (2,300 \times 0.402)\right)\)
  Project Z = \(\left((3,000 \times 0.8333) + (2,100 \times 0.694) + (3,500 \times 0.579) + (580 \times 0.482)\right)\)
  5,000 = 1,263
  This is ranked as 2:3:1 in favour of Project Z.

CASE STUDY 2

BETTER PLASTIC INDUSTRIES LIMITED (BPI)

Better Plastic Industries Limited (BPI) is a manufacturer of high quality plastic products, including executive plastic chairs. The company is situated at Agbara Industrial Estate in Ogun State of Nigeria. The company has recently been taken over by Golden Plastic International Plc (GPI), a multi-national company.

Mr. Kelani Oluwalogbon of GPI has been sent to review the budgeting and reporting procedures used by BPI and finds that monthly budgets are prepared for each department. He asks to see the last budget statement for a typical department and is shown the statement for the Plastic Chair Department whose manager is Chidi Uke.
BUDGET FOR THE MONTH OF SEPTEMBER 2004

DEPARTMENT: PLASTIC CHAIR DEPARTMENT
ACTUAL RESULTS: 37,500 units with 106,050 labour hours

<table>
<thead>
<tr>
<th></th>
<th>ACTUAL RESULT</th>
<th>BUDGETED RESULT</th>
<th>VARIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct materials</td>
<td>756,000</td>
<td>720,000</td>
<td>- 36,000</td>
</tr>
<tr>
<td>Direct labour</td>
<td>369,000</td>
<td>360,000</td>
<td>- 9,000</td>
</tr>
<tr>
<td>Variable production overhead</td>
<td>237,000</td>
<td>216,000</td>
<td>- 21,000</td>
</tr>
<tr>
<td>Fixed production overhead</td>
<td>177,000</td>
<td>168,000</td>
<td>- 9,000</td>
</tr>
<tr>
<td>Variable admin. overhead</td>
<td>123,000</td>
<td>120,000</td>
<td>- 3,000</td>
</tr>
<tr>
<td>Fixed admin. overhead</td>
<td>150,000</td>
<td>144,000</td>
<td>- 6,000</td>
</tr>
<tr>
<td>Total costs</td>
<td>1,812,000</td>
<td>1,728,000</td>
<td>- 84,000</td>
</tr>
<tr>
<td>Sales value</td>
<td>2,325,000</td>
<td>2,232,000</td>
<td>+ 93,000</td>
</tr>
<tr>
<td>Profit</td>
<td>513,000</td>
<td>504,000</td>
<td>+ 9,000</td>
</tr>
</tbody>
</table>

Mr. Oluwalogbon discovered that the budget was based on 36,000 units with a standard labour content of 2.85 hours and went to Chidi to find out his reactions to the budget and what use he makes of the budgeting system. To Mr. Oluwalogbon’s surprise, Chidi was not enthusiastic about the system and thought it is of little value to a departmental manager.

Chidi lamented, "It was introduced about a year ago by consultants without any explanation. Frankly, I think they put a ready-made system developed elsewhere. It doesn’t seem to help me to run my department. For example, last month’s statement showed positive variance on profit, yet, I know costs have risen, though nothing like as much as the statement shows, so I would have expected to be down on budgeted profit yet according to this, I am N9,000 up. It just doesn’t make sense, so I tend to ignore it altogether.”

After leaving Chidi, Mr. Oluwalogbon visited several other departmental managers. Oluwalogbon decided as a matter of urgency to try to make the budgeting system more useful and more acceptable to the departmental managers.

Required:
(a)  (i) Re-draft the budget statement in a more informative manner.
     (ii) Reconcile the budgeted profit with the actual profit.

(b)  What behavioural problems are brought out in the case?
     (ICAN PE II, PILOT QUESTIONS & SOLUTIONS 2005)

SOLUTIONS TO CASE STUDY 2

BEETTER PLASTIC INDUSTRIES LIMITED (BPI)

<table>
<thead>
<tr>
<th></th>
<th>BUDGET</th>
<th>FLEXED BUDGET</th>
<th>ACTUAL RESULT</th>
<th>VARIANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNITS SOLD</td>
<td>36,000</td>
<td>37,500</td>
<td>37,500</td>
<td></td>
</tr>
<tr>
<td>Sales</td>
<td>2,232,000</td>
<td>2,325,000</td>
<td>2,325,000</td>
<td></td>
</tr>
<tr>
<td>Less: Direct Material</td>
<td>(720,000)</td>
<td>(750,000)</td>
<td>(756,000)</td>
<td>- 6,000</td>
</tr>
<tr>
<td>Direct Labour</td>
<td>(360,000)</td>
<td>(375,000)</td>
<td>(369,000)</td>
<td>- 6,000</td>
</tr>
<tr>
<td>Variable Production Overhead</td>
<td>(216,000)</td>
<td>(225,000)</td>
<td>(237,000)</td>
<td>- 12,000</td>
</tr>
<tr>
<td>Variable Admin.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CASE STUDY

<table>
<thead>
<tr>
<th>Overhead</th>
<th>(120,000)</th>
<th>(125,000)</th>
<th>(123,000)</th>
<th>+ 2,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribution</td>
<td>816,000</td>
<td>850,000</td>
<td>840,000</td>
<td>- 10,000</td>
</tr>
<tr>
<td>Less: Fixed Production Overhead</td>
<td>(168,000)</td>
<td>(168,000)</td>
<td>(177,000)</td>
<td>- 9,000</td>
</tr>
<tr>
<td>Fixed Admin.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overhead</td>
<td>(144,000)</td>
<td>(144,000)</td>
<td>(150,000)</td>
<td>- 6,000</td>
</tr>
<tr>
<td></td>
<td>504,000</td>
<td>538,000</td>
<td>513,000</td>
<td>- 25,000</td>
</tr>
</tbody>
</table>

(ii) OPERATING STATEMENT

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted profits</td>
<td>538,000</td>
</tr>
<tr>
<td>Cost variance A F</td>
<td></td>
</tr>
<tr>
<td>Material cost variance</td>
<td>6,000</td>
</tr>
<tr>
<td>Labour cost variable</td>
<td>6,000</td>
</tr>
<tr>
<td>Variable production overhead</td>
<td>12,000</td>
</tr>
<tr>
<td>Variable admin. overhead</td>
<td>2,000</td>
</tr>
<tr>
<td>Fixed Production overhead</td>
<td>9,000</td>
</tr>
<tr>
<td>Fixed admin. overhead</td>
<td>6,000</td>
</tr>
<tr>
<td></td>
<td>33,000</td>
</tr>
<tr>
<td></td>
<td>8,000</td>
</tr>
<tr>
<td></td>
<td>(25,000)</td>
</tr>
<tr>
<td>Actual profit</td>
<td>513,000</td>
</tr>
</tbody>
</table>

Explanation

The flexed budget represents expected revenue and costs for the 37,500 units.

Actual Result represents revenue and costs for the same volume of units compared with flexed budget and reconcile with profit.

(b) Behavioural Problems:
(i) No participation;
(ii) No effective control;
(iii) Potentially unethical actions;
(iv) Human information processing factor is lacking; and
(v) No satisfaction - due to lack of motivation.

CASE STUDY 3

TOYIN POPOOLA PLC

(Source: Adapted - Drury, C. (2004); Management and Cost Accounting)

Your firm has been consulted by the Managing Director of Toyin Popoola plc, which owns a chain of retail stores. Each store has departments selling furniture, tableware and kitchenware. Departmental Managers are responsible to a Store Manager, who is in turn responsible to head office (HO).

All goods for sale are ordered centrally and stores sell at price fixed by Head Office. Store managers (aided by Departmental Managers) order stocks from Head Office and stores are charged interest based on month-end stock levels. Head office appoints all permanent staff and sets all pay levels. Store managers can engage or dismiss temporary workers, and are responsible for store running expenses.
The introduction to Popoola Plc's management accounting manual states:

'Budgeting starts three months before the budget year, with product sales projections which are developed by Head Office buyers in consultation with each store's departmental managers. Expense budgets, adjusted for expected inflation, are then prepared by Head office for each store. Popoola Plc's accounting year is divided into 13 four-weekly control periods, and the budgeted sales and expenses are assigned to periods with due regard to seasonal factors. The budgets are completed one month before the year begins on 1st January.

'All Head Office expenses are recharged to stores in order to give the clearest indication of the "bottom line" profit of each store. These Head office costs are mainly buying expenses, which are recharged to stores according to their square footage.

'Store reports comparing actual results with budgets are on the desks of Head office and store management one week after the end of each control period. Significant variations in performance are then investigated, and appropriate action taken.'

Adunni Modupe is the Manager of Toyn Popoola Plc. She is eligible for a bonus equal to 5% of the amount by which her store's 'bottom-line' profit exceeds the year's budget. However, Adunni Modupe sees no chance of a bonus this year, because major roadworks near the store are disrupting trade. Her store report for the four weeks ending 21 June is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Actual (₦)</th>
<th>Budget (₦)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>98,850</td>
<td>110,000</td>
</tr>
<tr>
<td>Costs:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of goods(including stock losses)</td>
<td>63,100</td>
<td>70,200</td>
</tr>
<tr>
<td>Wages and salaries</td>
<td>5,300</td>
<td>5,500</td>
</tr>
<tr>
<td>Rent</td>
<td>11,000</td>
<td>11,000</td>
</tr>
<tr>
<td>Depreciation of store fittings</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Distribution costs</td>
<td>4,220</td>
<td>4,500</td>
</tr>
<tr>
<td>Other store running expenses</td>
<td>1,970</td>
<td>2,000</td>
</tr>
<tr>
<td>Interest charge on stocks</td>
<td>3,410</td>
<td>3,500</td>
</tr>
<tr>
<td>Store's share of Head Office costs</td>
<td>2,050</td>
<td>2,000</td>
</tr>
<tr>
<td>Store profit</td>
<td>7,300</td>
<td>10,800</td>
</tr>
<tr>
<td></td>
<td>98,850</td>
<td>110,000</td>
</tr>
<tr>
<td>Stocks held at end of period</td>
<td>341,000</td>
<td>350,000</td>
</tr>
<tr>
<td>Store fittings at written down value</td>
<td>58,000</td>
<td>58,000</td>
</tr>
</tbody>
</table>

**Required:**

(a) Make recommendations for the improvement of Popoola Plc's store report, briefly justifying each recommendation; and

(b) Prepare a report for the managing director of Popoola Plc reviewing the company's responsibility delegation, identifying the major strengths and weaknesses of Popoola Plc's management control system, and recommending any changes you consider appropriate.
SOLUTIONS TO CASE STUDY 3

TOYIN POPOOLA PLC

(a) Recommendations are as follows:

(i) For cost control and managerial performance evaluation, expenses should be separated into their controllable and non-controllable categories. Two separate profit calculations should be presented: controllable profit, which is appropriate for measuring managerial performance, and a ‘bottom-line’ net profit, which measures the economic performance of each store rather than the manager.

(ii) The report should be based on an ex-post basis. In other words, if the environment is different from that when the original budget was set, actual performance should be compared with a budget that reflects any changed conditions. For example, the budget should be adjusted to reflect the effect of the roadworks.

(iii) Actual expenses should be compared with flexed budgets and not the original budget.

(iv) Each store consists of three departments. The report should therefore analyse gross profits by departments. Selling prices and the cost of goods sold are beyond the control of the stores’ managers, but each departmental manager can influence sales volume. An analysis of gross profits by departments and a comparison with previous periods should provide useful feedback on sales performance and help in deciding how much space should be allocated to each activity.

(v) Stock losses should be minimized. Such loses are controllable by departmental managers. The cost of stock losses should therefore be monitored and separately reported.

(vi) The budget should include cumulative figures to give an indication of trends, performance to date and the potential annual bonus.

(vii) Any imputed interest charges should be based on economic values of assets and not historic costs.

(b) The report should include a discussion of the following:

(i) Review of delegation policies: Head office purchases the goods for sale, fixes selling prices, appoints permanent staff and sets pay levels. Stores managers are responsible for stores’ running expenses, employment of temporary staff and control of stocks.

Purchasing is centralized, thus enabling the benefits of specialized buying and bulk purchasing to be obtained. Purchasing policies are coordinated with expected sales by consultation between head office buyers and stores and departmental managers. It is wise to make stores managers responsible for controlling stocks because they are in the best position to assess current and future demand.

Managers are responsible for sales volume but managers to appoint permanent staff. The stores’ managers are likely to be in a better position to be able to assess the abilities necessary to be a successful member of their own team.
(ii) Strengths of the management control system:

- Sales targets are set after consultation between head office and the departmental managers.
- The budgets are prepared well in advance of the start of the budget year, thus giving adequate time for consultation.
- Performance reports are available one week after the end of the period.
- Budgets are adjusted for seasonal factors.
- Significant variations in performance are investigated and appropriate action is taken.

(iii) Weaknesses of the management control system:

- There is no consultation in the setting of expense budgets.
- Actual costs are compared with a fixed budget and not a flexible budget.
- Costs are not separated into controllable and non-controllable categories.
- Budgets are set on an incremental basis with budgets set by taking last year's base and adjusting for inflation.
- Budgets are not revised for control purposes. Targets set for the original budget before the start of the year may be inappropriate for comparison with actual expenses incurred towards the end of the budget year.
- Using a budget that does not include ex-post results and that is not linked to controllable profit is likely to be demotivating, and results in managers having little confidence in the budget system.

(iv) Recommendations:

- Compare actual costs with a flexed budget.
- The performance report should separate costs into controllable and uncontrollable categories, and controllable profit should be highlighted. Any bonus payments should be related to controllable profit and not 'bottom-line' profits.
- Introduce monthly or quarterly rolling budgets.
- Ensure that the stores managers participate in setting the budget and accept the target against which they will be judged.
- Set targets using a zero-base approach.
- Consider extending the bonus scheme to departmental managers.

CASE STUDY 4

ADENIJI LIMITED

(Source: Adapted - Drury, C. (2004); Management and Cost Accounting)

Adeniji Ltd is a distributor of an industrial chemical in the South East of Nigeria. The chemical is supplied in drums which have to be stored at a controlled temperature. The company's objective is to maximize profits, and it commenced business on 1st October, 2003.

The Managing director's view;

"Mr Tunde, the managing director wishes to improve stock holding policy by applying the eco-
nomic order quantity model. Each drum of the chemical costs ₦50 from a supplier and sells for ₦60. Annual demand is estimated to be for 10,000 drums, which the managing director assumes to be evenly distributed over 300 working days. The cost of delivery is estimated at ₦25 per order and the annual variable holding cost per drum at ₦45 plus 10% of purchase cost.

Using these data the managing director calculates the economic order quantity and proposes that this should be the basis for purchasing decisions of the industrial chemical in future periods.

The Purchasing manager’s view:

"Written into the contract of the company’s Purchasing Manager, Mrs Olowolagba, is a clause that she will receive a bonus (rounded to the nearest ₦1) of 10% of the amount by which total annual inventory holding and order costs before such remuneration are below ₦10,000. Using the same assumptions as the Managing Director, the Purchasing Manager points out that in making his calculations, the Managing Director has not only ignored his bonus but also the fact that suppliers offer quantity discounts on purchase orders. In fact, if the order size is 200 drums or above, the price per drum for an entire consignment is only ₦49.90, compared to ₦50 when an order is between 100 and 199 drums; and ₦50.10 when an order is between 50 and 99 drums."

The Finance Director’s view:

"The company’s Finance Director, Mr Okiki, accepts the need to consider quantity discounts and pay a bonus, but he also feels the Managing Director’s approach is too simplistic. He points out that there is a lead time for an order of three days and that demand has not been entirely even over the past year. Moreover, if the company has no drums in stock, it will lose specific orders as potential customers will go to rival competitors in the region to meet their immediate needs."

In the circumstances, the managing director decides he should seek further advice on what course of action he should take.

Required:

(a) Calculate the economic order quantity as originally determined by the company’s managing director.

(b) Calculate the optimum economic order quantity, applying the Managing Director’s assumptions and after allowing for the Purchasing Manager’s bonus and for supplier quantity discounts, but without using an expected value approach.

(c) As an outside consultant, write a report to the managing director on the company’s stock ordering and stock holding policies. The report should inter alia refer to other factors he should consider when taking his final decision on stock ordering and stock holding policies.

**Solutions to Case Study 4**

**Adeniji Limited**

(a) \[\text{EOQ} = \sqrt{\frac{2DCo}{CC}} = \sqrt{\frac{2 \times 10,000 \times 25}{45 + 5}} = 100 \text{ units}\]

(b) Without any discount prices the \(\text{EOQ} = \sqrt{\frac{2 \times 10,000 \times 25}{45 + 5.01}} = 99.99 \text{ units}\)

Thus it is preferable to purchase 100 units at ₦50 rather than pay ₦50.01 for purchasing 99 units. To ascertain whether it is worthwhile increasing the purchase quantity from 100 to 200 units we must compare the total costs at each of these quantities.
Total costs with a reorder quantity of 100 units:

- Annual holding cost (\(100/2 \times \text{N} 50\)) = \(2,500\)
- Annual ordering costs (\(10,000/100 \times \text{N} 25\)) = \(2,500\)
- Total annual costs = \(5,000\)

Purchasing manager's bonus (10% of \(\text{N} 5,000\)) = \(500\)

Total costs with a reorder quantity of 200 units:

- Annual holding costs (\(200/2 \times \text{N} 49.99\)) = \(4,999\)
- Annual ordering costs (\(10,000/200 \times \text{N} 25\)) = \(1,250\)
- Total annual costs = \(6,249\)

Purchasing manager's bonus (10% of \(10,000 - \text{N} 6,249\)) = \(375\)

Annual purchase cost (\(10,000 \times \text{N} 4,990\)) = \(499,000\)

Total annual costs = \(505,624\)

The optimal order quantity is still 100 units.

(c) The probability distribution of demand over the three day lead time is as follows:

<table>
<thead>
<tr>
<th>Demand</th>
<th>Frequency</th>
<th>Probability</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>106</td>
<td>4</td>
<td>0.04</td>
<td>4.24</td>
</tr>
<tr>
<td>104</td>
<td>10</td>
<td>0.10</td>
<td>10.40</td>
</tr>
<tr>
<td>102</td>
<td>16</td>
<td>0.16</td>
<td>16.32</td>
</tr>
<tr>
<td>100</td>
<td>40</td>
<td>0.40</td>
<td>40.00</td>
</tr>
<tr>
<td>98</td>
<td>14</td>
<td>0.14</td>
<td>13.72</td>
</tr>
<tr>
<td>96</td>
<td>14</td>
<td>0.14</td>
<td>13.44</td>
</tr>
<tr>
<td>94</td>
<td>2</td>
<td>0.02</td>
<td>1.88</td>
</tr>
<tr>
<td>100</td>
<td>1.00</td>
<td></td>
<td>100.00</td>
</tr>
</tbody>
</table>

It is assumed that the reorder point will be set at 100 units (expected value). The expected costs for various levels of safety stock are as follows:

<table>
<thead>
<tr>
<th>Safety Stockpoint (units)</th>
<th>Reorder per order (units)</th>
<th>Stockout per order (units)</th>
<th>Stockout of stockout year (units)</th>
<th>Probability stockout cost</th>
<th>Expected holding cost</th>
<th>Holding expected cost</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>106</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>270</td>
<td>270</td>
</tr>
<tr>
<td>4</td>
<td>104</td>
<td>2</td>
<td>200</td>
<td>0.04</td>
<td>80</td>
<td>180</td>
<td>260</td>
</tr>
<tr>
<td>2</td>
<td>102</td>
<td>2</td>
<td>200</td>
<td>0.10</td>
<td>200</td>
<td>90</td>
<td>450</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>2</td>
<td>400</td>
<td>0.16</td>
<td>320</td>
<td>400</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>0.10</td>
<td>400</td>
<td></td>
<td>960</td>
</tr>
</tbody>
</table>

Notes:

During the year 100 orders will be made (10,000) units annual demand/EOQ of 100 units. Stockout per year in units is calculated by multiplying the stockouts per order by 100 orders.

Expected stockout costs = Annual stockout in units x probability of stockout x \(\text{N} 10\) lost Contribution

Holding cost = Safety stock x (Holding cost of \(\text{N} 50\) - saving of 10% on purchasing Manager's bonus)

It is assumed that stockout costs are equal to the lost contribution on the lost sales.
Conclusion:

Costs are minimized if a safety stock of 4 units is maintained.

(d) The following items should be included in the report:

(i) The disadvantages of ordering from only one supplier (e.g. vulnerability of disruption of supplies due to strikes/production difficulties or bankruptcy);
(ii) Failure to seek out cheap or alternative sources of supply;
(iii) It is assumed that no large price increases are anticipated that will justify holding additional stocks or that the stocks are not subject to deterioration or obsolescence;
(iv) It is assumed that lead time will remain unchanged. However, investigations should be made as to whether this or other suppliers, can guarantee a shorter lead time;
(v) The need to ascertain the impact on customer goodwill if a stockout occurs. The answer to (c) assumes that the company will merely lose the contribution on the sales and long-term sales will not be affected if a stockout occurs.

CASE STUDY 5

FOLAKE OLAWUYI LIMITED

(Source: Adapted - Drury, C. (2004); Management and Cost Accounting)

The Managing Director of Folake Olawuyi Ltd believes that a market exists for cartoon books. He has proposed that the company should market 100 best-selling books on internet which can be read using a special internet reader that is connected to a television screen. An internet disk containing an entire book can be purchased from an internet company at 40% of the average production cost of best-selling paperback books.

It is estimated that the average cost of producing paperback books is ₦1.50, and the average selling price of paperbacks is ₦3.95 each. Copyright fees of 20% of the average selling price of the paperback books would be payable to the publishers of the paperbacks plus an initial lump sum which is still being negotiated, but is expected to be ₦1.5 million. No tax allowances are available on this lump sum payment. An agreement with the publishers would be signed for a period of six years. Additional variable costs of staffing, handling and marketing are 20k per internet and fixed costs are negligible.

Folake Olawuyi Ltd has spent ₦100,000 on market research, and expects sales to be 1,500,000 units per year at an initial unit price of ₦2.

Folake Olawuyi would finance the venture with a bank loan at an interest rate of 16% per year. The company's money (nominal) cost of equity and real cost of equity are estimated to be 23% per year and 12.6% per year respectively. Folake Olawuyi money weighted average cost of capital and real weighted average cost of capital are 18% per year and 8% per year respectively. The risk free rate of interest is 11% per year and the market return is 17% per year.

Corporate tax is at the rate of 35%, payable in the year the profit occurs. All cash flows may be assumed to be at the year end, unless otherwise stated.
Required:
(a) Calculate the expected net present value of the cartoon book project.
(b) Explain the reasons for your choice of discount rate in your answer to part
(c) Discuss whether this rate is likely to be the most appropriate rate to use in the analysis of the proposed project.
(d) What further information would be useful to help the company decide whether to undertake the cartoon book project?

SOLUTIONS TO CASE STUDY 5
FOLAKE OLAWUYI LIMITED

(a) Calculation of expected NPV (N’000)

<table>
<thead>
<tr>
<th>Investment outlay</th>
<th>(1,500)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales at N’2 per unit</td>
<td>3,000 3,000 3,000 3,000 3,000 3,000</td>
</tr>
<tr>
<td>Variable costs at N’1.59 per unit</td>
<td>2,385 2,385 2,385 2,385 2,385 2,385</td>
</tr>
<tr>
<td>Taxable cash flows</td>
<td>615 615 615 615 615 615</td>
</tr>
<tr>
<td>Tax at 35%</td>
<td>215 215 215 215 215 215</td>
</tr>
<tr>
<td>Net cash flow</td>
<td>(1,100) 400 400 400 400 400 400</td>
</tr>
</tbody>
</table>

NPV at a discount rate of 8% = (N’400 x 4.623) - N’1500 = N’349,200

Notes:
Unit variable cost = Purchase cost (N’1.50 x 40%) + copyright fee (20% x N’3.95) + N’0.20 additional cost.
Market research is a sunk cost.
See part (b) of the answer for an explanation of why a discount rate of 8% has been used.
Note that the financing costs are incorporated in the discount rate and should not be included in the cash flows as this would lead to double counting.

(b) Assuming that the company wishes to maintain its current capital structure, the specific cost of financing the project should not be used as a discount rate. The project has been financed by a bank loan but this will result in less borrowing being used in the future as the company re-balances its finance to achieve the target capital structure. To reflect the company’s target capital structure, the weighted average cost of capital (WACC) should be used.

The money WACC should be used only if the cash flows are expressed in money/nominal terms (i.e. adjusted for inflation). Current cash flows have been used to calculate NPV. Current cash flows are equivalent to real cash flows when all cash flows increase at the general rate of inflation. This situation occurs in this question and therefore the cash flows are equivalent to real cash flows. Thus, the real WACC should be used to discount the cash flows.

The WACC represents the discount rate applicable to the company as a whole and reflects the average risk of all of the company’s assets. If the project has a different level of risk from the average risk of the assets of the company as a whole, the existing WACC will not represent the appropriate discount rate. In this situation, a separate risk adjusted discount rate should be used.

It is also assumed that all of the cash flows increased at the general rate of inflation. If the cash flows are subject to different rates of inflation, it will be incorrect to use current
prices. If this situation occurs, the cash flows should be adjusted by their specific rates of inflation and a nominal discount rate should be used.

(c) Possible additional information includes:

(i) Is the agreement likely to be renewed after 6 years?

(ii) Are competitors likely to enter the market and what impact would this have on the sales volume and price?

(iii) How accurate are the estimated cash flows?

(iv) How reliable is the supplier who supplies caroon book? Can the cartoon book be obtained from any other source or is the company dependent upon the only supplier?
GLOSSARY OF TERMS

Absorption Approach: A costing approach that considers all factory overhead costs (both variable and fixed) to be product (inventoriable) costs that become an expense in the form of manufacturing cost of goods sold only as sales occur.

Accelerated Depreciation: Any pattern of depreciation that writes off depreciable assets more quickly than does ordinary straight-line depreciation.

Account Analysis: Selecting a volume-related cost driver and classifying each account as a variable cost or as a fixed cost.

Accounting Rate-Of-Return (ARR): A non-DCF capital-budgeting technique expressed as the expected average annual operating income divided by the initial investment.

Accounting System: A formal mechanism for gathering organizing, and communicating information about an organization’s activities.

Accounts Payable: Amounts owed on open accounts whereby the buyer pays cash some time after the date of sale.

Accounts Receivable: Amounts owed to a company by customers who buy on open account.

Accrual Basis: A process of accounting that recognizes the impact of transactions on the financial statements in the time periods when revenues and expenses occur instead of when cash is received or disbursed.

Accrue: To accumulate a receivable or payable during a given period even though no explicit transaction occurs.

Activity Analysis: The process of identifying appropriate cost drivers and their effects on the costs of making a product or providing a service.

Activity-Based Accounting (ABA): A system that first accumulates overhead costs for each of the activities of an organization, and then assigns the costs of activities to the products, services, or other cost objects that caused that activity. Activity-based costing (ABC) See activity-based accounting

Advanced Manufacturing Technology (AMT): This is a general expression encompassing automated production technology, computer assisted design and manufacturing, flexible manufacturing systems, robotics, total quality control, advances in production management including materials requirements and manufacturing resources planning systems, just-in-time systems and so on.

Assets: Economic resources that are expected to benefit future activities.

Audit: An examination or in-depth inspection that is made in accordance with generally accepted auditing standards. It culminates into the accountant’s testimony that management’s financial statements are in conformity with generally accepted accounting principles.

Avoidable Costs: Cost that will not continue if an ongoing operation is changed or deleted.

Balanced Scorecard: A performance measurement system that strikes a balance between financial and operating measures, links performance to rewards, and gives explicit recognition to the diversity of stakeholder interests.
Behavioral Implications: The accounting system’s effect on the behavior (decisions) of managers.

Bench Marks: General rules of thumb specifying appropriate levels for financial ratios.

Book Value: The original cost of equipment less accumulated depreciation, which is the summation of depreciation charged to past periods.

Break-Even Point: The level of sales at which revenue equals expenses and net loss or profit is zero.

Budget: A quantitative expression of a plan of action, and an aid to coordinating and implementing the plan.

Budgeted Factory-Overhead Rate: The budgeted total overhead cost divided by the budgeted cost driver activity.

By-Product: A product that is not individually identifiable until manufacturing reaches a split-off point, but has relatively insignificant total sales value.

Capacity Costs: The fixed costs of being able to achieve a desired level of production or to provide a service while maintaining product or service attributes such as quality.

Capital Budget: A budget that details the plan expenditures for facilities, equipment, new products and other long term investments.

Capital Turnover: Revenue divided by invested capital.

Capital Budgeting Decisions: Decisions that have significant financial effects beyond the current year.

Cash Basis: A process of accounting where revenue and expense recognition would occur when cash is received and disbursed.

Cash Budget: A statement of planned cash receipts and disbursements.

Cash Equivalents: Short-term investments that can easily be converted into cash with little delay.

Coefficient Of Determination (R²): A measurement of how much of the fluctuation of a cost is explained by changes in the cost driver.

Committed Fixed Costs: Costs arising from the possession of facilities, equipment and a basic organization: large, indivisible chunks of cost that the organization is obligated to incur or usually would not consider avoiding.

Common Costs: Those costs of facilities and services that are shared by users.


Continuous Budget: A common form of master budget that adds a month in the future as the month just ended is dropped.
Contribution Approach: A method of internal (management accounting) reporting that emphasizes the distinction between variable and fixed costs for the purpose of decision making.

Contribution Margin: The sales price minus the variable cost per unit measured as a percentage.

Controllable Cost: Any cost that is influenced by a manager’s decisions and actions.

Controller/Comptroller: The top accounting officer of an organization. The term comptroller is used primarily in government organisations.

Conversion Costs: Direct labour costs plus factory overhead costs.

Corporation: A business organized as a separate legal entity and owned by its stockholders.

Cost: A sacrifice or giving up of resources for a particular purpose, frequently measured by the monetary units that must be paid for goods and services.

Cost Accounting: That part of the accounting system that measures costs for the purposes of management decision making and financial reporting.

Cost Accounting Systems: The techniques used to determine the cost of a product, service, or other cost objective by collecting and classifying costs and assigning them to cost objects.

Cost Accumulation: Collecting costs by some natural classification such as materials or labour.

Cost Allocation: Tracing and reassigning costs to one or more cost centres such as departments, customers, or products.

Cost Behavior: The responsiveness of a cost item to changes in activities.

Cost Center: A responsibility center for which costs are accumulated.

Cost Drivers: Activities that affect costs.

Cost Function: An algebraic equation used by managers to describe the relationship between a cost and its cost driver(s).

Cost Measurement: The first step in estimating or predicting costs as a function of appropriate cost drivers.

Cost Objective: Any activity or resource for which a separate measurement of costs is desired. Examples include departments, products, and territories.

Cost Of Capital: What a firm must pay to acquire more capital, whether or not it actually has to acquire more capital to take on a project.

Cost Of Quality Report: A report that displays the financial impact of quality.

Cost Pool: A group of individual costs that is allocated to cost objectives using a single cost driver.

Cost Prediction: The application of cost-measures to expected future activity levels to forecast future costs.
**Cost Recovery:** A concept in which assets such as inventories, prepayments, and equipment are carried forward as assets because their costs are expected to be recovered in the form of cash inflows (or reduced cash outflows) in future periods.

**Cost Benefit Balance:** Weighing estimated costs against probable benefits, the primary consideration in choosing among accounting systems and methods.

**Cost-Management System:** Identifies how management's decisions affect costs, by first measuring resources used in performing the organization's activities and then assessing the effects on costs of changes in those activities.

**Cost-Volume-Profit (CVP) Analysis:** The study of the effects of output volume on revenue (sales), expenses (costs), and net income (net profit).

**Cross-Sectional Comparisons:** Comparison of a company's financial ratios with ratios of other companies or with industry averages for the same period.

**Current Assets:** Cash and all other assets that are reasonably expected to be converted to cash or sold or consumed during the normal operating cycle.

**Current Cost:** The cost to replace an asset, as opposed to its historical cost.

**Current Liabilities:** An organization's debts that fall due within the coming year or within the normal operating cycle if longer than a year.

**Currently Attainable Standards:** Levels of performance that can be achieved by realistic levels of efforts.

**Cycle Time:** The time taken to complete a product or service, or any of the components of a product or service.

**Decentralisation:** Delegation of freedom to make decisions. The lower in the organization that this freedom exists, the greater the decentralization.

**Decision Making:** The purposeful choice from among a set of alternative courses of action designed to achieve some objective.

**Decision Model:** Any method for making a choice, sometimes requiring elaborate quantitative procedures.

**Depreciation:** The periodic cost of equipment which is spread over (or charged to) the future in which the equipment is expected to be used.

**Differential Approach:** An approach that compares two alternatives by computing the differences in cash flows between alternatives and then converting these differences in cash flows to their present values.

**Differential Cost:** The difference in total costs between two alternatives.

**Direct Costs:** Cost that can be identified specifically and exclusively with a given cost objective in an economically feasible way.

**Direct Method:** A method for allocating service department costs that ignores other service departments when any given service department's costs are allocated to the revenue-producing (operating) departments.
**Direct-Labor Costs:** The wages of all labour that can be traced specifically and exclusively manufactured goods in an economically feasible way.

**Direct-Material Costs:** The acquisition costs of all materials that are physically identified as a part of the manufactured goods and that may be traced to the manufactured goods in an economical way.

**Discount Rate:** See required rate of return.

**Discounted-Cash-Flow (DCF) Model-S:** A type of capital-budgeting model that focuses on cash inflows and outflows and explicitly and systematically incorporates the time value of money.

**Discretionary Fixed Costs:** Cost determined by management as part of the periodic planning order to meet the organisation's goals.

**Discriminatory Pricing:** Charging different prices to different customers for the product or service.

**Earnings Per Share:** Profit after tax less preference dividend

Number of ordinary shares issued

**Effectiveness:** The degree to which a goal, objective, or target is met.

**Efficiency:** The degree to which inputs are used in relation to a given level of outputs.

**Efficient Capital Market:** A market in which market prices fully reflect all information available to the public.

**Engineering Analysis:** The systematic review of materials, supplies, labor, support services, and facilities needed for products and services: measuring cost behavior according to what costs should be, not by what costs have been.

**Equities:** The claims against, or interests in, an organization's assets.

**Equivalent Units:** The number of completed units that could have been produced from the inputs applied.

**Expected Cost:** The cost most likely to be attained.

**Expenses:** Gross decreases in assets from delivering goods or services.

**Factory Burden:** See factory-overhead costs.

**Factory-Overhead Costs:** All costs other than direct material or direct labor that are associated with the manufacturing process.

**Favourable Expense Variable:** A variance that occurs when actual expenses are less than budgeted expenses.

**Financial Budget:** The part of master budget that focuses on the effects that the operating budget and other plans (such as capital budget and repayments of debt) will have on cash.

**Financial Planning Models:** Mathematical model of the master budget that can react to any set of assumptions about sales, costs, or product.
First-In, First-Out (FIFO): An inventory method that assumes that the stock acquired is sold (used up) first.

First-In, First-Out (FIFO) Process Costing Method: A process costing method that sharply distinguishes the current work done from previous work done on the beginning inventory of work in process.

Fixed Assets: Physical items that can be seen and touched such as property, plant, and equipment.

Fixed Cost: A cost that shows no responsiveness to changed in activity levels.

Fixed Overhead Rate: The amount of fixed manufacturing overhead applied to each unit of production. It is determined by dividing the budgeted fixed overhead by the expected volume of production for the budget period.

Flexible Budget: A budget that adjusts for changes in sales volume and other cost-driver activities.

Flexible-Budget Variances: The difference between the flexible budget and the actual result

Full Cost The total of all manufacturing costs plus the total of all selling and administrative costs.

Functional Analysis: An analysis of the relationships between product functions, their perceived value to the customer and their cost of production.

General Price Index: A comparison of the average price of a group of goods and services at one date with the average price of a similar group at another date.

Generally Accepted Accounting Principles (GAAP): Broad concepts or guidelines and detailed practices, including all conventions, rules, and procedures that together make up accepted accounting practice at a given time.

Goal Congruence: A condition where employees, working in their own personal interests make decisions that help meet the overall goals of the organization.

Going Concern Convention See continuity convention.

Goodwill: The excess of the cost of an acquired company over the sum of the fair market values of its identifiable individual assets less its liabilities.

Gross Book Value: The original cost of an asset before deducting accumulated depreciation.

Gross Margin: The excess of sales over the total cost of goods sold.

Gross Profit: See gross margin.

High-Low Method: A simple method for measuring a linear cost function from past cost data, focusing on the highest-activity and lowest-activity and fitting a line through these two points.

Historical Cost: The amount originally paid to acquire an asset.
**Hybrid-Costing System:** An accounting system that is a blend of ideas from both job costing and process costing.

**Ideal Standards:** See perfection standards.

**Idle Time:** An indirect labor cost consisting of wages paid for unproductive time caused by machine breakdowns, material shortages and sloppy scheduling.

**Incentives:** Those formal and informal performance-based rewards that enhance managerial effort toward organizational goals.

**Indirect Costs:** Cost that cannot be identified specifically and exclusively with a given cost objective in an economically feasible way.

**Indirect Labour:** All factory labour wages, other than those for direct labor and manager salaries.

**Inflation:** A general decline in the purchasing power of the monetary unit.

**Intangible Assets:** Long-lived assets that are not physical in nature. Examples are goodwill, franchises, trademarks and copyrights.

**Internal Control Systems:** Methods and procedures to prevent errors and irregularities, detect errors and irregularities, and promote operating efficiency.

**Internal Rate Of Return (IRR):** The discount rate that makes the net present value of the project equal to zero.

**Inventory Turnover:** The number of times the average inventory is sold per year.

**Investment Center:** A responsibility center whose success is measured not only by its income but also by relating that income to its invested capital, as in a ratio of income to the value of the capital employed.

**Job Costing:** See job-order costing.

**Job Order:** See job-cost record.

**Job-Cost Record:** A document that shows all costs for a particular product, service or batch of products.

**Job-Cost Sheet:** See job cost record

**Job-Order Costing:** The method of allocating costs to products that are readily identified by individual units or batches, each of which require varying degrees of attention and skills.

**Joint Costs:** The costs of manufacturing joint products prior to the split-off point.

**Joint Products:** Two or more manufactured products that (1) have relatively significant sales values and (2) are not separately identifiable as individual products until their split-off point.

**Just-In-Time (JIT):** A philosophy to eliminate waste by reducing the time products spend in the production process and eliminating the time products spend on activities that do not add value.
Just-In-Time (JIT): production system. A system in which an organization purchases materials and parts and produces components just when they are needed in the production process, the goal being to have zero inventory, because holding inventory is non-value added activity.

Labour Time Tickets: The record of time a particular direct worker spends on each job.

Liabilities: The entity’s economic obligations to non-owners.

Limiting-Factor: The item that restricts or constraints the production or sale of a product or service.

Long-Range Planning: Producing forecasted financial statements for five- or ten-year period.

Lower-Of-Cost-Or-Market (LCM): An inventory method in which the current market is compared with its cost (derived by specific identification, FIFO, LIFO or weighted average) and the lower of the two is selected as the basis for the valuation of goods at a specific inventory date.

Management Accounting: The process of identifying, measuring, accumulating, analyzing, preparing, interpreting and communicating information that helps managers fulfill organizational objectives.

Management Audit: A review to determine whether the policies and procedures specified by top management have been implemented.

Management by Exception: Concentrating on areas that deviate from the plan and ignoring areas that are presumed to be running smoothly.

Management By Objectives (MBO): The joint formulation by a manager and his or her subordinates of a set goals and plans for achieving the goals for a forthcoming period.

Management Control System: A logical integration of management accounting tools to gather and report data and to evaluate performance.

Margin Of Safety: Sensitivity of constituent factors of profit to poor operational conditions.

Marginal Cost: The additional cost resulting from producing and selling one additional unit.

Marginal Income: See contribution margin.

Marginal Income Tax Rate: The tax rate paid on additional amounts of pretax income.

Marginal Revenue: The additional revenue resulting from the sale of an additional unit.

Mark-Up: The amount by which price exceeds cost.

Master Budget: A budget that summarizes the planned activities of all sub-units of an organization.

Mixed Costs: Cost that contain elements of both fixed and variable costs.

Net Book Value: The original cost of an asset less any accumulated depreciation.

Net Worth: A synonym for owner’s equity.
**Net-Present-Value (NPV):** A discounted-cash-flow approach to capital budgeting that discounts all expected future cash flows to the present using a minimum desired rate of return.

**Non-Value-Added Costs:** Cost that can be eliminated without affecting a product’s value to the customer.

**Normal Costing:** A costing system that applies actual direct materials and actual direct labour cost to products or services but uses standard for applying overheads.

**Operating Budget:** A major part of a master budget that focuses on the income statement and its supporting schedules.

**Operational Variances:** These are variances which compare actual result with those that are considered should have been achieved by a reasonably efficient management during the past period.

**Opportunity Cost:** The maximum available contribution to profit forgone.

**Participative Budgeting:** Budgets formulated with the active participation of all affected employees.

**Payback Time:** The measure of the time it will take to recoup, in the form of cash inflows from operations, the initial naira of outlay.

**Period Costs:** Cost that are deducted as expenses during the current period without going through an inventory stage.

**Planning Variances:** These are the differences between the original budget (ex-ante) and the revised budget (ex-post).

**Post Audit:** A follow-up evaluation of capital-budgeting decisions.

**Practical Capacity:** Maximum or full capacity.

**Predatory Pricing:** Establishing prices so low that competitors are driven out of the market so that the predatory prices then has no significant competition and can raise prices dramatically.

**Price Variance:** The difference between actual input prices and expected input prices multiplied by the actual quantity of inputs used.

**Product Life Cycle:** The various stages through which a product passes, from conception and development through introduction into the market through maturation and, finally, withdrawal from the market.

**Production Cycle Time:** The time from initiating production to delivering the goods to the customer.

**Production-Volume Variance:** A variance that appears whenever actual production deviates from the expected volume of production used in computing the fixed overhead rate.

**Productivity:** A measure of outputs divided by inputs.

**Profit Centers:** A responsibility center for controlling revenues as well as costs (or expenses) that is, profitability.
**Quality Control:** The effort to ensure that products and services conform to customer requirements.

**Recovery Period:** The number of years over which an asset is depreciated for tax purposes.

**Relevant Range:** The limit of cost-driver activity within which a specific relationship between cost and other cost driver is valid.

**Required Rate Of Return:** The minimum desired rate of return, based on the firm’s cost of capital.

**Residual Income:** Net income less ‘imputed’ interest.

**Residual Value:** The predicted sales value of a long-lived asset at the end of its useful life.

**Responsibility Accounting:** Identifying what parts of the organization have primary responsibility for each objective, developing measures of achievement of objectives, and creating reports of these measures by organization sub-unit or responsibility center.

**Responsibility Center:** A set of activities assigned to a manager, a group of managers, or employees.

**Retained Income:** The ownership claim arising a result of profitable operations.

**Return On Sales:** See income percentage on revenue.

**Sales Budget:** The results of decisions to create conditions that will generate a desired level of sales.

**Sales Forecast:** A prediction of sales under a given set of conditions.

**Sales Mix:** The relative proportions or combinations of quantities of products that constitute total sales.

**Scorekeeping:** The accumulation and classification of data.

**Sensitivity Analysis:** The systematic varying of budget data input to determine the effects of each change on the budget.

**Split-Off Point:** The juncture of manufacturing where the joint products become individually identifiable.

**Standard Cost:** A carefully determined cost per unit that should be attained.

**Standard Cost Systems:** Accounting systems that value products according to standard costs only.

**Step Costs:** Cost that change abruptly at intervals of activity because the resources and their costs come in indivisible lump sum.

**Sunk Cost:** A cost that has already been incurred and, therefore, is irrelevant to the decision making process. Synonyms are historical or past cost.
**Target Costing:** A strategy in which companies first determine price at which they can sell a new product and then design a product or service produced at a low enough cost to provide an adequate profit margin.

**Throughput Accounting:** A management accounting system which focuses on ways by which the maximum return per unit of bottleneck activity can be achieved.

**Total Project Approach:** An approach that compares two or more alternatives by computing the impact on cash flows for each alternative and then converting these total cash flows to their present values.

**Total Quality Management (TQM):** The application of quality principles to all of the organization’s endeavors to satisfy customers.

**Transaction-Based Costing:** Activity-based costing.

**Transfer Price:** The amount charged by one segment of an organization for a product or service that it supplies to another segment of the same organization.

**Usage Variance:** The difference between the quantity of inputs actually used and the quantity of inputs that should have been used to achieve the actual quantity of output multiplied by the expected price of input.

**Value Chain:** The sequence of functions that adds value to the company’s products or service.

**Value-Added Cost:** The necessary cost of an activity that cannot be eliminated without affecting a product’s value to the customer.

**Variable Budget:** See flexible budget.

**Variable Cost:** A cost that move in sympathy with activity level.
BIBLIOGRAPHY


APPENDIX VI

STUDY AND EXAMINATION TECHNIQUES

6.0 This appendix contains notes on:

(a) Using the questions and answers provided in the manual;
(b) Effective study; and
(c) Examination technique.

Questions and answers

6.1 Introduction

1. Two types of question are provided in this manual:

   (i) Questions set at the end of chapter with answers provided in Appendix I
   (ii) Comprehensive standard examination questions in Appendix II
   (iii) Solution to comprehensive questions in Appendix III
   (iv) Solution to case study questions in Appendix IV

Questions with answers

2. These questions are either:

   (i) questions intended to test the understanding of the points arising out of the particular chapter; or
   (ii) examination questions inserted at a stage where it is considered the student will be able to give a reasonable answer.

3. Most answers are given in outline but some examination answers go a little further in order to provide greater guidance and provide students with the basis for study.

4. Where answers are comprehensive you couldn’t be expected to write them in the time allowed. Do not worry if you feel you couldn’t write such answers; you are not expected to. But you must grasp the main points or principles involved which will form the basis for good marks in an examination.

5. Do not worry if your answer differs, there is often more than one approach. You must satisfy yourself however, that it is only the approach that differs, and that you haven’t missed the fundamental principles.

Using the answers

6. Have a shot at each question yourself before consulting the answer. you will achieve nothing if you don't do this. Write your answer out in full or jot down the main points. Do not hurry to the answer.

7. Look at the answer (in the case of examination answers). Study the particular area thoroughly making sure of your understanding. Repeat the process outlined in the above after a suitable interval. You must do this to get any benefit at all. Make sure the main points stick!

8. Just browsing through the answers will really get you nowhere. You must test yourself by writing down your version of the answer.
6.2 Effective study

Introduction

1. These notes are intended for those who are new to studying for examination subjects, although those who are not may also benefit. They have been written in relation to study involving the reading of textbooks, and the apply to all subjects. It is often extremely difficult to pick out the important principles such books.

General

2. Study means more than just reading a piece of literature. It means close concentrated reading with a notebook at your side. Unless you’re one of a few people don’t kid yourself you can absorb material by just one general read through it, you cannot!

3. Read a small area, making notes as you go along. Then ask yourself -what have I just learnt? Write down what you think it was all about. Then look again and you may be surprised to find you’ve missed a key point or points -they must be down in your notebook and eventually in your head.

Compilation of notebook

4. A well compiled NOTEBOOK is a must. Use block capitals or different colour inks to headline the main areas and subdivisions of those areas. Notes made during lectures or private study should not go straight into your NOTEBOOK. Take them on a “rough” paper and write them in your NOTEBOOK as soon as possible after the lecture or study period, thinking about what you are writing. Practise the illustration in the method yourself as man time as possible.

Memory aids

5. Mnemonics are very useful - if the sequence of points in the text book isn’t significant change it, it makes for a better mnemonic.

6. Association of the points with familiar objects which will serve to recall them is also useful.

7. Some people memorise things by saying them over and over out loud, others have to write them down time after time including formulae.

8. Many students have small blank cards and using one side of each card for each study area, put down the main points. They carry the cards everywhere with them and use every opportunity to study them. As they are small they are easily carried. It is surprising how much of your day can be utilised in this way.

Programme

9. Map out a programme for yourself; set targets and achieve them. One thing is certain, studying is not easy but it is not too difficult if you go about it in an orderly purposeful way. Many students fail their examinations through bad preparation. Tackle your studies as you would a project at work, systematically.
Allocate a number of hours each week for each subject. Try fixing specific times for each subject, then keep to them by refusing to let anything keep you from your planned task. Revision

Revise periodically. The nearer the examination gets, the more you should concentrate on the major headlines in your notebook and less with the supporting details.

### 6.3 Examination technique

**First impressions**

1. However well prepared you may be, you are still likely to look at the paper on the day and say to yourself, after a quick look at the questions, “There’s not much there I can do”.

2. The atmosphere of the examination room has something to do with this. Try to blot everything from your mind other than the job in hand. Concentrate hard. If you feel a bit panicky (most people do - despite the apparent looks of serenity around you) grip the table, take a deep breath, and get on with it. Remember things are never as bad as they seem!

**Time allocation**

3. Allocate each question time appropriate to the number of marks. At the end of the allotted time for a question go on to the next - remember, the first 5 to 10 marks on the new question are more readily picked up than the last 1 or 2 previous question.

4. The temptation will be to say "I’ll write just one more sentence", but before you know where you are you’ll have written several more and probably just managed to scrape another mark, whereas the same time spent on the next question could have earned 5 or 6 marks. TIME ALLOCATION IS IMPORTANT.

5. If you are running out of time write down the main headings first, leaving a few lines between each - at least the examiner will see that you had the overall picture. Then go back putting in as much supporting detail as you can.

6. It is advisable to spend 15 minutes in reading all the questions and then 150 minutes in answering the questions (i.e. one mark is 1.5 minutes (40 marks of multiple choice and short-answers questions should student spend more than 60 minutes). On no account should student spend more than 60 minutes on 40 marks question. The remaining 15 minutes should be spent in reading over and making more points which you might have forgotten in the course of solving the problem.

**SUMMARY**

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<td>Comprehensive question</td>
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<td>180 minutes</td>
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If students can train themselves in this direction, it will be of immense value, not only on Management Accounting but also on other subject.

General approach

7. Read the instructions at the top of the paper.

8. Read the question paper once through. Make your choice of questions quickly. Pick the easiest (if one appears so) and get on with it.

Individual questions

9. Read the question again carefully. The question will involve a key principle or set of principles. What are they? It is so easy to make the wrong decision at this stage, so read the question, underlining what appear to be the key words. This should help you. Irrelevancy has been heavily criticised by examiners.

10. Do not rush into action with your pen yet. Jot down on a piece of scrap paper (not on question paper) the main headings you will use in your answer. All this will take time - about 5 minutes or more, but, the careful thought and outline answer represents marks already earned.

11. If the question is set out in a particular sequence, i.e:
   a. ......................
   b. ......................
   c. ...................... etc.

   Then answer it in that sequence or you’ll have a hostile examiner to cope with.

12. Use the particular terminology used in the question, the examiner can then link the points in your answer to the relevant parts of the question.

13. Assumptions are sometimes required (for example because of the lack of standardisation of terminology in this subject). Having stated your assumptions, make sure that what you write is consistent with them. Do ensure, however, that your assumptions are valid and are not just a device for changing the meaning of the question to suit your knowledge!

Layout of answer

14. Tabulate where appropriate, using block capitals for your main headings and underline subheadings. Underline words or phrases which require emphasis. Use a ruler.

15. Leave a line between your paragraphs and subparagraphs. This makes for a good layout. However, do not write on every other line within paragraphs, or on one side of the paper only - examiners are waste conscious!

16. The use of different colour pens, where appropriate, is useful but don’t overdo it. In fact one black and one red felt-tip pen would be sufficient (use the felt-tip pens which have a fine point ).
Charts and diagrams

17. A descriptive heading or title must be given to each diagram (using the one in the question if indicated).

18. Do not squeeze a diagram into a corner - spread it out.

19. Do not clutter your diagram up with too much detail - this defeats the object, which should be clarity.

20. Give a key to the symbols and the different lines you've used, and again - use a ruler.

End of examination procedure

21. Have a quick look at each answer, checking for grammatical errors and badly formed letters.

22. Ensure each answer sheet has your number on it and don't leave any answer sheet lying on the table.

Conclusion

23. Good technique plays a large part in examination success; this is a fact. Refuse to be panicked, keep your head, and with reasonable preparation, you should make it.

24. Remember - you don't have to score 100% to pass.

25. A final point; once you're in the examination room stay there and make use of every minute at your disposal.

26. Practise your technique when answering the questions set in this manual.

27. Remember that you should not take your telephone to the examination hall or any object that is not permitted.


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