CPA

Certified Public Accountant Examination

Stage: Advanced A2.2

Subject Title: Strategic Performance Management

Study Manual

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Driving Sustainable Performance

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INSTITUTE OF
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Foundation A2.2

A2.2 STRATEGIC PERFORMANCE MANAGEMENT

First Edition 2012

This study manual has been fully revised and updated

in accordance with the current syllabus.

It has been developed in consultation with experienced lecturers.

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Stage: Advanced Level 2

Subject Title: A2.2 Strategic Performance Management

Aim

The aim of this subject is to ensure that students have the ability to conduct a critical, strategic analysis of unfamiliar business situations. This includes the ability to select, integrate and apply the appropriate techniques and approaches in order to identify problems, opportunities, and recommended strategies in specific situations.

Strategic Performance Management as an Integral Part of the Syllabus

This subject builds on the technical knowledge of Managerial Finance, Management Accounting, and other disciplines acquired in the earlier examination stages. Strategic Performance Management requires students to integrate and expand that knowledge so as to provide a framework for strategic analysis of business issues.

Learning Outcomes

On successful completion of this subject students should be able to:

- Select, integrate, and apply strategic performance management techniques which are appropriate to the particular context of specific (but novel and possibly unstructured) business situations described in a case study, through the application of critical strategic thinking, appropriate professional scepticism and ethical judgement.

- Justify a portfolio of strategic performance management techniques selected by reference to the particular illustrative context of a case study situation (and not merely by repetition of abstract or textbook knowledge) and:

  – Predict the strategic advantages for the organisation of applying the proposed techniques in the particular situation;

  – Predict any possible adverse side-effects and propose means of minimising such effects.

- Critically evaluate existing and proposed strategic performance management structures as described in a particular case study, and:

  - Construct an improved set of strategic performance management structures which builds on any identified strengths of existing structures while implementing any new structures identified as necessary;

  - Justify the improved set of strategic performance management structures in its totality (as opposed to justifying only specific elements in a disconnected fashion).

- Assess the likely effects of existing and proposed strategic performance management structures on intra-organisational behaviours, work practices, and group norms (in the context of the business situation of an entity described in a case study) and:

  - Propose means of ameliorating any adverse effects.

  - Propose means of maximising the extent and strategic advantage of any favourable effects.

- Evaluate the implications for particular organisations' strategic performance management systems of emerging developments in the fields of information technology (including e-commerce), business process re-engineering, benchmarking, and corporate governance and propose changes to the strategic performance management systems of a specific organisation described in a case study in the light of such emerging developments.

Syllabus:

1) Advanced Decision-Making

- Pricing decisions (including strategic considerations, revenue management, profit maximisation, services pricing, and product bundling).

- Target costing & Lifecycle costing.

- Product & segment profitability analysis.

- Customer profitability analysis.

- Theory of constraints, throughput and back-flush accounting.

- Activity-based analysis for decision-making.

- Measuring and managing uncertainty,risk (including risk appraisal, expected values, maximax / maximin and sensitivity analysis).

- Decision making with multiple limiting factors including the formulation of problems and interpretation of results using linear programming and the simplex algorithm).

- Assessment of mutually exclusive projects, projects with unequal lives.

2) Planning and Control

- The purpose of budgetary control systems.

- Alternative approaches to budgeting (including incremental budgeting, zero-based budgeting, activity-based budgeting, rolling budgets, and 'beyond budgeting' approaches).

- Budgetary control of engineered, committed, and discretionary costs.

- Advanced variance analysis (including sales mix & yield; materials mix & yield; planning & operational; market size & market share).

- Critical appraisal of standard costing and variance analysis in modern manufacturing environments.

- Advantages and disadvantages of forecasting techniques including: time series, trend analysis, smoothing techniques and seasonal variances.

3) Performance Evaluation

- Divisional profitability: Return on investment and residual income.

- The distinction between economic and managerial performance evaluation.

- Economic value added ®.

- Value-based management.

- Transfer pricing (including Cost-plus, Market, Negotiated & Dual prices).

- Interaction of transfer pricing and taxation.

4) Performance Measurement Systems

- Mission statements, objectives, strategies and goals.

- Performance measurement in modern manufacturing environments (including JIT, TQM, world class manufacturing, and supply chain management issues).

- Scenario planning (what if analysis).

- Alternative competitive strategies.

- Monitoring of the external environment (including competitor accounting).

- Financial and non-financial performance measurement.
- Performance measurement models, including the balanced scorecard.
- Incentive schemes.

5) Current Developments in Strategic Performance Management

- Benchmarking.
- Impact of developments in information technology and ecommerce.
- Business process re-engineering.
- Corporate governance.

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STUDY UNIT 1

Activity Based Costing

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EXAM GUIDE

Activity Based Costing ABC was regularly examined in the professional 1 Strategic Management Accounting paper and is an important topic on this paper also.

ACTIVITY BASED COSTING

An alternative to absorption costing is activity based costing (ABC).

ABC involves the identification of the factors (drivers) which cause the costs of an organisation's major activities. Support overheads are charged to products on the basis of their usage of an activity.

- For costs that vary with production level in the short term, the cost driver will be volume related (labour or machine hours).
- Overheads that vary with some other activity (and not volume of production) should be traced to products using transaction-based cost drivers such as production runs or number of orders received.

Reasons for the development of ABC

The traditional cost accumulation system of **absorption costing** was developed in a time when most organisations produced only a **narrow range of products** (so that products underwent **similar operations** and consumed **similar proportions of overheads**). And **overhead costs were only a very small fraction of total costs**, direct labour and direct material costs accounting for the largest proportion of the costs. The **benefits** of more accurate systems for **overhead allocation** would probably have been relatively **small.** In addition, **information processing costs were high.**

In recent years, however, there has been a **dramatic fall** in the costs of processing information**.** And**,** with the advent of **advanced manufacturing technology (AMT) and in a production environment which uses machines such as computer controlled equipment (lathes, drilling machines and hoists etc.) and computers in general**, direct labour may account for as little as 5% of a product's cost. It therefore now appears difficult to justify the use of direct labour or direct material as the basis for absorbing overheads or to believe that errors made in attributing overheads will not be significant.

Many resources are used in **non-volume related support activities**, (which have increased due to AMT) such as setting-up, production scheduling, inspection and data processing, not to mention finance, marketing and personnel departments etc. These support activities assist the efficient manufacture of a wide range of products and are **not, in general, affected by changes in production volume**. They tend to **vary in the long term according to the range and complexity** of the products manufactured rather than the volume of output.

The wider the range and the more complex the products, the more support services will be required. Consider, for example, factory X which produces 10,000 units of one product, the Alpha, and factory Y which produces 1,000 units each of ten slightly different versions of the Alpha. Support activity costs in the factory Y are likely to be a lot higher than in factory X but the factories produce an identical number of units. For example, factory X will only need to set-up once whereas Factory Y will have to set-up the production run at least ten times for the ten different products. Factory Y will therefore incur more set-up costs for the same volume of production.

Traditional costing systems, which assume that all products consume all resources in proportion to their production volumes, tend to **allocate too great a proportion of overheads to high volume products** (which cause relatively little diversity and hence use fewer support services) and **too small a proportion of overheads to low volume products** (which cause greater diversity and therefore use more support services). Activity based costing (ABC) attempts to overcome this problem.

Definition of ABC

Activity based costing (ABC) involves the identification of the factors which cause the costs of an organisation's major activities. Support overheads are charged to products on the basis of their usage of the factor causing the overheads.

The major ideas behind activity based costing are as follows.

a) **Activities cause costs.** Activities include ordering, materials handling, machining, assembly, production scheduling and despatching.
b) **Producing products creates demand for the activities.**
c) Costs are assigned to a product **on the basis of the product's consumption of the activities.**

Outline of an ABC system

An ABC system operates as follows.

Step 1 Identify an organisation's major activities.

Step 2 Identify the factors which determine the size of the costs of an activity/cause the costs of an activity. These are known as **cost drivers.**

A **cost driver** is a factor which causes a change in the cost of an activity.

Look at the following examples.

Costs	**Possible cost driver**
Ordering costs	Number of orders
Materials handling costs	Number of production runs
Production scheduling costs	Number of production runs
Despatching costs	Number of despatches

Step 3 Collect the costs associated with each cost driver into what are known as **cost pools**.

Step 4 Charge costs to products on the basis of their usage of the activity. A product's usage of an activity is measured by the number of the activity's cost driver it generates.

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ABSORPTION COSTING VERSUS ABC

The following example illustrates the point that traditional cost accounting techniques result in a misleading and inequitable division of costs between low-volume and high-volume products, and that ABC can provide a more meaningful allocation of costs.

Example: Activity based costing

Suppose that Coolplan manufactures four products, W, X, Y and Z. Output and cost data for the period just ended are as follows:

	Output units	*Number of production runs in the period*	*Material cost per unit*	*Direct labour hours per unit*	*Machine hours per unit*
				2	
W	10	2	20.00	2	1
X	10	2	80.00	6	3
Y	100	5	20.00	2	1
Z	100	5	80.00	6	3
	220	14	200	16	8

Direct labour cost per hour	RWF 5
Overhead costs	RWF
Short run variable costs	3,080
Set-up costs	10,920
Expediting and scheduling costs	9,100
Materials handling costs	7,700
	30,800

Required

Prepare unit costs for each product using conventional costing and ABC.

Solution

Using a **conventional absorption costing approach** and an absorption rate for overheads based on either direct labour hours or machine hours, the product costs would be as follows.

	W	X	Y	Z	Total
	RWF '000	RWF '000	RWF '000	RWF '000	
Direct material	200	800	2,000	8,000	11,000
Direct labour	20	60	200	600	880
Overheads *	700	2,100	7,000	21,000	30,800
	920	2,960	9,200	29,600	42,680
Units produced	10	10	100	100	
Cost per unit	92	296	92	296	

* RWF30,800,000 ÷ 440 hours = RWF70,000 per machine hour.

Using **activity based costing** and assuming that the number of production runs is the cost driver for set-up costs, expediting and scheduling costs and materials handling costs and that machine hours are the cost driver for short-run variable costs, unit costs would be as follows.

	Output units	*Number of production runs in the period*	*Material cost RWF '000 per unit*	*Direct labour hours per unit*	*Machine hours per unit*
W	10	2	20	2	1
X	10	2	80	6	3
Y	100	5	20	2	1
Z	100	5	80	6	3
	220	14	200		

Workings

Workings	Overheads	RWF '000			
1	3,080	440	M/c hours	7	per machine hour
2	10,920	14	Runs	780	per run
3	9,100	14	Runs	650	per run
4	7,700	14	Runs	550	per run

Summary

Product	*Conventional costing unit cost* RWF '000	*ABC unit cost* RWF '000	*Difference per unit* RWF '000	*Difference in total* RWF '000
W	92	425	333	3,330
X	296	503	207	2,070
Y	92	128	36	3,600
Z	296	206	-90	-9,000
				0

The figures suggest that the traditional volume-based absorption costing system is flawed.

a) It **under-allocates overhead costs to low-volume products** (here, W and X) and **over-allocates overheads to higher-volume products** (here Z in particular).

b) It **under-allocates overhead costs to smaller-sized products** (here W and Y with just one hour of work needed per unit) and **over allocates overheads to larger products** (here X and particularly Z).

ABC versus traditional costing methods

Both traditional absorption costing and ABC systems adopt the two stage allocation process.

Allocation of overheads

ABC establishes separate cost pools for support activities such as despatching. As the costs of these activities are assigned directly to products through cost driver rates, reapportionment of service department costs is avoided.

Absorption of overheads

The principal difference between the two systems is the way in which overheads are absorbed into products.

a) Absorption costing most commonly uses two **absorption bases** (labour hours and/or machine hours) to charge overheads to products.
b) ABC uses many **cost drivers** as absorption bases (eg number of orders or despatches).

Absorption rates under ABC should therefore be more closely linked to the causes of overhead costs.

Cost drivers

The principal idea of ABC is to focus attention on **what causes costs to increase,** i.e. the cost drivers.

a) The **costs that vary with production volume**, such as power costs, should be traced to products using production **volume-related cost drivers**, such as direct labour hours or direct machine hours.

   Overheads which do not vary with output but **with some other activity** should be traced to products using **transaction-based cost drivers**, such as number of production runs and number of orders received.

b) Traditional costing systems allow overheads to be related to products in rather more arbitrary ways producing, it is claimed, less accurate product costs.

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MERITS AND CRITICISMS OF ABC

ABC has both advantages and disadvantages, and tends to be more widely used by larger organisations and the service sector.

As you will have discovered when you attempted the question above, there is nothing difficult about ABC. Once the necessary information has been obtained it is similar to traditional absorption costing. This simplicity is part of its appeal. Further merits of ABC are as follows.

a) The **complexity of manufacturing has increased**, with wider product ranges, shorter product life cycles and more complex production processes. **ABC recognises this complexity with its multiple cost drivers.**

b) In a more competitive environment, companies must be able to assess product profitability realistically. **ABC facilitates a good understanding of what drives overhead costs**.

c) In modern manufacturing systems, overhead functions include a lot of non-factory-floor activities such as product design, quality control, production planning and customer services. **ABC is concerned with all overhead costs** and so it takes management accounting beyond its 'traditional' factory floor boundaries.

d) ABC is particularly useful for service industries where an individual member of staff may be involved in transactions which concern different “product” or service lines each day e.g. a bank teller who may receive cash to deposit, deal with a credit card, or sell an insurance policy.

Criticisms of ABC

It has been suggested by critics that **activity based costing has some serious flaws**.

a) Some measure of (arbitrary) cost apportionment may still be required at the cost pooling stage for items like rent, rates and building depreciation.

b) Can a single cost driver explain the cost behaviour of all items in its associated pool?

c) Unless costs are caused by an activity that is measurable in quantitative terms and which can be related to production output or a service activity, cost drivers are not easily usable. What drives the cost of the annual external audit, for example?

d) ABC is sometimes introduced because it is fashionable, not because it will be used by management to provide meaningful product costs or extra information. If management is not going to use ABC information, an absorption costing system may be simpler and therefore more cost-effective to operate.

e) The cost of implementing and maintaining an ABC system can exceed the benefits of improved accuracy.

f) **Implementing** ABC is often problematic.

g) The calculations can be iterative, such as apportioning HR dept. costs to IT when IT costs are also apportioned to production and to HR Department

IMPLICATIONS OF SWITCHING TO ABC

Switching to ABC has implications for pricing, sales strategy, performance management and decision making.

Switching to ABC is often problematic. Recent journal articles have highlighted the following issues.

a) The incorrect belief that ABC can solve all an organisation's problems
b) Lack of the correct type of data
c) Difficulty in determining appropriate cost drivers

'World-wide adoption rates for ABC have peaked at 20 per cent and a declining number of firms is giving it further consideration.' (Tom Kennedy, *Financial Management*, May 2000). Recent UK studies have found ABC usage rates of about 25%, with larger organisations and service sector companies being most likely to use it.

Pricing

An ABC system gives management a good understanding of the cost structures of making and selling a wide range of products. Switching to ABC can change **cost per unit calculations** substantially. If an organisation determines prices based on cost i.e. using **cost-plus pricing**, greater costing information will be very useful and prices will change.

Many organisations however price their products according to what the market will bear, so if costs are re-calculated, it is the **profit margin** for a product that will change rather than its price.

Consider a business that produces a **large volume** standard product and a number of **variants** which are more refined versions of the basic product and sell in low volumes at a higher price. Such companies are common in practice in the modern business environment. In practice, also, such companies absorb fixed overheads on a conventional basis such as direct labour hours, and price their products by adding a mark up to full cost.

In the situation described, the **majority of the overheads** would be allocated to the **standard** range, and only a small percentage to the up-market products. The result would be that the profit margin achieved on the standard range would be much lower than that on the up-market range.

Thus the traditional costing and pricing system indicates that the firm might be wise to concentrate on its high margin, up-market products and drop its standard range. This is **absurd**, however. Much of the overhead cost incurred in such an organisation is the cost of **support activities** like production scheduling: the more different **varieties** of product there are, the **higher** the level of such activities will become. The cost of marketing and distribution also increases disproportionately to the volume of products being made.

The bulk of the overheads in such an organisation are actually the '**costs of complexity**'. Their arbitrary allocation on the basis of labour hours gives an entirely **distorted** view of production line profitability; many products that appear to be highly profitable actually make a loss if costs are allocated on the basis of what activities cause them.

The problem arises with **marginal cost-plus** approaches as well as with absorption cost based approaches, particularly in a modern manufacturing environment, where a relatively small proportion of the total cost is variable. The implication in both cases is that conventional costing should be abandoned in favour of ABC.

Case Study

In a survey reported in *Accountancy Age* ('The price is right… or is it?', June 2002), it was found that 'For many companies, pricing decisions are a “seat-of-the-pants” affair. There is generally low take-up of the analytical tools and techniques an accountant would expect to use in making financial decisions. The most extensively used technique was 'face to face' research.' ABC was in third place, after competitive analysis but before breakeven analysis.

The survey also found that the leaders [most successful companies in the survey at using price management to achieve business objectives] …"focus on customer segments, differentiate products to serve them, pay attention to quality and deliver on customer care. This costs money but they see it as a way of reducing unit cost and delivering the economies of scale which lead to competitive prices and market leadership'.

Significantly too, the leaders are more likely to use realistic cost allocation methodologies, such as activity-based costing, when they take pricing decisions. Some 62% of leaders ranked this either 'very important' or 'important' compared with just 23% of laggards.

'Confident – and profitable – pricing depends on knowing direct and indirect costs attributable to a particular product or service … It's not surprising leader companies take better pricing decisions when they are more likely to have this information at their fingertips.'

Sales strategy

As we have seen, the introduction of ABC has implications for the cost per unit, price and profit margin. For example, a product with few set-ups, material movements or inspections will have lower costs under ABC than traditional absorption costing. The organisation could decide to reduce the product's selling price but if it is a **high volume** product, the number of units sold may not increase sufficiently to compensate for the loss in total revenue and contribution.

ABC may result in a change in **profit margins**, with previously high margin products now being seen as less profitable. This can result in increased sales efforts on different products, especially if the sales department is rewarded on the basis of profits.

Performance management

The information provided by analysing activities can support performance management provided it is used carefully and with full appreciation of its implications.

Planning

Before an ABC system can be implemented, management must analyse the organisation's activities, determine the extent of their occurrence and establish the relationships between activities, products/services and their cost.

The **information database** produced from such an exercise can then be **used as a basis for forward planning and budgeting**. For example, once an organisation has set its budgeted production level, the database can be used to determine the number of times that particular activities will need to be carried out, thereby establishing necessary departmental staffing and machine levels. Financial budgets can then be drawn up by multiplying the budgeted activity levels by cost per activity.

This activity-based approach may not produce the final budget figures but it can **provide the basis for different possible planning scenarios**.

Control

The information database also provides an insight into the way in which **costs are structured and incurred in service and support departments**. Traditionally it has been difficult to control the costs of such departments because of the lack of relationship between departmental output levels and departmental cost. With ABC, however, it is possible to control or manage the costs by **managing the activities which underlie them** by monitoring a number of key performance measures.

Decision making

Many of ABC's supporters claim that it can assist with decision making in a number of ways.

- Provides accurate and reliable cost information
- Establishes a long-run product cost
- Provides data which can be used to evaluate different ways of delivering business.

It is therefore particularly suited to the following types of decision.

- Pricing
- Promoting or discontinuing products or parts of the business
- Redesigning products and developing new products or new ways to do business

Note, however, that an ABC cost is **not a true cost**, it is **simply an average cost** because some costs such as depreciation are still arbitrarily allocated to products. An ABC cost is therefore **not a relevant cost** for all decisions.

The traditional cost behaviour patterns of fixed cost and variable cost are felt by advocates of ABC to be **unsuitable** for longer-term decisions, when resources are not fixed and changes in the volume or mix of business can be expected to have an impact on the cost of all resources used, not just short-term variable costs.

ABC attempts to **relate the incidence of costs to the level of activities undertaken**. A **hierarchy of activities** has been suggested.

Type of activities	Costs are dependent on ….	Examples
Unit level	Volume of production	Machine power
Batch level	Number of batches	Set-up costs
Product sustaining	Existence of a product group/line	Product management
Facility sustaining	Organisation simply being in business	Rent and rates

The difference between a unit product cost determined using traditional absorption costing and one determined using ABC will depend on the proportion of overhead cost which falls into each of the categories above.

If most overheads are related to unit level and facility level activities, the costs will be similar.

If the overheads tend to be associated with batch or product level activities they will be significantly different.

Consider the following example.

Example: batch-level activities

XYZ produces a number of products including product D and product E and produces 500 units of each of products D and E every period at a rate of ten of each every hour. The overhead cost is Rwf 500 million and a total of 400,000 direct labour hours are worked on all products. A traditional overhead absorption rate would be Rwf1,250 per direct labour hour and the overhead cost per product would be Rwf125.

Production of D requires five production runs per period, while production of E requires 20. An investigation has revealed that the overhead costs relate mainly to 'batch-level' activities associated with setting-up machinery and handling materials for production runs.

There are 1,000 production runs per period and so overheads could be attributed to XYZ's products at a rate ofRwf 500,000 per run.

- Overhead cost per D = (RWF500,000 × 5 runs)/500 = RWF5,000
- Overhead cost per E = (RWF500,000 × 20 runs)/500 = RWF20,000

These overhead costs are activity based and recognise that overhead costs are incurred due to batch level activities. The fact that E has to be made in frequent small batches, perhaps because it is perishable, means that it uses more resources than D. This is recognised by the ABC overhead costs, not the traditional absorption costing overhead costs.

In the **modern manufacturing environment**, production often takes place in short, discontinuous production runs and a high proportion of product costs are incurred at the design stage. An increasing proportion of **overhead costs** are therefore **incurred at batch or product level**.

Such an analysis of costs gives management an **indication of the decision level at which costs can be influenced**. For example, a decision to reduce production costs will not simply depend on making a general reduction in output volumes: production may need to be organised to reduce **batch** volumes; a **process** may need to be modified or eliminated; **product lines** may need to be merged or cut out; **facility** capacity may need to be altered.

CUSTOMER PROFITABILITY ANALYSIS (CPA)

Customer profitability analysis uses an activity based approach to relate revenues and costs to groups of customers in order to assess their relative profitability.

Traditionally, **management accounting reports** have been analysed on a **product by product** basis. In the **modern business environment**, however, in which it is vital that organisations respond promptly to the demands of customers, **analysis on the basis of customers** can provide vital management information.

Analysing customers

Profitability can vary widely between different customers because various **overhead costs** are, to some extent, **variable and customer driven**.

- Discounts
- Sales force
- Quality control
- Merchandising
- Distribution
- Promotions
- Financing costs
- Enquiries

Suppose a hotel offers a number of services such as a swimming pool, a gym and a nightly dinner dance.

a) Older guests may attend the dinner dance.

b) Families may use the swimming pool.

c) People without children may appreciate the gym.

By charging services to the guests using them, a cost per bed night can be calculated for each guest group. **Strategies for attracting the most profitable guest group** can then be adopted.

Whether individual customers or groups of customers are costed largely depends on the number of customers.

a) A manufacturing company supplying six companies would cost each customer separately.

b) A supermarket or bank would cost groups of similar customers. UK banks divide their customers into categories such as single and 30ish, married with young children, older couples who are pensioners and so on.

Marketing departments should be aiming to **attract and retain profitable customers** but in order to do this they need to **know which customers are profitable** and **how much can be spent on retaining them**. The **costing system** should **provide the necessary answers**. Also, banks know that a young “expnsive” customer may well become middle-aged and more profitable.

Customer profitability analysis (CPA) is 'the analysis of the revenue streams and service costs associated with specific customers or customer groups'.

Customer profitability analysis (CPA) provides important information which allows an organisation to determine both **which classes of customers it should concentrate on** and the **prices it should charge for customer services**. Its use ensures that those customers **contributing sizeably to the profitability** of the organisation receive a **comparable amount of attention** from the organisation.

Customer revenues

Customer revenues are cash flows from customers. They are influenced by different factors, mainly **allowances and discounts**.

a) Some types of customer **store and distribute goods** (e.g. wholesalers) or **promote** the goods in return for an **allowance**.

b) By giving a **discount** a company may **encourage bulk orders**, which may be cheaper to provide and may result in higher sales volume. Studies on customer profitability have found large price discounting to be a key explanation for a group of customers being below expected profitability, however. Sales representatives may have given customers large price discounts unrelated to their current or potential value to the company, perhaps to meet bonuses dependent on sales volumes. Two customers may be purchasing the same volumes but the price discount given to one may make it unprofitable, while the other is profitable.

Case Study

The USA company *General Electric*, which manufactures and sells refrigerators and so on, used to give substantial discounts to customers who placed large orders. This did not result in customers buying more products. Instead GE's sales orders bunched in particular weeks of the year. In turn this led to an uneven production and distribution flow, which increased costs. The company found that, by removing the discounts while at the same time guaranteeing swift delivery, order size decreased and profits increased.

Customer costs and ABC

The creation of cost pools for activities in **ABC** systems allows organisations to arrange costs in a variety of different ways. Because different customers use different amounts of activities, it is possible to **build up costs for individual customers or groups of customers** on an activity basis so that their **relative profitability** can be assessed.

Examples of the build up of customer costs using an activity based system

Activity	Cost driver
Order taking	Number of orders taken
Sales visits	Number of sales visits
Emergency orders	Number of rushed orders
Delivery	Miles travelled

Case Study

Drury cites the case of Kanthal, a Swedish company in the Sandvik Group that sells electric heating elements. Customer-related selling costs represented 34% of total costs. In the past Kanthal had allocated these costs on the basis of sales value when customer profitability studies were carried out. The company then introduced an ABC system in order to determine the resources consumed by different customers.

An investigation identified two cost drivers for the resources used to service different customers.

a) **Number of orders placed.** Each order had a large fixed cost, which did not vary with the number of items ordered. A customer ordering 10 items 100 times cost more to service than a customer placing a single order for 1,000 items.
b) **Non-standard production items.** These cost more to manufacture than standard items.

A cost per order and the cost of handling standard and non-standard items were calculated and a CPA carried out on the basis of the previous year's sales. The analysis showed that only 40% of customers were profitable, and a further 10% lost 120% of the profits. In other words, 10% of customers incurred losses equal to 120% of Kanthal's total profits. Two of the most unprofitable customers were actually in the top three in terms of total sales volume but made many small orders of non-standard items.

Unprofitable customers identified by CPA should be persuaded to **alter their buying behaviour** so they become profitable customers. In the Kanthal example above, unprofitable customers should be discouraged from placing lots of small orders and/or from buying non-standard products.

The **activity based approach** also **highlights where cost reduction efforts should be focused**. Kanthal should concentrate on reducing ordering cost and the cost of handling non-standard items.

Activity-based CPA allows an organisation to adopt a more **market-orientated approach** to management accounting.

Customer profitability statement

There is no set format, but it would normally be similar to the one below. Note that financing costs have been included.

	RWFm	RWF m
Revenue at list prices		100
Less: discounts given		8
Net revenue		92
Less: cost of goods sold		50
Gross margin		42
Less: customer specific costs (such as those listed above)	28	
financing costs:		
credit period	3	
customer specific inventory	2	
		33
Net margin from customer		9

Example

Seth supplies shoes to N and to K. Each pair of shoes has a list price of Rwf50,000 and costs Seth Rwf25,000. As K buys in bulk it receives a 10% trade discount for every order for 100 pairs of shoes or more. N receives a 15% discount irrespective of order size, because that company collects the shoes, thereby saving Seth any distribution costs. The cost of administering each order is Rwf50,000 and the distribution cost is Rwf1,000,000 per order. N makes 10 orders in the year, totalling 420 pairs of shoes, and K places 5 orders for 100 pairs.

Required: **Fill in the blank in the sentence below**.

The most profitable customer for Seth is …………… .

Answer

The correct answer is N.

It can be shown that Seth earns more from supplying Narayan, despite the larger discount percentage.

	K	*N*
	RWF '000	RWF '000
Revenue	25,000	21,000
Less: discount	2,500	3,150
Net revenue	22,500	17,850
Less: cost of shoes	(12,500)	(10,500)
customer transport cost	(5,000)	–
customer administration cost	(250)	(500)
Net gain	4,750	6,850

The difference on a unit basis is considerable.

Number of pair of shoes sold	500	420
Net gain per pair of shoes sold	RWF9,500	RWF16,310
Net gain per RWF 1,000 of sales revenue	RWF190	RWF 326

Costing customers

Not all customers cost the same to serve even if they require the same products. A customer will cost more to serve if based a long way from the factory (delivery costs increase), or places rush orders (production scheduling is interrupted, special transport is required), or requires a high level of after-sales service and technical assistance.

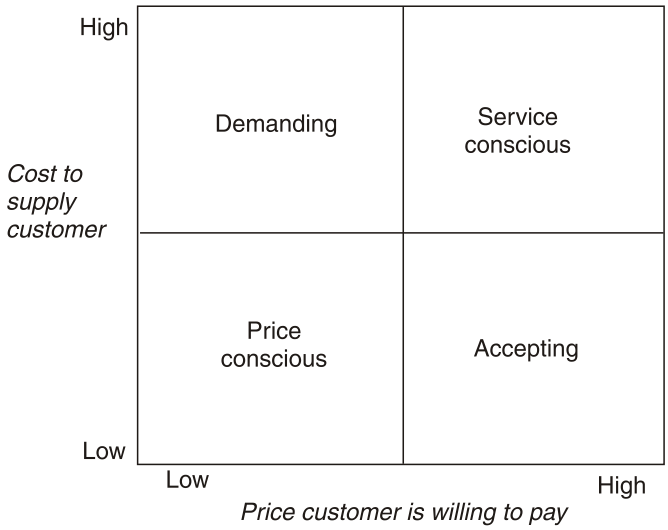
In order to analyse different customers it may therefore be useful to review **non-financial data**.

	Customer		
	X	*Y*	*Z*
Number of purchase orders	10	20	30
Number of sales visits	5	5	5
Number of deliveries	15	20	55
Distance per delivery	50	20	70
Number of emergency orders	1	0	4

Customer Y may be the cheapest to serve because of the number of deliveries per order, the lower distance travelled and the lack of emergency orders.

Categorising customers

It is not possible to 'cost' future dealings with customers accurately because the number and size of orders and rush orders is likely to be unpredictable. It is, however, possible to gain a broad idea of the amount of profit that can be expected from a particular category of customer. Customers can be categorised in the following grid.



The aim is to **attract as many accepting customers as possible**. Such customers will have a low 'cost to supply' perhaps because they are located close by or do not place rush orders, and are prepared to accept a high price. **Many large retail organisations fall into the demanding category** because they expect the supplier to deal with rush orders, change production methods to suit them and so on. It is undesirable for a **small supplier to be tied to a large demanding customer** who has the power to threaten the withdrawal of its custom if the supplier does not acquiesce.

Alternatively, customers can be analysed using **decision grid analysis (DGA)**, as illustrated in the following diagram.

Positive contribution as a % of sales

Low volume	POTENTIAL	WINNERS	High volume
	LOSERS	PROBLEM	

Negative contribution as a % of sales

Customers and life cycle costing

Customers can also be **costed over their expected 'life cycle'** and the expected future cash flows relating to the customer may be discounted. It is rarely possible to predict accurately the life cycle of a particular customer unless contracts are awarded for a specific time period. Nevertheless the information is valuable as **the longer the customer remains with the organisation** the **more profitable** the customer becomes. This is valuable information and may show the **importance of creating and retaining loyal customers**.

CHAPTER ROUNDUP

- An alternative to absorption costing is activity based costing (ABC).
  ABC involves the identification of the factors (cost drivers) which cause the costs of an organisation's major activities. Support overheads are charged to products on the basis of their usage of an activity.

  - For costs that vary with production level in the short term, the cost driver will be volume related (labour or machine hours).
  - Overheads that vary with some other activity (and not volume of production) should be traced to products using transaction-based cost drivers such as production runs or number of orders received.

- ABC has both advantages and disadvantages, and tends to be more widely used by larger organisations and the service sector.

- Switching to ABC has implications for pricing, sales strategy, performance management and decision making.

STUDY UNIT 2

Pricing Decisions

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DEMAND

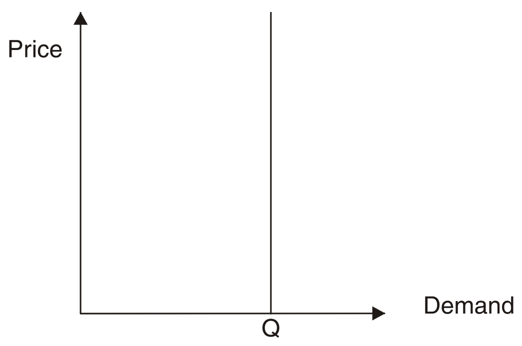
In the first sections of this chapter you will be learning about the many issues that need to be considered in decisions about the price which can be charged for a product or service. The first issues relate to demand.

Issue 1: the relationship between price and demand

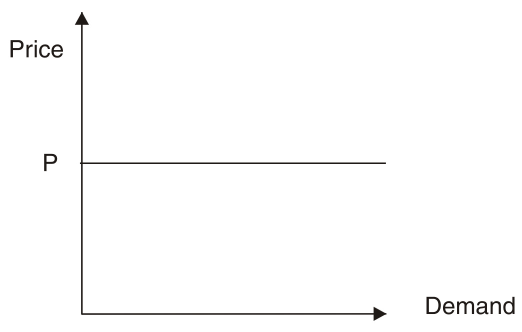
Demand is normally **elastic** because demand will increase as prices are lowered.

There are two extremes in the relationship between price and demand. A supplier can either **sell a certain quantity, Q, at any price** (as in graph (a)). Demand is totally unresponsive to changes in price and is said to be **completely inelastic**. Alternatively, **demand might be limitless at a certain price** P (as in graph (b)), but there would be no demand above price P and there would be little point in dropping the price below P. In such circumstances demand is said to be **completely elastic**.

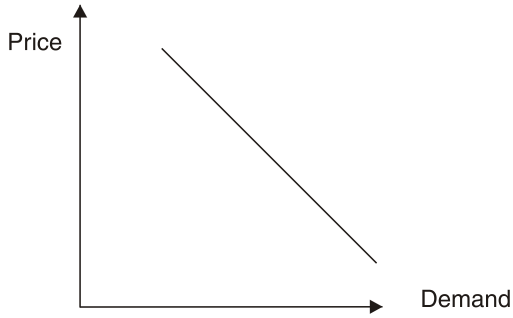
(a)



(b)



A more **normal situation** is shown below. The **downward-sloping** demand curve shows the inverse relationship between unit selling price and sales volume. As one rises, the other falls. Demand is **elastic** because demand will increase as prices are lowered.



Price elasticity of demand (η)

Price elasticity of demand is a measure of the extent of change in market demand for a good in response to a change in its price.

Price elasticity of demand (η), which is a measure of the extent of change in market demand for a good in response to a change in its price, is measured as:

$$\frac{\text{The change in quantity demanded, as a \% of demand}}{\text{The change in price, as a \% of the price}}$$

Since the demand goes up when the price falls, and goes down when the price rises, the elasticity has a negative value, but it is usual to ignore the minus sign.

Example: price elasticity of demand

The price of a good is RWF1,200 per unit and annual demand is 800,000 units. Market research indicates that an increase in price of RWF100 per unit will result in a fall in annual demand of 75,000 units. What is the price elasticity of demand?

Solution

Annual demand at RWF1,200 per unit is 800,000 units.

Annual demand at RWF1,300 per unit is 725,000 units.

% change in demand	=	(75,000/800,000) × 100% = 9.375%
% change in price	=	(100/1,200) × 100% = 8.333%
Price elasticity of demand	=	(–9.375/8.333) = –1.125

Ignoring the minus sign, price elasticity is 1.125.

The demand for this good, at a price of Rwf1,200 per unit, would be referred to as **elastic** because the **price elasticity of demand is greater than 1**.

Elastic and inelastic demand

The value of demand elasticity may be anything from zero to infinity.

Demand is referred to as **inelastic** if the absolute value is less than 1 and **elastic** if the absolute value is greater than 1.

Think about what this means.

a) Where demand is inelastic, the quantity demanded falls by a smaller percentage than the percentage increase in price.
b) Where demand is elastic, demand falls by a larger percentage than the percentage rise in price.

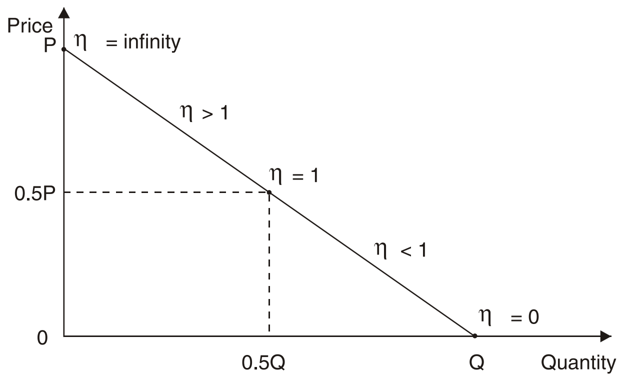
If **demand** is **elastic**, a reduction in price would lead to a rise in total sales revenue. If **demand** is **inelastic**, a reduction in price would lead to a fall in total sales revenue.

Price elasticity and the slope of the demand curve

Generally, **demand curves slope downwards**. Consumers are willing to buy more at lower prices than at higher prices. In general, **elasticity** will **vary** in value **along the length of a demand curve**.

a) If a downward sloping demand curve becomes **steeper** over a particular range of quantity, then demand is becoming **more inelastic**.
b) A **shallower** demand curve over a particular range indicates **more elastic** demand.

The ranges of price elasticity at different points on a downward sloping straight line demand curve are illustrated in the diagram below.



a) At **higher prices** on a straight line demand curve (the **top** of the demand curve), **small percentage price reductions** can bring **large percentage increases in quantity** demanded. This means that **demand is elastic** over these ranges, and **price reductions** bring **increases in total expenditure** by consumers on the commodity in question.

b) At **lower prices** on a straight line demand curve (the **bottom** of the demand curve), **large percentage price reductions** can bring **small percentage increases in quantity**. This means that **demand is inelastic** over these price ranges, and **price increases** result in **increases in total expenditure**.

Two special values of price elasticity

a) **Demand is perfectly inelastic (η = 0)**. There is **no change in quantity** demanded, **regardless of the change in price**. The demand curve is **a vertical straight line** (as in graph (a) in Issue 1).

b) **Perfectly elastic demand ($\eta = \infty$)**. Consumers will want to **buy an infinite amount**, but **only up to a particular price level**. Any price increase above this level will reduce demand to zero. The demand curve is a **horizontal straight line** (as in graph (b) in Issue 1).

Elasticity and the pricing decision

In practice, organisations will have only a rough idea of the shape of their demand curve: there will only be a limited amount of data about quantities sold at certain prices over a period of time *and*, of course, factors other than price might affect demand. Because any conclusions drawn from such data can only give an indication of likely future behaviour, management skill and expertise are also needed. Despite this limitation, an **awareness of the concept of elasticity can assist management with pricing decisions**.

(a) (i) With **inelastic demand**, **increase prices** because revenues will increase and total costs will reduce (because quantities sold will reduce).

(ii) With **elastic demand**, increases in prices will bring decreases in revenue and decreases in price will bring increases in revenue. Management therefore have to **decide** whether the **increase/decrease in costs will be less than/greater than the increases/decreases in revenue**.

(b) In situations of **very elastic demand**, overpricing can lead to massive drops in quantity sold and hence profits, whereas under-pricing can lead to costly inventory outs and, again, a significant drop in profits. **Elasticity must therefore be reduced by creating**

a customer preference which is unrelated to price (through advertising and promotion).

(c) In situations of **very inelastic demand**, customers are **not sensitive to price**. **Quality, service**, **product mix and location** are therefore **more important** to a firm's pricing strategy.

(d) In practice, the **prices** of many products, such as consumer durables, need to **fall** over time if demand is to rise. **Costs** must therefore **fall by the same percentage to maintain margins**.

Determining factors

Factors that determine the degree of elasticity	Detail
The price of the good	
The price of other goods	For two types of good the market demand is interconnected. a) **Substitutes**, so that an increase in demand for one version of a good is likely to cause a decrease in demand for others. Examples include rival brands of the same commodity (like *Coca-Cola* and *Pepsi-Cola*). b) **Complements**, so that an increase in demand for one is likely to cause an increase in demand for the other (e.g. cups and saucers).
Income	A rise in income gives households more to spend and they will want to buy more goods. However this phenomenon does not affect all goods in the same way. a) Normal goods are those for which a rise in income increases the demand. b) Inferior goods are those for which demand falls as income rises, such as cheaper juice or beer. c) For some goods demand rises up to a certain point and then remains unchanged, because there is a limit to which consumers can or want to consume. Examples are basic foodstuffs such as salt and cassava.
Tastes and fashions	A change in fashion will alter the demand for a good, or a particular variety of a good. Changes in taste may stem from psychological, social or economic causes. There is an argument

Factors that determine the degree of elasticity	Detail
	that tastes and fashions are created by the producers of products and services. There is undeniably some truth in this, but the modern focus on responding to customers' needs and wants suggests otherwise.
Expectations	Where consumers believe that prices will rise or that shortages will occur they will attempt to inventory up on the product, thereby creating excess demand in the short term.
Obsolescence	Many products and services have to be replaced periodically. a) Physical goods are literally 'consumed'. Carpets become threadbare, glasses get broken, foodstuffs get eaten, children grow out of clothes. b) Technological developments render some goods obsolete. Manual office equipment has been largely replaced by electronic equipment, because it does a better job, more quickly, quietly, efficiently and effectively. c) Software programmes become “overtaken” by new innovations. Operations systems viz. Windows 7 has replaced previous systems
Size of the market	The larger the market, the more inelastic the demand for the product in broad terms. For example, the demand for bread is relatively inelastic, whereas that the more expensive cuts of beef may be more elastic.
Necessities	Demand for basic items such as rice toilet rolls and cassava/manihot is, on the whole, price inelastic.

Issue 2: demand and the market

Economic theory suggests that the volume of **demand** for a good in **the market as a whole** is influenced by a variety of variables.

- The price of the good
- The price of other goods
- Expectations
- Obsolescence
- Tastes and fashion
- The perceived quality of the product
- The size and distribution of household income

Issue 3: demand and the individual firm

The **volume of demand for one organisation's goods rather than another's** is influenced by three principal factors: product life cycle, quality and marketing.

Product life cycle

Product life cycle is 'The period which begins with the initial product specification, and ends with the withdrawal from the market of both the product and its support. It is characterised by defined stages including research, development, introduction, maturity, decline and abandonment.'
(CIMA *Official Terminology*)

Most products pass through the following phases.

Phase	Description
Introduction	The product is introduced to the market. Heavy capital expenditure will be incurred on product development and perhaps also on the purchase of new non-current assets and building up inventory for sale. On its introduction to the market, the product will begin to earn some revenue, but initially demand is likely to be small. Potential customers will be unaware of the product or service, and the organisation may have to spend further on advertising to bring the product or service to the attention of the market.
Growth	The product gains a bigger market as demand builds up. Sales revenues increase and the product begins to make a profit. The initial costs of the investment in the new product are gradually recovered.
Maturity	Eventually, the growth in demand for the product will slow down and it will enter a period of relative maturity. It will continue to be profitable. The product may be modified or improved, as a means of sustaining its demand.
Saturation and decline	At some stage, the market will have bought enough of the product and it will therefore reach 'saturation point'. Demand will start to fall. For a while, the product will still be profitable in spite of declining sales, but eventually it will become a loss-maker and this is the time when the organisation should decide to stop selling the product or service, and so the product's life cycle should reach its end.

Case Study

During 2001, low cost PC maker Dell had to discount prices heavily to show continual growth despite market saturation.

The life expectancy of a product will influence the pricing decision. **Short-life products** must be quite **highly priced** so as to give the manufacturer a chance to **recover the investment** and **make a worthwhile** return. This is why fashion goods and new high technology goods, for example, tend to be highly priced.

The current tendency is towards shorter product life cycles. Notwithstanding this observation, the **life cycles** of different products may **vary in terms of length of phases, overall length and shape**.

a) Fashion products have a very short life and so do high technology products because they become rapidly out-dated by new fashions and new technological developments.
b) **Different versions of the same product may have different life cycles**, and consumers are often aware of this. For example, the prospective buyer of a new car is more likely to purchase a recently introduced Ford than a Nissan that has been on the market for several years, even if there is nothing to choose in terms of quality and price.

Quality

One firm's product may be perceived to be better quality than another's, and may in some cases actually be so, if it uses sturdier materials, goes faster or does whatever it is meant to do in a 'better' way. Other things being equal, **the better quality good will be more in demand** than other versions.

Marketing

You may be familiar with the 'four Ps' of the marketing mix, all of which influence demand for a firm's goods.

P…	Details
Price	
Product	
Place	This refers to the place where a good can be, or is likely to be, purchased. • If a good is difficult to obtain, potential buyers will turn to substitutes. • Some goods have no more than local appeal.
Promotion	This refers to the various means by which firms draw attention to their products and services. • A good brand name is a strong influence on demand. • Demand can be stimulated by a variety of promotional tools, such as free gifts, money off, shop displays, direct mail and media advertising.

In recent years, **emphasis** has been placed, especially in marketing, on the importance of **non-price factors in demand**. Thus the roles of product quality, promotion, personal selling and distribution and, in overall terms, brands, have grown. While it can be relatively easy for a competitor to copy a price cut, at least in the short term, it is much **more difficult to copy a successful brand image**.

Some larger organisations go to considerable effort to estimate the demand for their products or services at differing price levels; in other words, they produce estimated demand curves. A **knowledge of demand curves can be very useful**: for example, a large transport company such as *KBS* might be considering an increase in bus fares. The effect on total revenues and profit of the fares increase could be estimated from a knowledge of the demand for transport services at different price levels. If an increase in the price per ticket caused a large fall in demand (that is, if demand were price-elastic) total revenues and profits would fall; whereas a fares increase when demand is price-inelastic would boost total revenue and since a transport authority's costs are largely fixed, would probably boost total profits too.

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OTHER ISSUES THAT INFLUENCE PRICING DECISIONS

As well as demand, a **range of other issues influence pricing decisions** including the market in which an organisation operates, competition, quality and price sensitivity.

Issue 4: markets

The price that an organisation can charge for its products will be determined to a greater or lesser degree by the market in which it operates. Here are some familiar terms that might feature as background for a question or that you might want to use in a written answer.

a) **Perfect competition**: many buyers and many sellers all dealing in an identical product. Neither producer nor user has any market power and both must accept the prevailing market price.

b) **Monopoly**: one seller who dominates many buyers. The monopolist can use his market power to set a profit-maximising price.

c) **Monopolistic competition**: a large number of suppliers offer similar, but not identical, products. The similarities ensure elastic demand whereas the slight differences give some monopolistic power to the supplier.

d) **Oligopoly**: where relatively few competitive companies dominate the market. Whilst each large firm has the ability to influence market prices the unpredictable reaction from the other giants makes the final industry price indeterminate. **Cartels** are often formed.

Issue 5: competition

In established industries dominated by a few major firms, it is generally accepted that a price initiative by one firm will be countered by a price reaction by competitors. In these circumstances, prices tend to be fairly **stable**, unless pushed upwards by inflation or strong growth in demand.

If a rival cuts its prices in the expectation of increasing its market share, a firm has several options.

a) It will **maintain its existing prices** if the expectation is that only a small market share would be lost, so that it is more profitable to keep prices at their existing level. Eventually, the rival firm may drop out of the market or be forced to raise its prices.

b) It may **maintain its prices but respond with a non-price counter-attack**. This is a more positive response, because the firm will be securing or justifying its current prices with a product change, advertising, or better back-up services.

c) It may **reduce its prices**. This should protect the firm's market share so that the main beneficiary from the price reduction will be the consumer.

d) It may **raise its prices and respond with a non-price counter-attack**. The extra revenue from the higher prices might be used to finance an advertising campaign or product design changes. A price increase would be based on a campaign to emphasise the quality difference between the firm's own product and the rival's product.

Fighting a price war

Peter Bartram (*Financial Management*, March 2001) suggested a number of ways to fight a price war.

a) **Sell on value, not price,** where value is made up of service, response, variety, knowledge, quality, guarantee and price.

b) **Target service, not product market niches,** to build in the six non-price factors in (a) above.

Case Study

The Marriott hotel chain has chosen to compete in the premium market on service. When guests arrive, instead of queuing at a busy reception, they are met at the front door by a host who gives them their room key.

c) **Use 'package pricing' to attract customers**

Case Study

Computer retailers in Europe and USA such as Time and PC World have beaten discounters by offering peripherals, discounted software and extended warranties as part of their more expensive packages.

a) **Make price comparisons difficult.** Terrestrial and mobile phone companies offer a bewildering variety of rates and discount offers which disguise the core price and make comparisons almost impossible.

b) **Build up key accounts**, as it is cheaper to get more business from an existing customer than to find a new one. Customer profitability analysis, covered in Chapter 16, is important here.

c) **Explore new pricing models.** E-business provides opportunities to use new pricing models.

(i) On-line auctions for a wide range of products are carried out on certain websites.

(ii) Other websites use a 'community shopping' pricing model, where the price of an item falls as more people buy it.

(iii) Marginal cost pricing is used on certain websites to get rid of inventory such as unsold theatre tickets and holidays.

Case Study

The makers of desk-top printers sell printers at a heavily discounted price and make up the "difference" by heavily priced ink cartridges. Coca Cola is experimenting with a vending machine that varies the cost of a can of coke in line with changes in temperature: the hotter the weather, the higher the price.

Other issues

Issue	Explanation/example
Price sensitivity	This will vary amongst purchasers. Those that can pass on the cost of purchases will be the least sensitive and will therefore respond more to other elements of perceived value. For example, the business traveller will be more concerned about the level of service and quality of food in looking for an hotel than price, provided that it fits the corporate budget. In contrast, the family on holiday is likely to be very price sensitive when choosing an overnight stay.
Price perception	This is the way customers react to prices. For example, customers may react to a price increase by buying more. This could be because they expect further price increases to follow (they are 'stocking up'). Some believe that the more expensive an item the better the quality. Some people buy expensive to show off !!
Compatibility with other products	A typical example is operating systems on computers, for which a user would like to have a wide range of compatible software available. For these types of product there is usually a **cumulative effect on demand**. The more people who buy one of the formats, the more choice there is likely to be of software for that format. This in turn is likely to influence future purchasers. The owner of the rights to the preferred format will eventually find little competition and will be able to charge a premium price for the product.
Competitors	An organisation, in setting prices, sends out signals. Competitors are likely to react to these signals in some way. In some industries (such as petrol retailing) pricing moves in unison; in others, price changes by one supplier may initiate a price war, with each supplier undercutting the

Issue	Explanation/example
	others. Competition is discussed in more detail below.
Competition from substitute products	These are products which could be transformed for the same use or which might become desirable to customers at particular price levels. For example, Coffee beans, ground coffee and Instant Coffee: As Instant coffee becomes more expensive, so ordinary ground coffee or even roasted beans become more attractive. One way around this is to sell Instant coffee granules rather than powder.
Suppliers	If an organisation's suppliers notice a price rise for the organisation's products, they may seek a rise in the price for their supplies to the organisation on the grounds that it is now able to pay a higher price.
Inflation	In periods of inflation the organisation may need to change prices to reflect increases in the prices of supplies and so on. Such changes may be needed to keep relative (real) prices unchanged.
Quality	In the absence of other information, customers tend to judge quality by price. Thus a price change may send signals to customers concerning the quality of the product. A price rise may indicate improvements in quality, a price reduction may signal reduced quality, for example through the use of inferior components.
Incomes	In times of rising incomes, price may become a less important marketing variable compared with product quality and convenience of access (distribution). When income levels are falling and/or unemployment levels rising, price will become a much more important marketing variable.
Ethics	Ethical considerations are a further factor, for example whether or not to exploit short-term shortages through higher prices.

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PROFIT MAXIMISATION IN IMPERFECT MARKETS

In imperfect markets there will be an optimum **price/output level** at which profits are maximised.

Some businesses enjoy a **monopoly** position in their market or something akin to a monopoly position, even in a competitive market. This is because they develop a unique marketing mix, for example a unique combination of price and quality, or a monopoly in a localised area.

The significance of a monopoly situation is as follows.

a) The business has choice and flexibility in the prices it sets.
b) Because the business has this freedom of choice in pricing, it will find that at **higher prices** demand for its products or services will be **less**. Conversely, at **lower prices**, demand for its products or services will be **higher**.
c) There will be an **optimum** price/output level at which profits will be maximised.

(Note. Imperfect markets are markets in which price is affected by the amount supplied to the market and/or there is limited demand.)

Case Study

A large public transport organisation might be considering an increase in bus fares fares. The effect on total revenues and profit of the fares increase could be estimated from a knowledge of the demand for transport services at different price levels. If an increase in the price per ticket caused a large fall in demand (that is, if demand were price-elastic) total revenues and profits would fall; whereas a fares increase when demand is price-inelastic would boost total revenue and since a transport organisation's costs are largely fixed, would probably boost total profits too.

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DERIVING THE DEMAND CURVE

The demand curve shows the relationship between the price charged for a product and the subsequent demand for that product.

When demand is linear the **equation for the demand curve is P = a – bQ/ΔQ**

where P = the price

Q = the quantity demanded

a = the price at which demand would be nil

b = the amount by which the price falls for each stepped change in demand

ΔQ = the stepped change in demand

The constant a is calculated as follows.

$$a = \text{current price} + \left(\frac{\text{Current quantity at current price}}{\text{Change in quantity when price is changed by b}} \times b \right)$$

You need to learn these formulae.

This looks rather complicated in words, but it is very easy once the numbers are substituted. **Note that you are not given these formulae in the exam.**

Example: deriving the demand curve

Note the currency values are in thousands of francs(Rwf in this example = Rwf'000)

The current price of a product is Rwf12. At this price the company sells 60 items a month. One month the company decides to raise the price to Rwf14, but only 45 items are sold at this price. Determine the demand equation.

Solution

Step 1 **Find the price at which demand would be nil**

Assuming demand is linear, each increase of RWF2 in the price would result in a fall in demand of 15 units. For demand to be nil, the price needs to rise from its current level by as many times as there are 15 units in 60 units (60/15 = 4) i.e. to RWF12 + (4 × RWF2) = RWF20.

Using the formula above, this can be shown as a = RWF12 + ((60/15) × RWF2)= RWF20

Step 2 **Extract figures from the question**

The **demand equation** can now be determined as P = a – bQ/ΔQ = 20 – 2Q/15

Step 3 **Check your equation**

We can check this by substituting RWF12 and RWF14 for P.

$12 = 20 - (2 \times 60/15) = 20 - 8 = 12$

$14 = 20 - (2 \times 45/15) = 20 - 6 = 14$

The equation can also be re-arranged as $Q = \frac{(a \times \Delta Q) - (\Delta Q \times P)}{b}$

Example: profit maximisation and the demand curve

Maximum demand for JL's product is 10,000 units per annum. Demand will reduce by 100 units for every RWF1,000 increase in the selling price. JL has calculated that the profit-maximising level of sales for the coming year will be 8,000 units.

Required

Calculate the price at which these units will be sold.

Solution

a = $(10{,}000/100 \times \text{RWF}1{,}000)$ = RWF100,000

b = RWF1,000

ΔQ = 100

$\therefore$ P = 100,000 – Q/100,000

Now Q= 8,000

$\therefore$ P = RWF100,000 –(RWF 1,000 X 8,000)/100 = RWF20,000

Alternative approach without using the demand curve formula

When P = 0, demand (Q) = 10,000

When P = 1,000, demand (Q) = 9,900

$\therefore$ Demand (Q) = 10,000 – 100 P, where P is the selling price in RWF'000

(because demand will drop by 100 for every increase (from RWF0) of RWF1,000 in the selling price)

$\therefore$ If Q = 8,000, P = (10,000 – 8,000)/100 = RWF20 thousand

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THE PROFIT-MAXIMISING PRICE/OUTPUT LEVEL

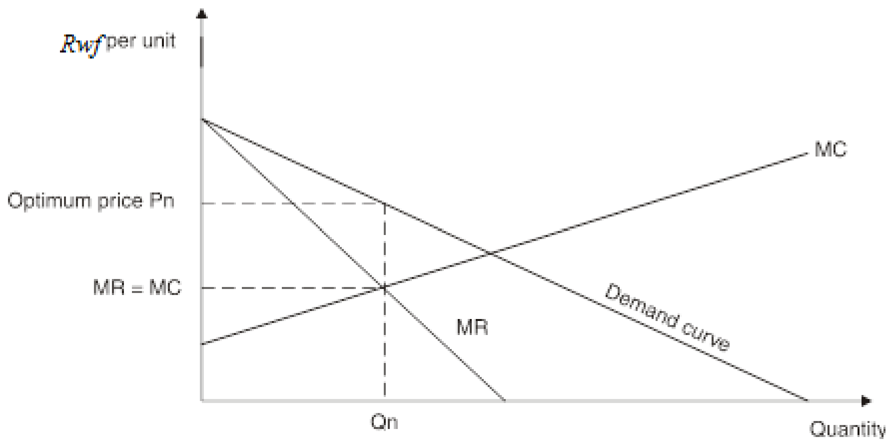
Microeconomic theory and profit maximisation

Microeconomic theory suggests that **as output increases**, the marginal cost per unit might rise (due to the law of diminishing returns) and whenever the firm is faced with a downward sloping demand curve, the **marginal revenue per unit will decline.**

Eventually, a level of output will be reached where the **extra cost** of making one extra unit of output is greater than the **extra revenue** obtained from its sale. It would then be unprofitable to make and sell that extra unit.

Profits will continue to be maximised only up to the output level where marginal cost has risen to be exactly equal to the marginal revenue.

Profits are maximised using marginalism theory when **marginal cost (MC) = marginal revenue (MR).**



Profits are **maximised** at the point where **MC = MR**, ie at a volume of Qn units. If we add a demand curve to the graph, we can see that at an output level of Qn, the sales price per unit would be Pn.

It is important to make a clear **distinction** in your mind between the **sales price** and **marginal revenue**. In this example, the optimum price is Pn, but the marginal revenue is much less. This is because the 'additional' sales **unit** to reach output Qn has only been achieved by reducing the unit sales **price** from an amount higher than Pn for **all** the units to be sold, not just the marginal extra one. The increase in sales volume is therefore partly offset by a reduction in unit price; hence MR is lower than Pn.

Determining the profit-maximising selling price: using equations

The **optimaum selling price** can be determined using equations (i.e. where MC = MR).

You could be **provided with equations for marginal cost and marginal revenue** and/or have to **devise them from information** in the question. By **equating the two equations** you can determine the optimum price. Remember, **marginal cost** is the **extra cost of producing one extra unit**, **marginal revenue** is the **extra revenue from that one extra unit**. **Marginal revenue may not be the same as** the **price** charged for all units up to that demand level, as to increase volumes the price may have to be reduced. The following example provides an illustration.

Example: MC = MR

MOC makes and sells a copyrighted, executive game for two distinct markets, in which it has a monopoly. The fixed costs of production per month are Rwf20,000,000 and variable costs per unit produced, and sold, are Rwf40,000. (The monthly sales can be thought of as X, where $X = X_1 + X_2$, with X_1 and X_2 denoting monthly sales in their respective markets.) Detailed market research has revealed the demand functions in the markets to be as follows, with prices shown as P_1, P_2.

Market 1:	$P_1 = 55{,}000 – 50X_1$
Market 2:	$P_2 = 200{,}000 – 200X_2$

(Note. These formulae are simple **linear equations**. They show how the price (P) can be determined for a given level of demand (X). So in market 1, at a level of demand of 100, the price (P) will be 55,000 – (50 × 100) = 50,000.)

From these, the management accountant has derived that the marginal revenue functions in the two markets are as follows.

Market 1:	$MR_1 = 55{,}000 – 100X_1$
Market 2:	$MR_2 = 200{,}000 – 400X_2$

(Note. In market 1, the marginal revenue if 100 units are sold is 55,000 – (100 × 100) = 45,000.)

The management accountant believes there should be price discrimination; the price is currently RWF50,000 per game in both markets.

Required

Analyse the information for the executive game and, given the management accountant's belief, do the following.

a) Calculate the price to charge in each market, and the quantity to produce (and sell) each month, to maximise profit.
b) Determine the revenue function for each market and the maximum monthly profit in total.
c) Calculate and comment on the change in total profitability and prices.

Solution

a) In both markets, **marginal cost = variable cost per unit** = RWF40,000

Profit is maximised when **marginal revenue = marginal cost**.

Market 1

$55{,}000 - 100X_1$	$= 40{,}000$
$100X_1$	$= 15{,}000$
X_1	$= 15{,}000/100 = 150$

and price $P_1 = 55{,}000 - (50 \times 150) =$ RWF47,500.

Hence the price in market 1 should be RWF47,500 per unit and 150 units should be produced.

Market 2

$200{,}000 - 400X_2$	$= 40{,}000$
$400X_2$	$= 160{,}000$
X_2	$= 160{,}000/400 = 400$

and price $P_2 = 200{,}000 - (200 \times 400) =$ RWF120,000

Hence the price in market 2 should be RWF120,000 per unit and 400 units should be produced.

Total number of items to be produced per month is 550.

b) **Revenue = unit price × number of units sold**

Market 1

Revenue = P_1X_1 = $55,000X_1 – 50X_1^2$

Market 2

Revenue = P_2X_2 = $200,000X_2 – 200X_2^2$

From (a), profit is maximised when

X_1 = 150 and X_2 = 400

P_1 = 47,5005 and P_2 = 120,000

At maximum profit:

Total revenue = (47,500 × 150) + (120,000 × 400) = RWF55,125,000

Total costs = 20,000,000 + (40,000 × 550) =RWF42,000,000

Total maximum monthly profit = RWF13,125,000

c) Currently the price is RWF50,000 in both markets.

Market 1 50,000 = 55 – $50X_1$

$50X_1$ = 55,000 – 50,000 = 5,000

X_1 = 5,000/50 = 100

Market 2 50,000 = 200,00 – $200X_2$

$200X_2$ = 200,000 – 50,000 = 150,000

X_2 = 150,000/200 = 750

Therefore the **total number of units** = 100 + 750 = 850.

Total revenue = RWF50,000 × 850 = RWF42,500,000.

Total cost = 20,000,000 + (40,000 × 850) = RWF54,000,000.

So the game **currently makes a loss** of RWF11,500,000.

Hence, if the prices are changed to RWF47,500 in market 1 and RWF120,000 in market 2, the company can expect to turn a monthly loss of RWF11,500,000 into a profit of RWF13,125,000.

One of the Section C, 25-mark questions in a pilot paper required the approach shown in the solution above.

Formulae for MC and MR are often derived using a mathematical technique known as differential calculus. This is well outside the scope of the syllabus, and so you will be provided with equations representing MC and MR if they are needed.

Note, however, that if a question states that the extra cost of producing one extra item is RWF20, say, you will be expected to realise that the MC is RWF20. Likewise, if you are told that **100 units are sold for RWF10 each**, but **101 can only be sold for RWF9.99**, the **MR of the 101st item is (101 × RWF9.99) – (100 × RWF10) = RWF8.99**.

This is a popular topic for exam questions.

The trickiest Section A question in the May 2005 exam, worth four marks, required candidates to calculate a profit-maximising selling price using equations for MC and MR.

Determining the profit-maximising selling price: visual inspection of a tabulation of data

The **optimum selling price** can also be determined using tabulation, graphs and gradients.

To determine the profit-maximising selling price:

a) Work out the **demand curve** and hence the **price** and the **total revenue** (PQ) at various levels of demand.
b) Calculate **total cost** and hence **marginal cost** at each level of demand.
c) Finally calculate **profit** at each level of demand, thereby determining the price and level of demand at which profits are maximised.

Example

Learning outcome: A(iii)

An organisation operates in a market where there is imperfect competition, so that to sell more units of output, it must reduce the sales price of all the units it sells. The following data is available for prices and costs.

Total output	*Sales price per unit (AR)*	*Average cost of output (AC)*
Units	RWF'000	RWF '000 per unit
0	–	–
1	504	720
2	471	402
3	439	288
4	407	231
5	377	201
6	346	189
7	317	182
8	288	180
9	259	186
10	232	198

The total cost of zero output is RWF600,000.

Complete the table below to determine the output level and price at which the organisation would maximise its profits, assuming that fractions of units cannot be made.

Units	*Price*	*Total revenue*	*Marginal revenue*	*Total cost*	*Marginal cost*	*Profit*
	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000
0						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						

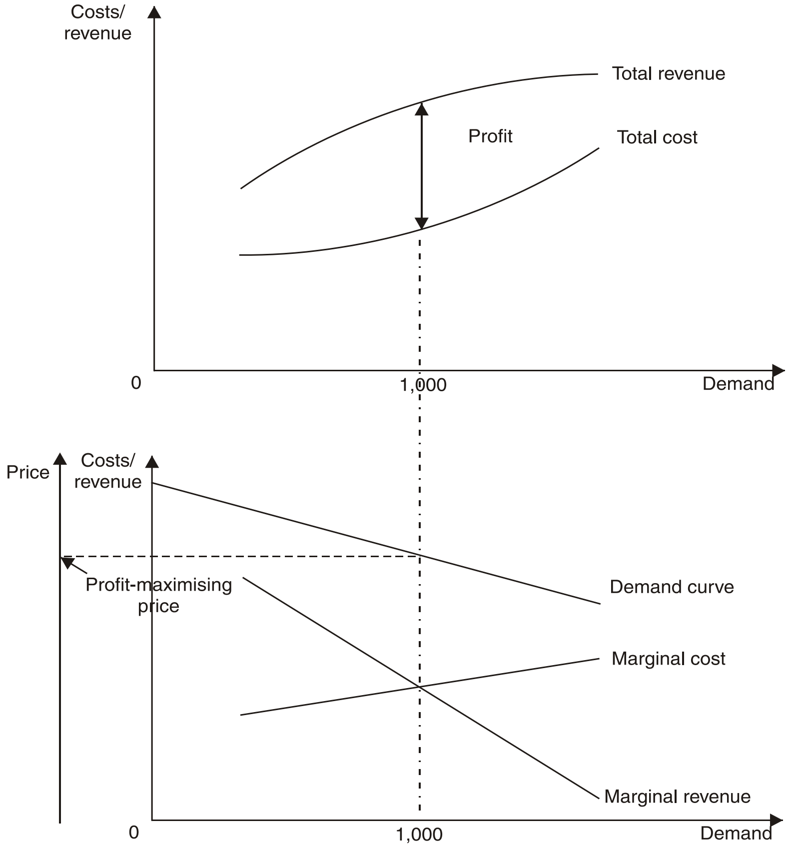
Solution

The correct answer is that profit is maximised at seven units of output and a price of RWF317,000 when MR is most nearly equal to MC.

Units	*Price*	*Total revenue*	*Marginal revenue*	*Total cost*	*Marginal cost*	*Profit*
	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000
0	0	0	0	600	-	(600)
1	504	504	504	720	120	(216)
2	471	942	438	804	84	138
3	439	1,317	375	864	60	453
4	407	1,628	311	924	60	704
5	377	1,885	257	1,005	81	880
6	346	2,076	191	1,134	129	942
7	317	2,219	143	1,274	140	945
8	288	2,304	85	1,440	166	864
9	259	2,331	27	1,674	234	657
10	232	2,320	(11)	1,980	306	340

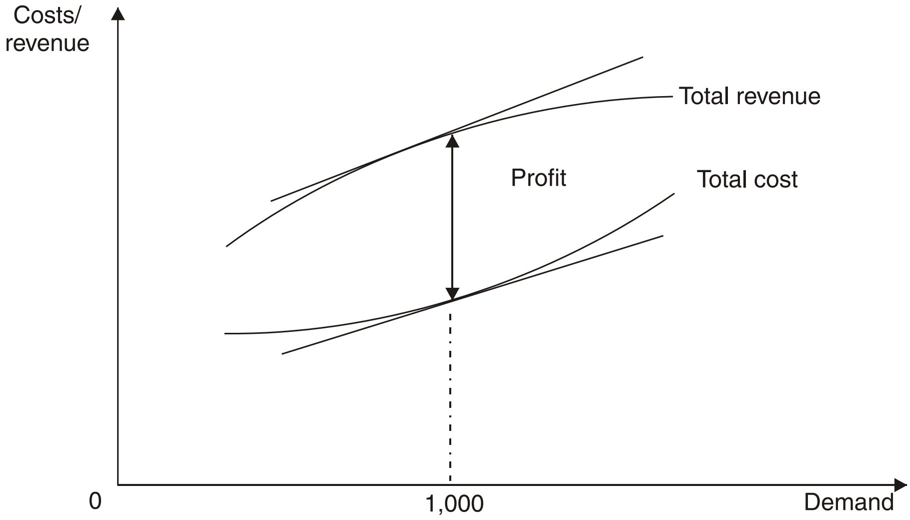
Determining the profit-maximising selling price: graphical approach

The diagrams below show that **profits are maximised** at the point where the **vertical distance** between the total revenue curve and the total costs curve is at a **maximum** (which is fairly obvious if you think about it since profits are maximised when the difference between cost and revenue is maximised). This profit-maximising demand level also **corresponds** to the point at which the **MC and MR curves intersect**, as we would expect. Notice how the profit-maximising price can be read off from the demand curve.



Determining the profit-maximising selling price: using gradients

Suppose we were to draw **tangents** to the total revenue and total cost curves at the **points at which profit is maximised**. As you can see, the gradients of these tangents **are the same**.



The **gradient of the total cost curve** is the **rate at which total cost changes with changes in volume**, which is simply **marginal cost**. Likewise, the **gradient of the total revenue curve** is the **rate at which total revenue changes with changes in volume,** which is the **marginal revenue**. At the **point of profit maximisation**, the two gradients are **equal** and hence, once again, **MC = MR.**

Optimum pricing in practice

There are problems with applying the approach described above in practice for the following reasons:

a) It assumes that the demand curve and total costs can be **identified with certainty**. This is unlikely to be so.
b) It ignores the **market research costs** of acquiring knowledge of demand.
c) It assumes the firm has **no production constraint** which could mean that the equilibrium point between supply and demand cannot be reached.
d) It assumes the objective is **to maximise profits**. There may be other objectives.

Case Study

Microsoft dominates the market for many types of computer software, but this domination was not achieved by setting short-term profit-maximising selling prices for the MS-DOS and Windows operating systems. By offering cheap licences to PC manufacturers for use of these operating systems, Microsoft word processing, spread-sheet, graphics and database packages have become almost industry-standard.

e) It assumes that **price is the only influence** on quantity demanded. We saw in Sections 1 and 2 that this is far from the case.

f) It is **complicated by** the issue of **price discrimination** (the practice of charging different unit selling prices for the same product). We look at price discrimination in the next chapter.

g) Although there are arguments for the **applicability** of the concept of the profit-maximising unit selling price in **traditional markets** where **homogenous, mass-produced** products are in **continuous supply** (such as public transport), the **modern trend** is towards **short product life cycles** and a **high degree of product differentiation**.

Further reading

Read the article that appeared in *Financial Management* in May 2006.

This article takes a humorous approach to the application of optimum pricing but could well form the basis of a question in the exam.

CHAPTER ROUNDUP

- **Demand** is normally **elastic** because demand will increase as prices are lowered.

- **Price elasticity of demand** is a measure of the extent of change in market demand for a good in response to a change in its price.

- If **demand** is **elastic** a reduction in price would lead to a rise in total sales revenue. If **demand** is **inelastic**, a reduction in price would lead to a fall in total sales revenue.

- The **volume of demand for one organisation's goods rather than another's** is influenced by three principal factors: product life cycle, quality and marketing.

- As well as demand, a **range of other issues influence pricing decisions** including the market in which an organisation operates, competition, quality and price sensitivity.

- In imperfect markets there will be an **optimum price/output level** at which profits are maximised.

- When demand is linear the **equation for the demand curve** is **P = a – bQ/ΔQ**

  Where:

P	= the price
Q	= the quantity demanded
a	= the price at which demand would be nil
b	= the amount by which the price falls for each stepped change in demand
ΔQ	= the stepped change in demand

The constant a is calculated as follows.

$$a = \text{current price} + \left(\frac{\text{Current quantity at current price}}{\text{Change in quantity when price is changed by b}} \times b \right)$$

You need to learn these formulae.

- **Profits are maximised** using marginalism theory when **marginal cost (MC) = marginal revenue (MR)**.

- The **optimum selling price** can be determined using equations (i.e. when MC = MR).

- The **optimum selling price** can also be determined using tabulation, graphs and gradients.

STUDY UNIT 3

Pricing Approaches And Strategies

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FULL COST-PLUS PRICING

In **full cost-plus pricing** the sales price is determined by calculating the full cost of the product and then adding a percentage mark-up for profit. The most important criticism of full cost-plus pricing is that it fails to recognise that since sales demand may be determined by the sales price, there will be a profit-maximising combination of price and demand.

Reasons for its popularity

In practice cost is one of the most important influences on price. Many firms base price on simple **cost-plus rules** (costs are estimated and then a mark-up is added in order to set the price). A study by *Lanzilotti* gave a number of **reasons** for the **predominance of this method**.

a) Planning and use of scarce capital resources are easier.
b) Assessment of divisional performance is easier.
c) It emulates the practice of successful large companies.
d) Organisations fear government action against 'excessive' profits.
e) There is a tradition of production rather than of marketing in many organisations.
f) There is sometimes tacit collusion in industry to avoid competition.
g) Adequate profits for shareholders are already made, giving no incentive to maximise profits by seeking an 'optimum' selling price.
h) Cost-based pricing strategies based on internal data are easier to administer.
i) Over time, cost-based pricing produces stability of pricing, production and employment.

Full cost-plus pricing is a method of determining the sales price by calculating the full cost of the product and adding a percentage mark-up for profit.

Setting full-cost plus prices

The 'full cost' may be a fully absorbed production cost only, or it may include some absorbed administration, selling and distribution overhead.

A business might have an idea of the percentage profit margin it would like to earn, and so might **decide on an average profit mark-up** as a general guideline for pricing decisions. This would be particularly **useful for** businesses that carry out a large amount of **contract work or jobbing work**, for which individual job or contract prices must be quoted regularly to prospective customers. However, the percentage profit **mark-up does not have to be rigid and fixed**, but can be varied to suit the circumstances. In particular, the percentage mark-up can be varied to suit demand conditions in the market.

Question

Learning outcome: A(ii)

A product's full cost is RWF4,750 and it is sold at full cost plus 70%. A competitor has just launched a similar product selling for RWF7,990.

Required

Fill in the gap in the sentence below.

The cost-plus percentage will need to be reduced by**......** %.

Answer

The correct answer is that the cost-plus percentage will need to be reduced by 2%.

Profits = (7,990 – 4,750) = 3,240

Mark-up = (3,240/4,750) × 100% = 68%

∴% needs to be reduced by (70 – 68)% = 2%

Example: full cost-plus pricing

Markup Ltd has begun to produce a new product, Product X, for which the following cost estimates have been made.

	RWF'000
Direct materials	27
Direct labour:8 hrs at RWF2,5000 per hour	20
Variable production overheads: machining, ½ hr at RWF6,000 per hour	3
	50

Production fixed overheads are budgeted at RWF300,000,000 per month and, because of the shortage of available machining capacity, the company will be restricted to 10,000 hours of machine time per month. The absorption rate will be a direct labour rate, however, and budgeted direct labour hours are 50,000 per month. It is estimated that the company could obtain a minimum contribution of RWF10,000 per machine hour on producing items other than product X.

The direct cost estimates are not certain as to material usage rates and direct labour productivity, and it is recognised that the estimates of direct materials and direct labour costs may be subject to an error of ± 15%. Machine time estimates are similarly subject to an error of ± 10%.

The company wishes to make a profit of 20% on full production cost from product X.

Required

Ascertain the full cost-plus based price.

Solution

Even for a relatively 'simple' cost-plus pricing estimate, some problems can arise, and certain assumptions must be made and stated. In this example, we can identify two problems.

a) Should the opportunity cost of machine time be included in cost or not?
b) What allowance, if any, should be made for the possible errors in cost estimates?

Different assumptions could be made.

a) Exclude machine time opportunity costs: ignore possible costing errors

	RWF'000
Direct materials	27.00
Direct labour (8 hours)	20.00
Variable production overheads	3.00
Fixed production overheads (at $\frac{300\text{ m}}{25\text{ m}}$ = RWF6,000 per direct labour hour)	48.00
Full production cost	98.00
Profit mark-up (20%)	19.60
Selling price per unit of product X	117.60

b) Include machine time opportunity costs: ignore possible costing errors

	RWF '000
Full production cost as in (a)	98.00
Opportunity cost of machine time: contribution forgone (½ hr × RWF10,000)	5.00

Adjusted full cost	103.00
Profit mark-up (20%)	20.60
Selling price per unit of product X	123.60

c) **Exclude machine time opportunity costs but make full allowance for possible under-estimates of cost**

	RWF '000	RWF '000
Direct materials	27.00	
Direct labour	20.00	
	47.00	
Possible error (15%)	7.05	
		54.05
Variable production overheads	3.00	
Possible error (10%)	0.30	
		3.30
Fixed production overheads (4 hrs × €12)	48.00	
Possible error (labour time) (15%)	7.20	
		55.20
Potential full production cost		112.55
Profit mark-up (20%)		22.51
Selling price per unit of product X		135.06

d) **Include machine time opportunity costs and make a full allowance for possible under-estimates of cost**

Potential full production cost as in (c)	112.55
Opportunity cost of machine time:	
potential contribution forgone (½ hr × RWF 10,000 × 110%)	5.50
Adjusted potential full cost	118.05
Profit mark-up (20%)	23.61
Selling price per unit of product X	141.66

Using different assumptions, we could arrive at any of four different unit prices in the range RWF k117.60 to RWF k141.66.

Problems with and advantages of full cost-plus pricing

There are several serious **problems** with relying on a full cost approach to pricing.

a) It **fails to recognise** that since demand may be determining price, **there will be a profit-maximising combination of price and demand**.
b) There may be a need to **adjust prices to market and demand conditions**.
c) **Budgeted output volume** needs to be established. Output volume is a key factor in the overhead absorption rate.
d) A **suitable basis for overhead absorption** must be selected, especially where a business produces more than one product.

However, it is a **quick, simple and cheap** method of pricing which can be delegated to junior managers (which is particularly important with jobbing work where many prices must be decided and quoted each day) and, since the size of the profit margin can be varied, a decision based on a price in excess of full cost should ensure that a company working at normal capacity will **cover all of its fixed costs and make a profit.**

Example: full cost-plus versus profit-maximising prices

Tiger has budgeted to make 50,000 units of its product, timm. The variable cost of a timm is RWF5,000 and annual fixed costs are expected to be RWF150,000,000.

The financial director of Tiger has suggested that a mark-up of 25% on full cost should be charged for every product sold. The marketing director has challenged the wisdom of this suggestion, and has produced the following estimates of sales demand for timms.

Price per unit (RWF'000)	9	10	11	12	13
Demand (units)	*42,000*	*38,000*	*35,000*	*32,000*	*27,000*

Required

a) Calculate the profit for the year if a full cost-plus price is charged.
b) Calculate the profit for the year if a profit-maximising price is charged.
c)

Assume in both (a) and (b) that 50,000 units of timm are produced regardless of sales volume.

Solution

The full cost per unit comprises RWF k5 of variable costs plus RWF k3 of fixed costs (RWF k8 in total). A 25% mark-up on this cost gives a selling price of RWF k10 per unit so that sales demand would be 38,000 units. (Production is given as 50,000 units.) **Profit using absorption costing** would be as follows.

	RWF '000	RWF '000
Sales		380,000
Costs of production (50,000 units)		
Variable (50,000 × RWF k5)	250,000	
Fixed (50,000 × RWF k3)	150,000	
	400,000	
Less increase in inventory (12,000 units × 8)	(96,000)	
Cost of sales		304,000
Profit		76,000

Profit using marginal costing instead of absorption costing, so that fixed overhead costs are written off in the period they occur, would be as follows. (The 38,000 unit demand level is chosen for comparison.)

	RWF '000
Contribution (38,000 × RWF k(10 – 5))	190,000
Fixed costs	150,000
Profit	40,000

Since the company cannot go on indefinitely producing an output volume in excess of sales volume, this profit figure is more indicative of the profitability of timms in the longer term.

A **profit-maximising price** is one which gives the greatest net (relevant) cash flow, which in this case is the **contribution-maximising price**.

Price	*Unit contribution*	*Demand*	*Total contribution*
RWF ‘000	RWF ‘000	Units	RWF ‘000
9	4	42,000	168,000
10	5	38,000	190,000
11	6	35,000	210,000
12	7	32,000	224,000
13	8	27,000	216,000

The profit maximising price is RWF12,000, with annual sales demand of 32,000 units.

This example shows that a **cost-plus based price is unlikely to be the profit-maximising price**, and that a **marginal costing approach**, calculating the total contribution at a variety of different selling prices, will be **more helpful** for establishing what the profit-maximising price ought to be.

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MARGINAL COST-PLUS PRICING OR MARK-UP PRICING

Marginal cost-plus pricing involves adding a profit margin to the marginal cost of production/sales. A marginal costing approach is more likely to help with identifying a profit-maximising price.

Whereas a full cost-plus approach to pricing draws attention to net profit and the net profit margin, a variable cost-plus approach to pricing **draws attention to gross profit** and the **gross profit margin** or **contribution**.

Marginal cost-plus pricing/mark-up pricing is a method of determining the sales price by adding a profit margin on to either marginal cost of production or marginal cost of sales.

The advantages and disadvantages of a marginal cost-plus approach to pricing

Here are the **advantages**.

a) It is a **simple and easy** method to use.

b) The **mark-up percentage can be varied**, and so mark-up pricing can be adjusted to reflect demand conditions.

c) It **draws management attention to contribution**, and the effects of higher or lower sales volumes on profit. In this way, it helps to create a better awareness of the concepts and implications of marginal costing and cost-volume-profit analysis. For example, if a product costs RWF k10 per unit and a mark-up of 150% is added to reach a price of RWF k25 per unit, management should be clearly aware that every additional RWF k1 of sales revenue would add 600 francs to contribution and profit.

d) In practice, mark-up pricing is **used** in businesses **where there is a readily-identifiable basic variable cost**. Retail industries are the most obvious example, and it is quite common for the prices of goods in shops to be fixed by adding a mark-up (20% or 33.3%, say) to the purchase cost.

There are, of course, **drawbacks** to marginal cost-plus pricing.

a) Although the **size** of the mark-up can be varied in accordance with demand conditions, it **does not ensure that sufficient attention is paid to demand conditions, competitors' prices and profit maximisation**.

b) It **ignores fixed overheads** in the pricing decision, but the sales price must be sufficiently high to ensure that a profit is made after covering fixed costs.

In our study of decision making to date we have adopted a marginal cost approach in that we have considered the effects on contribution and have classed (most) fixed overheads as irrelevant. In pricing decisions, however, there is a conflict with such an approach because of the need for full recovery of all costs incurred.

ECONOMISTS' VERSUS ACCOUNTANTS' VIEWS ON PRICING DECISIONS

Economic theory claims that **profit is maximised** by setting a price so that **marginal cost equals marginal revenue**. But because most cost accounting systems are set up to provide information for financial reporting purposes, it can be **difficult to identify short-run or long-run marginal cost**, even if ABC is used.

Mike Lucas (*Management Accounting*, June 1999) looked at this topic. What follows is a summary of his article.

Research **by accountants** has suggested that **full costs** play an important role in many pricing and output decisions. The use of full cost is at odds with the **economists' view** that prices should be set at a level which **equates marginal cost and marginal revenue,** however.

Economic research findings

Economic research by Hall and Hitch in 1939 found that most organisations tended to **set prices by adding a fairly constant mark-up** to full cost for three principal **reasons**.

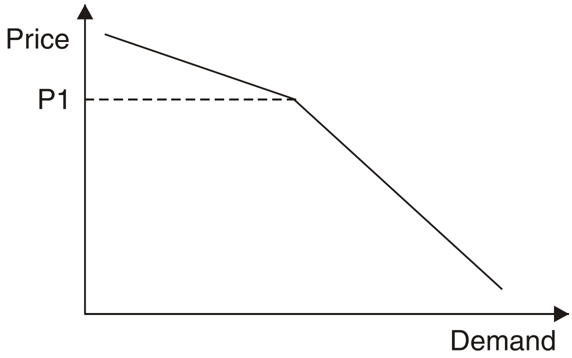
a) **Organisations have no knowledge of their demand curves** because of a lack of information about customers' preferences and/or competitor reaction to price changes.

b) Price stickiness

As illustrated in the diagram below (a **kinked demand curve**), an organisation may feel that if prices are increased above the current price P1, competitors will not match the increase, demand being very elastic. The increase in profit per unit will not compensate for the profit lost from the reduction in quantity sold, and so total profit will fall.

If price is reduced below the current price P1, competitors will match the price decrease, demand being inelastic. The small increase in the quantity sold will not compensate for the drop in profit per unit, and so total profit will fall.

The organisation would therefore be reluctant to increase or decrease the price from the current level if there are minor changes in costs or market conditions, giving rise to apparent price stickiness.



c) The frequent price changes which are likely to occur if **profit-maximising prices** are set (as prices are changed whenever there is a change in demand or costs) can be **administratively expensive** to bring in and can **inconvenience** sales staff, distributors as well as customers.

Economists countered the suggested predominance of cost-based approaches, however, with arguments of **'implicit marginalism'**, whereby **organisations act as though they are setting prices on the basis of equating MC and MR**, even if this approach is **not consciously adopted**. Evidence for this includes:

a) Discounting prices when market circumstances change and/or accepting a lower profit margin when competition increases. This is similar to using a marginal revenue function.
b) Reducing the overhead charged to products to reflect the short-term nature of some fixed costs. This is similar to using a marginal cost function.

Reconciling full cost pricing and marginalist, profit-maximising principles

Some economists have tried to show that full cost pricing is compatible with marginalist principles. One argument (by Koutsoylannis) is that:

Price (P) = average variable cost (AVC) + costing margin

where the costing margin = average fixed cost (AFC) + normal profit mark-up.

Taking AVC to be the best available approximation of long-run marginal cost, any adjustments made to the costing margin because of competitive forces can be viewed as the organisation attempting to establish its demand curve, and so – by implication – its marginal revenue function.

Accounting research

Problems with the methods used for accounting research may not have picked up on the fact that **organisations are constantly making adjustments to prices in order to meet market situations**, and, while many organisations might believe they set prices on a cost plus basis, these prices are the actual prices charged in just a few situations.

ABC and long-run marginal cost

As you will know from your Certificate level studies, **ABC costs** should be **long-run avoidable (marginal) costs** and so in theory **organisations using ABC** costs are **following economists' views of pricing**. The **treatment of 'indivisibilities' means that this is not necessarily the case**, however.

'Indivisibilities' occur when a **reduction in the level of activity does not lead to a proportionate reduction in resource inputs**. For example, a process may be duplicated so that output can be doubled but it may not necessarily be possible to halve the process if demand drops by 50%.

The **cost of indivisible resources** should therefore **not be attributed to individual products** as, to the extent that they are indivisible, they will be incurred regardless of the activity level and so are unavoidable in relation to a particular product.

Conclusion

Economic theory claims that profit is maximised by setting a price so that marginal cost equals marginal revenue. But because most cost accounting systems are set up to provide information for financial reporting purposes, it can be **difficult to identify short-run or long-run marginal cost, even if ABC is used**.

It is difficult to know whether organisations are carrying out the analysis necessary to determine marginal cost or whether the full cost provided by the accounting system is used for pricing decisions.

The **debate** over the theory of pricing therefore **continues**.

PRICING BASED ON MARK-UP PER UNIT OF LIMITING FACTOR

Another approach to pricing might be taken when a **business is working at full capacity, and is restricted by a shortage of resources** from expanding its output further. By deciding what target profit it would like to earn, it could **establish a mark-up per unit of limiting factor**.

Example: mark-up per unit of limiting factor

Suppose that a company provides a window cleaning service to offices and factories. Business is 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 a 40 hour week. They are paid RWF400 per hour. Variable expenses are RWF600 per hour. Fixed costs are RWF1,500,000 per week. The company wishes to make a contribution of at least RWF5,000 per hour.

The minimum charge per hour for window cleaning would then be as follows.

	RWF per hour
Direct wages	400
Variable expenses	600
Contribution	5,000
Charge per hour	6,000

The company has a total workforce capacity of (12 × 40) 480 hours per week, and so total revenue would be RWF2,880,000 per week, contribution would be (480 × RWF5,000) RWF2,400,000, leaving a profit after fixed costs of RWF900,000per week.

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PRICING STRATEGIES FOR SPECIAL ORDERS

The basic approach to pricing **special orders** is **minimum pricing**.

What is a special order?

A special order is a **one-off** revenue-earning opportunity. These may arise in the following situations.

a) When a business has a regular source of income but also has some **spare capacity** allowing it to take on extra work if demanded. For example a brewery might have a capacity of 500,000 barrels per month but only be producing and selling 300,000 barrels per month. It could therefore consider special orders to use up some of its spare capacity.

b) When a business has **no regular source of income** and relies exclusively on its ability to respond to demand. A building firm is a typical example as are many types of sub-contractors. In the service sector consultants often work on this basis.

The reason for making the distinction is that in the case of (a), a firm would normally attempt to cover its longer-term running costs in its prices for its regular product. Pricing for special orders need therefore **take no account of unavoidable fixed costs**. This is clearly not the case for a firm in (b)'s position, where special orders are the only source of income for the foreseeable future.

Minimum pricing

The minimum price is the **price at which the organisation would break even** if it undertook the work. It would have to cover the incremental costs of producing and selling the item and the opportunity costs of the resources consumed.

Firms with high overheads are faced with difficulties. Ideally some means should be found of identifying the causes of such costs. Activity based analysis might reveal ways of attributing overheads to specific jobs or perhaps of avoiding them altogether.

In today's competitive markets it is very much the **modern trend to tailor products or services to customer demand** rather than producing for stock. This suggests that **'special' orders may become the norm** for most businesses.

In the motor trade in the UK, an order for a new car is often fulfilled not from stock, but by programming that order into the manufacturing schedule. Each customer wants a different colour, trim and other accessories and it is cheaper to make to order than to make for stock in case a passing motorist wants just that car.

The same can be for furniture suites where many different combinations of colour/pattern and materials are available.

PRICING STRATEGIES FOR NEW PRODUCTS

Two pricing strategies for **new** products are **market penetration pricing** and **market skimming pricing**.

Tabulation

Suppose that Novo is about to launch a new product with a variable cost of RWF10,000 per unit. The company has carried out market research (at a cost of RWF15,000,000) to determine the potential demand for the product at various selling prices.

Selling price	*Demand*
RWF'000	Units
30	20,000
25	30,000
20	40,000

Its current capacity is for 20,000 units but additional capacity can be made available by using the resources of another product line. If this is done the lost contribution from the other product will be RWF35,000,000 for each additional 10,000 units of capacity.

How could we **analyse this information** for senior management in a way that helps them to **decide on the product's launch price**?

Tabulation is the approach to use with a problem of this type.

Selling price	*Demand*	*Variable costs*	*Opportunity costs*	*Total costs*	*Sales revenue*	*Contribution*
RWF ‘000	Units ('000)	RWF m	RWFm	RWF m	RWF m	RWF m
30	20	200	–	200	600	400
25	30	300	35	335	750	415
20	40	400	70	470	800	330

The **optimum price to maximise short-term profits is RWF25,000**. However, it is quite possible that the aim will **not** be to maximise short-term profits and a number of other strategies may be adopted, as discussed below.

The main **objections** to the approach described above are that it only **considers a limited range of prices** (what about charging RWF27,500?) and it **takes no account of the uncertainty of forecast demand**. However, allowance could be made for both situations by collecting more information.

First on the market?

A new product pricing strategy will depend largely on whether a company's product or service is the first of its kind on the market.

a) If the **product is the first of its kind**, there will be **no competition** - yet and the company, for a time at least, will be a **monopolist**. Monopolists have more influence over price and are able to set a price at which they think they can maximise their profits. A monopolist's price is likely to be higher, and its profits bigger, than those of a company operating in a competitive market.

b) If the new product being launched by a company is **following a competitor's product** onto the market, the pricing strategy will be **constrained by what the competitor** is already doing. The new product could be given a higher price if its quality is better, or it could be given a price which matches the competition. Undercutting the competitor's price might result in a price war and a fall of the general price level in the market.

Market penetration pricing

Market penetration pricing is a policy of low prices when the product is first launched in order to obtain sufficient penetration into the market.

Circumstances in which a penetration policy may be appropriate

a) If the firm wishes to **discourage new entrants** into the market
b) If the firm wishes to **shorten the initial period of the product's life cycle** in order to enter the growth and maturity stages as quickly as possible
c) If there are **significant economies of scale** to be achieved **from a high volume of output**, so that quick penetration into the market is desirable in order to gain unit cost reductions
d) If **demand is highly elastic** and so would respond well to low prices.

Penetration prices are prices which aim to **secure a substantial share in a substantial total market**. A firm might therefore **deliberately build excess production capacity** and set its prices very low. As demand builds up the spare capacity will be used up gradually and unit costs will fall; the firm might even reduce prices further as unit costs fall. In this way, early losses will enable the firm to dominate the market and have the lowest costs.

Market skimming pricing

Market skimming pricing involves charging high prices when a product is first launched and spending heavily on advertising and sales promotion to obtain sales.

As the product moves into the later stages of its life cycle, **progressively lower prices will be charged** and so the profitable 'cream' is skimmed off in stages until sales can only be sustained at lower prices.

The aim of market skimming is to **gain high unit profits early in the product's life**. High unit prices make it **more likely that competitors will enter the market** than if lower prices were to be charged.

Circumstances in which such a policy may be appropriate

a) Where the product is **new and different**, so that customers are prepared to pay high prices so as to be one up on other people who do not own it – e.g. the iPad.

b) Where the **strength** of demand and the **sensitivity of demand** to price are **unknown**. It is better from the point of view of marketing to start by charging high prices and then reduce them if the demand for the product turns out to be price elastic than to start by charging low prices and then attempt to raise them substantially if demand appears to be insensitive to higher prices.

c) Where **high prices** in the early stages of a product's life might **generate high initial cash flows**. A firm with liquidity problems may prefer market-skimming for this reason.

d) Where the firm **can identify different market segments** for the product, each prepared to pay progressively lower prices. If **product differentiation** can be introduced, it may be possible to continue to sell at higher prices to some market segments when lower prices are charged in others. This is discussed further below.

e) Where products may have a **short life cycle**, and so need to recover their development costs and make a profit relatively quickly.

OTHER PRICING STRATEGIES

Product differentiation may be used to make products appear to be different. **Price discrimination** is then possible.

Product differentiation and price discrimination

Price discrimination is the practice of charging different prices for the same product to different groups of buyers when these prices are not reflective of cost differences.

In certain circumstances the **same product** can be sold at different prices to **different customers**. There are a number of bases on which such discriminating prices can be set.

Basis	Detail
By market segment	A cross-border bus company could market its services at different prices in Rwanda and Uganda for say a return journey between Kampala and Kigali.
By product version	Many car models have **optional extras** which enable one brand to appeal to a wider cross-section of customers. The final price need not reflect the cost price of the optional extras directly: usually the top of the range model would carry a price much in excess of the cost of providing the extras - as a prestige appeal.
By place	Theatre seats are usually sold according to their location in the theatre so that patrons pay different prices for the same performance according to the seat type they occupy.
By time	This is perhaps the most popular type of price discrimination. Off-peak travel bargains, hotel prices and telephone charges are all attempts to increase sales revenue by covering variable but not necessarily average cost of provision. In Europe railway companies are successful price discriminators, charging more to rush hour rail commuters whose demand is inelastic at certain times of the day.

Price discrimination can only be effective if a number of **conditions** hold.

a) The market must be **segmentable** in price terms, and different sectors must show different intensities of demand. Each of the sectors must be identifiable, distinct and separate from the others, and be accessible to the firm's marketing communications.

b) There must be little or **no** chance of a **black market** developing (this would allow those in the lower priced segment to resell to those in the higher priced segment).

c) There must be little or **no** chance that **competitors** can and will undercut the firm's prices in the higher priced (and/or most profitable) market segments.

d) The cost of segmenting and **administering** the arrangements should not exceed the extra revenue derived from the price discrimination strategy.

'Own label' pricing: a form of price discrimination

Many supermarkets and multiple retail stores sell their 'own label' products, often at a lower price than established branded products. The supermarkets or multiple retailers do this by entering into arrangements with manufacturers, to supply their goods under the 'own brand' label.

Premium pricing

This involves making a product **appear 'different'** through **product differentiation** so as **to justify a premium price**. The product may be different in terms of, for example, quality, reliability, durability, after sales service or extended warranties. Heavy advertising can establish brand loyalty which can help to sustain a premium and premium prices will always be paid by those customers who blindly equate high price with high quality.

Product bundling

Product bundling is a variation on price discrimination which involves **selling a number of products or services as a package at a price lower than the aggregate of their individual prices**. For example a hotel might offer a package that includes the room, meals, use of leisure facilities and entertainment at a combined price that is lower than the total price of the individual components. This might encourage customers to buy services that they might otherwise not have purchased and so increase cash-flow and contribution to fixed overheads.

The **success** of a bundling strategy depends on the expected **increase in sales volume** and **changes in margin.** Other cost changes, such as in product handling, packaging and invoicing costs, are possible. **Longer-term issues** such as competitors' reactions must also be considered.

Another bundle could be a PC with software, printer and extended warranty insurance.

Pricing with optional extras

The decision here is very similar to that for product bundling. It rests on whether the **increase in sales revenue from the increased price that can be charged** is **greater** than the **increase in costs** required to incorporate extra features. Not all customers will be willing to pay a higher price for additional features if they do not want or need those features.

Psychological pricing

Psychological pricing strategies include **pricing a product at RWF19,990 instead of RWF20,000** and withdrawing an unsuccessful product from the market and then relaunching it at a higher price, the customer having equated the lower price with lower quality (which was not the seller's intention).

Multiple products and loss leaders

Most organisations sell a range of products. The management of the pricing function is likely to focus on the profit from the whole range rather than the profit on each single product. Take, for example, the use of **loss leaders:** a very low price for one product is intended to make consumers buy additional products in the range which carry higher profit margins.

Case Study

Printers for PCs – The printers are priced very attractive and low prices, but the ink cartridges are comparatively highly priced. Once you have bought the printer, the market for the ink cartridges is almost secure.

Using discounts

Reasons for using discounts to adjust prices

- To get rid of perishable goods that have reached the end of their shelf life
- To sell off seconds – cheaper than disposal and does help towards contribution
- Normal practice (e.g.2^{nd} hand and antiques trade)
- To increase sales volumes during a poor sales period without dropping prices permanently
- To differentiate between types of customer (wholesale, retail and so on)
- To get cash in quickly

Controlled prices

State owned or **nationalised industries** operate in a monopolistic environment. Their prices are regulated by the government or by a designated ministry. Over the next few years it is expected that shares in some will be offered to the public and they then will operate within the private sector. However they will probably be **overseen by an industry regulator.**

Regulators tend to concentrate on **price** so that these near monopolies cannot exploit their position (although the regulators are also concerned with quality of service/product and capital investment).

If a **price is regulated**, the **elasticity of demand is zero**: 'small' customers pay less than they otherwise would, whereas 'large' customers pay more than in a competitive environment.

In general though, prices have become **more flexible in recent year** through:

a) Introduction of discounted prices for very large customers
b) Entry of other companies into the market

If asked to **compare** two **pricing strategies** and to determine which is the **better**, you basically need to consider which produces the **higher cash inflows**.

When asked to assess the **financial viability** of the better strategy, however, you need to perform a **DCF appraisal** on the forecast cash flows.

CHAPTER ROUNDUP

- In **full cost-plus pricing** the sales price is determined by calculating the full cost of the product and then adding a percentage mark-up for profit. The most important criticism of full cost-plus pricing is that it fails to recognise, that since sales demand may be determined by the sales price, there will be a profit-maximising combination of price and demand.

- **Marginal cost-plus pricing** involves adding a profit margin to the marginal cost of production/sales. A marginal costing approach is more likely to help with identifying a profit-maximising price.

- **Economic theory** claims that **profit is maximised** by setting a price so that **marginal cost equals marginal revenue**. But, because most cost accounting systems are set up to provide information for financial reporting purposes, it can be **difficult to identify short-run or long-run marginal cost**, even if ABC is used.

- Another approach to pricing might be taken when a **business is working at full capacity, and is restricted by a shortage of resources** from expanding its output further. By deciding what target profit it would like to earn, it could **establish a mark-up per unit of limiting factor**.

- The basic approach to pricing **special orders** is **minimum pricing**.

- Two pricing strategies for **new** products are **market penetration pricing** and **market skimming pricing**.

- **Product differentiation** may be used to make products appear to be different. **Price discrimination** is then possible.

STUDY UNIT 4

Target Costing

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EXAM GUIDE

Target costing may form part of a question comparing its use to other costing techniques or it may form an entire question including calculation of a target cost.

WHAT IS TARGET COSTING?

Target costing involves setting a target cost by subtracting a desired profit margin from a competitive market price.

To compete effectively, organisations must continually redesign their products (or services) in order to shorten **product life cycles** (see Chapter 5). The **planning, development and design stage** of a product is therefore **critical** to an organisation's cost management process. Considering possible **cost reductions at this stage** of a product's life cycle (rather than during the production process) is now one of the most **important** issues facing management accountants in industry.

Here are some examples of **decisions made at the design stage** which **impact on the cost of a product.**

- The number of different components
- Whether the components are standard or not
- The ease of changing over tools

Japanese companies have developed target costing as a response to the **problem of controlling and reducing costs** over the product life cycle.

Target costing involves setting a target cost by subtracting a desired profit margin from a competitive market price.

Target cost is an estimate of a product cost which is determined by subtracting a desired profit margin from a competitive market price. This target cost may be less than the planned initial product cost but it is expected to be achieved by the time the product reaches the maturity stage of the product life cycle.

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IMPLEMENTING TARGET COSTING

In 'Product costing/pricing strategy' (*ACCA Students Newsletter*, August 1999),one of the examiners provided a useful summary of the steps in the implementation of the target costing process.

Step 1 Determine a product specification of which an adequate sales volume is estimated.

Step 2 Set a selling price at which the organisation will be able to achieve a desired market share.

Step 3 Estimate the required profit based on return on sales or return on investment.

Step 4 Calculate the target cost = target selling price – target profit.

Step 5 Compile an estimated cost for the product based on the anticipated design specification and current cost levels.

Step 6 Calculate target cost gap = estimated cost – target cost.

Step 7 Make efforts to close the gap – assuming estimated cost is greater than target cost and it usually is!. This is more likely to be successful if efforts are made to 'design out' costs prior to production, rather than to 'control out' costs during the production phase.

Step 8 Negotiate with the customer before making the decision about whether to go ahead with the project.

Case Study

The following comments appeared in an article in the Financial Times. (Emphasis is ours.)

'Mercedes-Benz, one of the world's most prestigious and tradition-laden carmakers, has taken its time to wake up to the daunting dimensions of the challenges it faces in the **rapidly-changing world car market** of the 1990s.

The company has accepted that radical changes in the world car market mean that Mercedes-Benz will no longer be able to demand premium prices for its products based on an image of effortless superiority and a content of the ultimate in automotive engineering.

Instead of developing the ultimate car and then charging a correspondingly sky-high price as in the past, Mercedes-Benz is taking the dramatic and radical step of moving to '**target pricing'. It will decide what the customer is willing to pay** in a particular product category – priced against its competitors – it will **add its profit margin** and then the real work will begin to **cost every part and component to bring in the vehicle at the target price**.

The following extracts are from an article which appeared three months later.

'The marketing motto for the Mercedes-Benz compact C-class is that it offers customers more car for their money.

It is the first practical example of the group's new pricing policy. The range embodies a principle new to Mercedes which states that **before any work starts a new product will be priced according to what the market will bear and what the company considers an acceptable profit. Then each component and manufacturing process will be costed to ensure the final product is delivered at the target price**.

Under the old system of building the car, adding up the costs and then fixing a price, the C-class would have been **between 15 per cent and 20 per cent dearer** than the 10-year-old outgoing 190 series, Mr Vöhringer said.

Explaining the practical workings of the new system, he explained that project groups for each component and construction process were instructed without exception to increase productivity by between 15 and 25 per cent. And they had to reach their targets in record time.

One result was that development time on the new models was cut to 40 months, about a third less than usual. But the most important effect, according to Mr Vöhringer, has been to **reduce** the **company's cost disadvantages vis-à-vis Japanese competitors in this class from 35 per cent to only 15 per cent**.'

DERIVING A TARGET COST

The target cost is calculated by starting with a market-based price and subtracting a desired profit margin. The target cost is simply the price minus the profit.

Example: target costing

A car manufacturer wants to calculate a target cost for a new car, the price of which will be set at RWF17,950,000. The company requires an 8% profit margin.

Required

What is the target cost?

Solution

Profit required	= 8% × RWF17,950,000	= RWF1,436,000
Target cost	= RWFk(17,950 – 1,436)	= RWF16,514,000

The car manufacturer will then need carefully to compile an estimated cost for the new car. ABC will help to ensure that costs allocated to the new model are more accurate.

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IMPLICATIONS OF USING TARGET COSTING

Target costing requires managers to **change** the way they think about the **relationship between cost, price and profit**.

a) **Traditionally** the approach is to develop a product, determine the production cost of that product, set a selling price, with a resulting profit or loss.
b) The **target costing approach** is to develop a product, determine the market selling price and desired profit margin, with a resulting cost which must be achieved.

With target costing there is a focus on:

a) **Price-led** costing.

b) **Customers**. Customer requirements for quality, cost and time are incorporated into product and process decisions. The value of product features to the customers must be greater than the cost of providing them.

c) **Design**. Cost control is emphasised at the design stage so any engineering changes must happen before production starts.

d) **Faster time to market**. The early external focus enables the business to get the process **right first time** and avoids the need to go back and change aspects of the design and/or production process. This then reduces the time taken to get a product to the market.

e) With Target Costing, it is too easy to design down to ensure the target cost is met and the manufacturer could be left with an inferior product

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CLOSING A TARGET COST GAP

The **target cost gap** is the estimated cost less the target cost. When a product is first manufactured, its target cost may well be much lower than its currently-attainable cost, which is determined by current technology and processes. Management can then set **benchmarks for improvement** towards the target costs, by improving technologies and processes. Various techniques can be employed.

- Reducing the **number of components**
- Using **cheaper staff**
- Using **standard components** wherever possible
- Acquiring new, more efficient **technology**
- **Training** staff in more efficient techniques
- Cutting out **non-value-added activities**
- Using **different materials** (identified using activity analysis etc)

Even if the product can be produced within the target cost the story does not end there. Target costing can be applied throughout the entire life cycle. Once the product goes into production target costs will therefore gradually be reduced. These reductions will be incorporated into the budgeting process. This means that cost savings must be actively sought and made continuously over the life of the product.

When answering a question on closing a target cost gap, make sure you refer to the specific circumstances of the business in the question.

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TARGET COSTING IN SERVICE INDUSTRIES

Target costing is difficult to use in service industries due to the **characteristics** and **information requirements** of service businesses.

Characteristics of services

Unlike manufacturing companies, services are characterised by **intangibility, inseparability, variability, perishability** and no **transfer of ownership.**

Examples of service businesses include:

a) **Mass service** eg the banking sector, transportation (rail, air), mass entertainment
b) **Either / or** eg fast food, teaching, hotels and holidays, psychotherapy
c) **Personal service** eg pensions and financial advice, car maintenance
d)

Services are any activity of benefit that one party can offer to another which is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product.'

(P Kotler, *Social Marketing)*

There are **five major characteristics** of services that distinguish them from manufacturing.

a) **Intangibility** refers to the lack of substance which is involved with service delivery. Unlike goods (physical products such as confectionery, books or even a CD with a software programme), there is no substantial material or physical aspects to a service: no taste, feel, visible presence and so on. For example, if you go to the theatre, you cannot take the 'play' with you when you leave.

b) **Inseparability/simultaneity**. Many services are created at the same time as they are consumed. (Think of dental treatment.) No service exists until it is actually being experienced/consumed by the person who is buying it.

c) **Variability/heterogeneity**. Many services face the problem of maintaining consistency in the standard of output. It may be hard to attain precise standardisation of the service offered, but customers expect it (such as with fast food).

d) **Perishability.** Services are innately perishable. The services of a beautician are purchased for a period of time. An audit may last 2 weeks and after that it is no more.

e) **No transfer of ownership.** Services do not result in the transfer of property. The purchase of a service only confers on the customer access to or a right to use a facility.

Information requirements of services

Service businesses need the same aggregate information as manufacturing firms, but also need performance data as to their cost and volume drivers. Operational information is likely to be more qualitative.

A service business needs a mix of **quantitative** and **non-quantitative** information to price its services properly, to optimise capacity utilisation and to monitor performance.

a) They need to control the **total cost** of providing the **service operation**.
b) They need positive **cash flow** to **finance activities**.
c) They need **operating information** to identify how costs are incurred and on what services.

Arguably, small service businesses, whose expenses are mainly overheads, provide a model, in miniature, of the requirements of **activity based costing**.

Are **'mass services'** any different?

a) Because mass services, such as cheque clearing, are largely automated, there may be a large **fixed cost base**.
b) Even if a service is heavily automated, each time the service is performed is a 'moment of truth' for the customer. Ensuring consistency and quality is important but this is true for small service businesses too.

Service industries, perhaps more than manufacturing firms, **rely on their staff**. Front-line staff are those who convey the 'service' – and the experience of the brand – to the consumer.

For service businesses, **management accounting information** should **incorporate** the **key drivers of service costs**.

- Repeat business
- Opportunity costs of not providing a service
- Churn rate (for subscriptions)*
- Avoidable / unavoidable costs
- Customer satisfaction surveys, complaints

* For any given period of time, the number of participants who discontinue their use of a service divided by the average number of total participants is the churn rate. Churn rate provides insight into the growth or decline of the subscriber base as well as the average length of participation in the service.

CHAPTER ROUNDUP

- **Target costing** involves setting a target cost by subtracting a desired profit margin from a competitive market price.

- Unlike manufacturing companies, services are characterised by **intangibility, inseparability, variability, perishability** and no **transfer of ownership.**

- **Service businesses need the same aggregate information** as manufacturing firms, but also need performance data as to their cost and volume drivers. Operational information is likely to be more qualitative.

STUDY UNIT 5

Lifecycle Costing

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EXAM GUIDE

Life cycle costing will probably form part of a question on costing techniques but it has equal weighting in the syllabus as the other management accounting techniques, so could form an entire question.

WHAT ARE LIFE CYCLE COSTS?

Life cycle costing tracks and accumulates costs and revenues attributable to each product over the entire product life cycle.

A product's life cycle costs are incurred **from its design stage through development to market launch, production and sales, and finally to its eventual withdrawal from the market**. The component elements of a product's cost over its life cycle could therefore include the following.

- **Research & development costs**
  - Design
  - Testing
  - Production process and equipment
- The **cost of purchasing any technical data** required
- **Training costs** (including initial operator training and skills updating)
- **Production costs**
- **Distribution costs**. Transportation and handling costs
- **Marketing costs**
  - Customer service
  - Field maintenance
  - Brand promotion
- **Inventory costs** (holding spare parts, warehousing and so on)
- **Retirement and disposal costs**. Costs occurring at the end of a product's life

Life cycle costs can apply to **services**, customers and projects as well as to physical products.

Traditional cost accumulation systems are based on the financial accounting year and tend to dissect a product's life cycle into a series of 12-month periods. This means that traditional management accounting systems **do not accumulate costs over a product's entire life cycle** and **do not** therefore **assess a product's profitability over its entire life.** Instead they do it on a periodic basis.

Life cycle costing, on the other hand, **tracks and accumulates actual costs and revenues** attributable to each product **over the entire product life cycle.** Hence the total profitability of any given product can be determined.

Life cycle costing is the accumulation of costs over a product's **entire** life.

THE PRODUCT LIFE CYCLE

A **product life cycle** can be divided into five phases.

- Development
- Introduction
- Growth
- Maturity
- Decline

Every product goes through a life cycle.

a) **Development.** The product has a research and development stage where costs are incurred but no revenue is generated.

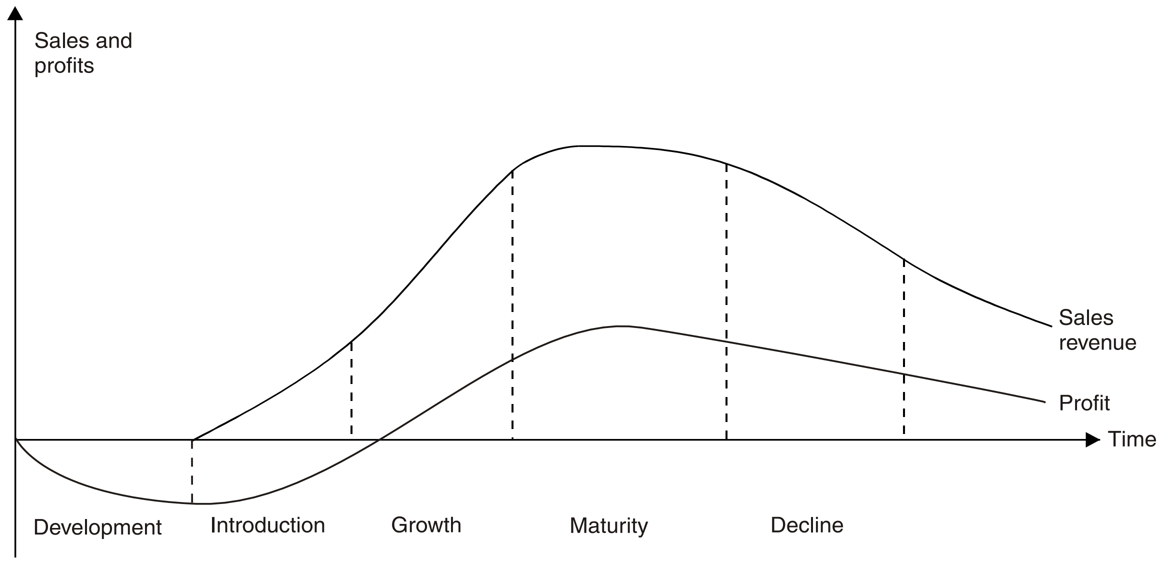
b) **Introduction**. The product is introduced to the market. Without advertising or some similar means, the potential customers will be unaware of the product or service – more cost without revenue.

c) **Growth**. The product gains a bigger market as demand builds up. Sales revenues increase and the product begins to make a profit.

d) **Maturity**. Eventually, the growth in demand for the product will slow down and it will enter a period of relative maturity. It will continue to be profitable. The product may be modified or improved, as a means of sustaining its demand.

e) **Decline**. At some stage, the market will have bought enough of the product and it will therefore reach 'saturation point'. Demand will start to fall. Eventually it will become a loss-maker and this is the time when the organisation should decide to stop selling the product or service.

The level of sales and profits earned over a life cycle can be illustrated diagrammatically as follows.



The horizontal axis measures the duration of **the life cycle**, which **can last** from, say, **18 months to several hundred years**. Children's crazes or fad products have very short lives while some products, such as binoculars (invented in the eighteenth century) can last a very long time.

Problems with traditional cost accumulation systems

Traditional cost accumulation systems do not tend to relate **research and development costs** to the products that caused them. Instead they **write off** these costs on an annual basis **against** the **revenue generated by existing products**. This makes the existing products seem **less profitable** than they really are. If research and development costs are not related to the causal product the true profitability of that product cannot be assessed.

Traditional cost accumulation systems usually **total all non-production costs** and record them as a **period expense**.

THE IMPLICATIONS OF LIFE CYCLE COSTING

Life cycle costing has implications on pricing, performance management and decision-making.

With life cycle costing, non-production costs are traced to individual products over complete life cycles.

a) The total of these costs for each individual product can therefore be reported and compared with revenues generated in the future.
b) The visibility of such costs is increased.
c) **Individual product profitability can be better understood** by attributing *all* costs to products.
d) As a consequence, **more accurate feedback information** is available on the organisation's success or failure in developing new products. In today's competitive environment, where the ability to produce new or updated versions of products is paramount to the survival of an organisation, this information is vital.

The importance of the early stages of the life cycle

It is reported that some organisations operating within an **advanced manufacturing technology** environment find that approximately 90% of a product's life cycle cost is determined by decisions made early within the cycle - at the design stage. Life cycle costing is therefore particularly suited to such organisations and products, monitoring spending and commitments to spend during the early stages of a product's life cycle.

In order to compete effectively in today's market, organisations need to **redesign continually their products** with the result that **product life cycles** have become much **shorter**. The **planning, design and development stages of a product's cycle** are therefore **critical** to an organisation's cost management process. Cost reduction at this stage of a product's life cycle, rather than during the production process, is one of the most important ways of reducing product cost.

Maximising the return over the product life cycle

Design costs out of products

Between 70% to 90% of a product's life cycle costs are determined by decisions made early in the life cycle, at the design or development stage. Careful design of the product and manufacturing and other processes will keep cost to a minimum over the life cycle.

Minimise the time to market

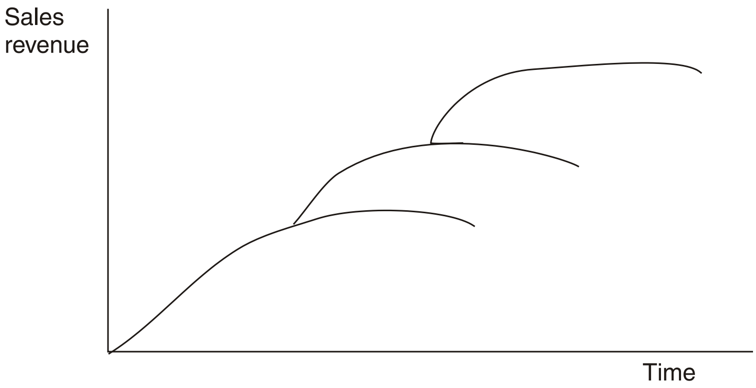
This is the time from the conception of the product to its launch. More products come onto the market nowadays and development times have been reduced over the years. Competitors watch each other very carefully to determine what types of product their rivals are developing. If an organisation is launching a new product it is vital to get it to the market place as soon as possible. This will give the product as long a period as possible without a rival in the market place and should mean increased market share in the long run. Furthermore, the life span may not proportionally lengthen if the product's launch is delayed and so sales may be permanently lost. It is not unusual for the product's overall profitability to fall by 25% if the launch is delayed by six months. This means that it is usually worthwhile incurring extra costs to keep the launch on schedule or even to speed up the launch.

Minimise breakeven time (BET)

A short BET is very important in keeping an organisation liquid. The sooner the product is launched the quicker the research and development costs will be repaid, providing the organisation with funds to develop further products.

Maximise the length of the life span

Product life cycles are not predetermined; they are set by the actions of management and competitors. Once developed, some products lend themselves to a number of different uses; this is especially true of materials, such as plastic, PVC, nylon and other synthetic materials. The life cycle of the material is then a series of individual product curves nesting on top of each other as shown below.



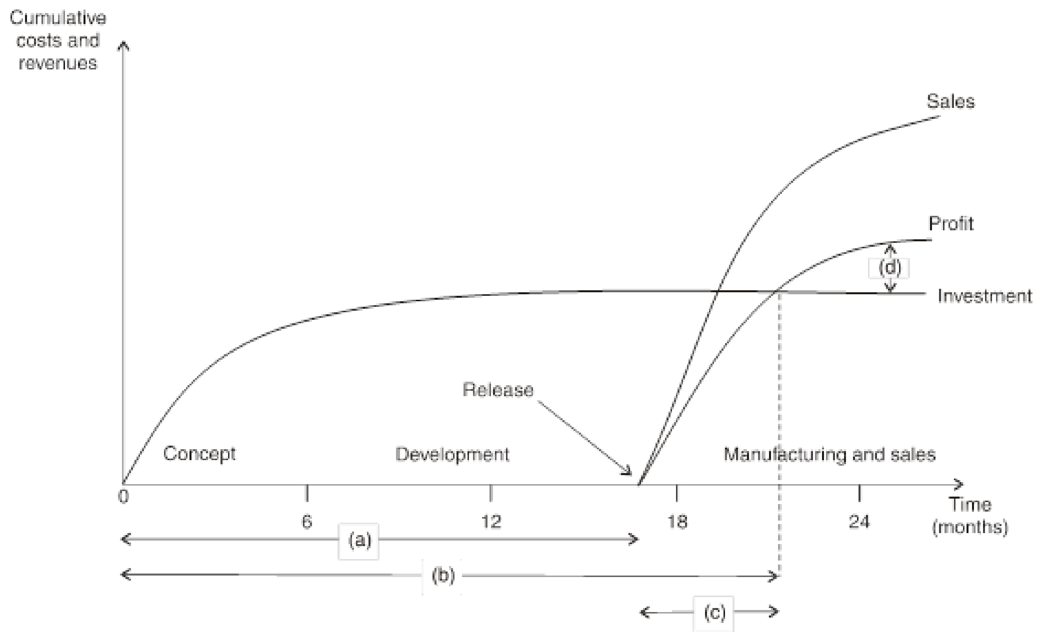
By entering different national or regional markets one after another an organisation may be able to maximise revenue. This allows resources to be better applied, and sales in each market to be maximised. On the other hand, in today's fast moving world, an organisation could lose out to a competitor if it failed to establish an early presence in a particular market.

Minimise product proliferation

If products are updated or superseded too quickly, the life cycle is cut short and the product may just cover its R and D costs before its successor is launched.

Manage the product's cashflows

Hewlett-Packard developed a **return map** to manage the lifecycle of their products. Here is an example.



Key time periods are measured by the map:

a) Time to market
b) Breakeven time
c) Breakeven time after product launch
d) Return factor (the excess of profit over the investment)

Changes to planned time periods can be incorporated into the map (for example, if the development plan takes longer than expected) and the resulting changes to the return factor at set points after release highlighted.

Service and project life cycles

A service organisation will have services that have life cycles. The only difference is that the **R & D stages** will not exist in the same way and will not have the same **impact** on subsequent costs. The **different processes** that go to form the complete service are important, however, and consideration should be given in advance as to how to carry them out and arrange them so as to minimise cost.

Products that take years to produce or come to fruition are usually called **projects**, and **discounted cash flow calculations** are invariably used to cost them over their life cycle in advance. The projects need to be **monitored** very carefully over their life to make sure that they **remain on schedule** and that **cost overruns** are not being incurred.

Customer life cycles

Customers also have life cycles, and an organisation will wish to **maximise the return from a customer over their life cycle**. The aim is to **extend the life cycle of a particular customer** or decrease the 'churn' rate, as the Americans say. This means **encouraging customer loyalty**. For example, Europe some large chain retail outlets issue **loyalty cards** that offer discounts to loyal customers who return to the shop and spend a certain amount with the organisation. As existing customers tend to be more profitable than new ones they should be retained wherever possible.

Customers become more profitable over their life cycle. The profit can go on increasing for a period of between approximately four and 20 years. For example, if you open a bank account, take out insurance or invest in a pension, the company involved has to set up the account, run checks and so on. The initial cost is high and the company will be keen to retain your business so that it can recoup this cost. Once customers get used to their supplier they tend to use them more frequently, and so there is a double benefit in holding on to customers. For example, you may use the bank to purchase shares on your behalf, or you may take out a second insurance policy with the same company.

The projected cash flows over the full lives of customers or customer segments can be analysed to highlight the worth of customers and the importance of customer retention. It may take a year or more to **recoup the initial costs of winning a customer**, and this could be referred to as the **payback period** of the investment in the customer.

Example

Solaris specialises in the manufacture of solar panels. It is planning to introduce a new slimline solar panel specially designed for small houses. Development of the new panel is to begin shortly and Solaris is in the process of determining the price of the panel. It expects the new product to have the following costs.

	Year 1	*Year 2*	*Year 3*	*Year 4*
Units manufactured and sold	2,000	15,000	20,000	5,000
	RWF ‘000	RWF ‘000	RWF ‘000	RWF‘000
R&D costs	1,900,000	100,000	-	-
Marketing costs	100,000	75,000	50,000	10,000
Production cost per unit	500	450	400	450
Customer service costs per unit	50	40	40	40
Disposal of specialist equipment				300,000

The Marketing Director believes that customers will be prepared to pay RWF500,000 for a solar panel but the Financial Director believes this will not cover all of the costs throughout the lifecycle.

Required

Calculate the cost per unit looking at the whole life cycle and comment on the suggested price.

Answer

Lifecycle costs

	RWFmillions
R&D (1,900 + 100)	2,000
Marketing (100 + 75 + 50 + 10)	235
Production (1,000 + 6,750 + 8,000 + 2,250)	18,000
Customer service (100 + 600 + 800 + 200)	1,700
Disposal	300
Total lifecycle costs RWF m	22,235
Total production ('000 units)	42
Cost per unit RWF'000	529.40

The total lifecycle costs are RWF 529,400 per solar panel which is higher than the price proposed by the marketing director. Solaris will either have to charge a higher price or look at ways to reduce costs.

CHAPTER ROUNDUP

- **Life cycle costing** tracks and accumulates costs and revenues attributable to each product over the entire product life cycle.

- A **product life cycle** can be divided into five phases.
  - Development
  - Introduction
  - Growth
  - Maturity
  - Decline

- Life cycle costing has implications on pricing, performance management and decision-making.

STUDY UNIT 6

Backflush Accounting

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EXAM GUIDE

You will need to understand how modern manufacturing techniques have led to new management accounting techniques. This topic could easily form an entire 25 mark question but you will not be required to produce the double entry accounts.

COSTING SYSTEMS AND MANUFACTURING PHILOSOPHY

Costing systems have evolved to reflect a **manufacturing philosophy** that is based on the need to achieve **competitive advantage**.

- Flexibility and the ability to respond quickly to customer demands are vital.
- Product life cycles are shorter and products must be brought to the market quickly.
- New technology has been introduced.

Costing systems

a) Designed to **complement** the organisation's **operations flow**

b) Should **reflect management philosophy** and **style**

c) Provide **information** which management can use to **plan and control** operations on a daily, monthly and longer-term basis

d) **Changes in manufacturing philosophy and new technology** (CAM (computer aided manufacturing) and FMS (flexible manufacturing system)) require **changes in information and cost reporting systems**

- Collecting information in a different way
- Rethinking what data need to be collected
- Rethinking what information should be reported

e) **New Systems**

- Unit quantities (rather than monthly monetary values) reported to production employees
- Performance measures based on output (rather than hours worked) reported to management

f) **Activities important to the organisation's success** should **determine the information required**. These might include:

- Accurate product costing
- Information to control costs
- Knowledge of customer costs
- Cost reduction

Traditional manufacturing philosophy

a) Labour and manufacturing equipment are so valuable they should not be left idle.

b) Resulting raw materials and stock not needed should be stored (thus hiding inefficient and uneven production methods).

c) To increase efficiency and reduce production cost per unit, batch sizes and production runs should be as large as possible.

d) Concerned with balancing production run costs and inventory holding costs.

Modern manufacturing philosophy

a) **Smooth, steady** production flow (**throughput**)

b) **Flexibility**, providing the customer with exactly what is wanted, exactly when it is wanted (making the organisation a more complex affair to manage), so as to achieve **competitive advantage**.

c) **Volume versus variety**

d) **JIT**

Just-in-time (JIT)

Just-in-time is an approach to operations planning and control based on the idea that **goods and services should be produced only when they are needed**, and neither too early (so that inventories build up) nor too late (so that the customer has to wait).

Just-in-time is a system whose objective is to produce or procure products or components as they are required rather than for inventory.

In **traditional** manufacturing, where there is a production process with several stages, management seek to **insulate each stage** in the process from disruption by another stage, by means of **producing for**, and **holding, inventory**.

For example, suppose a manufacturing process consists of four consecutive stages. In a traditional manufacturing system, there would be inventories of raw materials and finished goods, and also inventories of part-finished items between stage 1 and stage 2, between stage 2 and stage 3 and between stage 3 and stage 4. If there is disruption to production at, say, stage 2, the other stages would not be immediately affected. Stages 3 and 4 would continue to operate, using the inventories of part-finished items from stages 2 and 3. Stage 1 would also continue to operate, producing inventory for stage 2. The responsibility for resolving the disruption would fall mainly on the managers of the stage affected, which in this example would be the management of stage 2.

In contrast, in its extreme form, a JIT system seeks to hold zero inventories. In the same four-stage process described above, a disruption at any stage would immediately have an impact on all the other stages. For example, if a disruption occurs at stage 2, stages 3 and 4 will have to stop working because they have no output from stage 2. Stage 1 will also have to stop working, because it will only produce when stage 2 is ready to receive and use its output.

With JIT, a **disruption at any point in the system becomes a problem for the whole operation to resolve**. Supporters of JIT management argue that this will improve the likelihood of the problem being resolved, because it is in the interests of everyone to resolve it. They also argue that inventories help to hide problems within the system, so that problems go unnoticed for too long.

JIT can be regarded as an approach to management that encompasses a **commitment to continuous improvement** and the **search for excellence** in the **design and operation of the**

production management system. Its aim is to streamline the flow of products through the production process and into the hands of customers.

BACKFLUSH COSTING

Backflush costing is suitable for use in a JIT environment. Costs are attached to output only, thereby simplifying the costing system.

Backflush accounting is the name given to the method of keeping cost accounts employed if **backflush costing** is used. The two terms are almost interchangeable.

Traditional costing systems v backflush costing

Traditional costing systems use **sequential tracking** (also known as **synchronous tracking**) to track costs sequentially as products pass from raw materials to work in progress, to finished goods and finally to sales. In other words, material costs are charged to WIP when materials are issued to production, direct labour and overhead costs are charged in a similar way as the cost is incurred or very soon after.

If a production system such as **JIT** is used, sequentially tracking means that **all entries are made at almost the same moment** and so a different accounting system can be used. In **backflush accounting, costs are calculated and charged when the product is sold, or when it is transferred to the finished goods store**.

Backflush costing is 'a more simplified costing system for allocating costs between stocks and cost of goods sold…... The purpose of this is to eliminate detailed accounting transactions. Rather than tracking the movement of materials through the production process, a backflush costing system focuses first on the output of the organisation and then works backwards when allocating cost between costs of goods sold and stocks, with no separate accounting for WIP.' (Drury)

Backflush costing and standard costs

Budgeted or standard costs are used to **work backwards** to 'flush' out manufacturing costs for the units produced. (Hence the rather unattractive name for the system!) The application of **standard costs** to finished goods units, or to units sold, is used in order to calculate cost of goods sold, thereby **simplifying** the costing system and creating **savings** in administrative effort. In a true backflush accounting system, **records** of materials used and work in progress are not required as material cost can be calculated from either finished goods or goods sold.

When backflush costing is appropriate

Backflush costing is appropriate for organisations trying to keep **inventories to the very minimum**. In such circumstances, the recording of every little increase in inventory value, as each nut and bolt is added, is simply an expensive and **non-value-added activity** that should be eliminated.

Example: Backflush accounting

A company operates a backflush costing system.

The standard cost of product X is:

	RWF ‘000
Materials	6
Conversion	8
	14

Details of transactions in the month were:

Raw materials b/f	2,000
Purchases	10,000
Conversion	15,000
Cost of goods sold	20,500

Required

What is the closing balance on raw materials account?

Solution

RAW MATERIAL

	RWF '000		
B/f	2,000	(W1)	8,200
Cash	10,000	C/f	3,800
	12,000		12,000

CONVERSION

RWF '000		RWF '000
15,000	(W1)	12,300

COST OF GOODS SOLD

RWF '000	RWF '000
20,500	

Working 1

Raw materials 10/25 × 20,500 = 8,200

Conversion 15/25 × 20,500 = 12,300

You will not be required to produce double entry accounts in your exam. The emphasis will be on explanation and discussion.

Possible problems with backflush costing

The successful operation of backflush costing rests upon **predictable levels of efficiency** and **stable material prices and usage**. In other words there should be **insignificant cost variances**.

a) It is only appropriate for JIT operations where production and sales volumes are approximately equal.
b) Some people claim that it should not be used for **external reporting** purposes. If, however, **inventories are low** or are practically **unchanged** from one accounting period to the next, operating income and inventory valuations derived from backflush accounting will **not be materially different from the results using conventional systems**. Hence, in such circumstances, backflush accounting is acceptable for external financial reporting.
c) It is vital that adequate production controls exist so that **cost control** during the production process is maintained.

Advantages of backflush costing

a) It is much simpler, as there is no separate accounting for WIP.
b) The number of accounting entries should be greatly reduced, as are the supporting vouchers, documents and so on.
c) The system should discourage managers from producing simply for inventory since working on material does not add value until the final product is completed or sold.

Backflush costing and modern database/warehouse accounting

a) With modern barcode readers and ordering systems, stock control and accounting can be built into modern ERP (enterprise resource planning) and accounting database systems such as SAP or Oracle. From the authorisation of the initial request/order, no further special voucher entries are required.

b) Stock/WIP/FG are automatically taken care of in this type of accounting and so there is no saving here.

c) The number of accounting entries are not affected.

d) BUT the system can be instructed to produce “backflush costing” reports to discourage managers from producing simply for inventory since working on material does not add value until the final product is completed or sold.

CHAPTER ROUNDUP

- **Costing systems** have evolved to reflect a **manufacturing philosophy** that is based on the need to achieve **competitive advantage**.

  - Flexibility and the ability to respond quickly to customer demands are vital.
  - Product life cycles are shorter and products must be brought to the market quickly.
  - New technology has been introduced.

- **Just-in-time** is an approach to operations planning and control based on the idea that **goods and services should be produced only when they are needed**, and neither too early (so that inventories build up) nor too late (so that the customer has to wait).
- **Backflush costing** is suitable for use in a JIT environment. Costs are attached to output only, thereby simplifying the costing system.

STUDY UNIT 7

Throughput Accounting

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EXAM GUIDE

Questions on this topic are likely to be a mixture of calculation and discussion. You may be required to use your knowledge of limiting factors from previous studies.

THEORY OF CONSTRAINTS

Throughput accounting is a product management system which aims to maximise throughput, and therefore cash generation from sales, rather than profit. A **just in time (JIT)** environment is operated, with buffer inventory kept only when there is a **bottleneck**.

The **T**heory **o**f **C**onstraints (TOC) is an **approach to production management**. Its key financial concept is to turn materials into sales as quickly as possible, thereby maximising the net cash generated from sales. This is achieved by striving for balance in production processes, and so evenness of production flow is also an important aim.

Theory of constraints (TOC) is an approach to production management which aims to maximise sales revenue less material and variable overhead cost. It focuses on factors such as bottlenecks which act as constraints to this maximisation.

Bottleneck or **binding constraint –** an activity which has a lower capacity than preceding or subsequent activities, thereby limiting throughput.

One process will inevitably act as a **bottleneck** (or limiting factor) and constrain throughput – this is known as the **binding constraint** in TOC terminology. Steps should be taken to remove this by buying more equipment, improving production flow and so on. But ultimately there will always be a binding constraint, unless capacity is far greater than sales demand or all processes are totally in balance, which is unlikely.

Output through the binding constraint should never be delayed or held up otherwise sales will be lost. To avoid this happening a **buffer inventory** should be built up immediately prior to the bottleneck or binding constraint. This is the only inventory that the business should hold, with the exception of possibly a very small amount of finished goods inventory and raw materials that are consistent with the JIT approach.

Operations prior to the binding constraint should operate at the same speed as the binding constraint, otherwise work in progress (other than the buffer inventory) will be built up. According to TOC, inventory costs money in terms of storage space and interest costs, and so **inventory is not desirable**.

The overall aim of TOC is to **maximise throughput contribution** (sales revenue – material cost) while keeping **conversion cost** (all operating costs except material costs) and **investment costs** (inventory, equipment and so on) to the **minimum.** A strategy for increasing throughput contribution will only be accepted if conversion and investment costs increase by a lower amount than the increase in contribution.

THROUGHPUT ACCOUNTING

The concept of throughput accounting has been developed from TOC as an alternative system of cost and management accounting in a **JIT** environment.

Throughput Accounting (TA) is an approach to accounting which is largely in sympathy with the JIT philosophy. In essence, TA assumes that a manager has a given set of resources available. These comprise existing buildings, capital equipment and labour force. Using these resources, purchased materials and parts must be processed to generate sales revenue. Given this scenario the most appropriate financial objective to set for doing this is the maximisation of throughput (Goldratt and Cox, 1984) which is defined as: sales revenue *less* direct material cost.

(Tanaka, Yoshikawa, Innes and Mitchell, *Contemporary Cost Management*)

TA for JIT is said to be based on three concepts.

a) **Concept 1**

In the short run, most costs in the factory (with the exception of materials costs) are **fixed** (the opposite of ABC, which assumes that all costs are variable). These fixed costs include direct labour. It is useful to group all these costs together and call them **Total Factory Costs (TFC).**

b) **Concept 2**

In a JIT environment, all stock is a 'bad thing' and the **ideal stock level is zero.** Products should not be made unless a customer has ordered them. When goods are made, the factory effectively operates at the rate of the slowest process, and there will be unavoidable idle capacity in other operations.

Work in progress should be **valued at material cost only** until the output is eventually sold, so that no value will be added and no profit earned until the sale takes place. Working on output just to add to work in progress or finished goods inventory creates no profit, and so should not be encouraged.

c) **Concept 3**

Profitability is determined by the rate at which 'money comes in at the door' (that is, sales are made) and, in a JIT environment, this depends on **how quickly** goods can be produced to satisfy customer orders. Since the goal of a profit-oriented organisation is to make money, inventory must be sold for that goal to be achieved. The bottleneck slows the process of making money.

Bottleneck.

The aim of modern manufacturing approaches is to match production resources with the demand for them. This implies that there are **no constraints,** termed binding constraint in TA, within an organisation. The throughput philosophy entails the identification and elimination of these bottlenecks by overtime, product changes and process alterations to reduce set-up and waiting times.

Where throughput cannot be eliminated by say prioritising work, and to avoid the build-up of work in progress, **production must be limited to the capacity of the bottleneck** but this capacity must be **fully** utilised**.** If a rearrangement of existing resources or buying-in resources does not alleviate the bottleneck, investment in new equipment may be necessary.

The elimination of one bottleneck is likely to lead to the creation of another at a previously satisfactory location, however. The management of bottlenecks therefore becomes a primary concern of the manager seeking to increase throughput.

There are other factors which might limit throughput other than a lack of production resources (bottlenecks) and these need to be addressed as well.

a) The existence of an uncompetitive selling price
b) The need to deliver on time to particular customers
c) The lack of product quality and reliability
d) The lack of reliable material suppliers
e) The shortage of production resources

Is it good or bad?

TA is seen by some as **too short term**, as all costs other than direct material are regarded as fixed. Moreover, it **concentrates on direct material costs** and does nothing for the control of other costs such as overheads. These characteristics make throughput accounting a **good complement for ABC**, however, since aspects of ABC focus on labour and overhead costs.

TA attempts to maximise throughput whereas traditional systems attempt to maximise profit. By attempting to maximise throughput, an organisation could be producing in excess of the profit-maximising output. **Production scheduling problems** inevitably mean that the maximising of throughput is never attained, however, and so a **throughput maximising approach** could well **lead to the profit-maximising output** being achieved.

TA helps to direct attention to bottlenecks and focus management on the key elements in making profits, inventory reduction and reducing the response time to customer demand.

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PERFORMANCE MEASURES IN THROUGHPUT ACCOUNTING

Performance measures in throughput accounting are based around the concept that only **direct materials** are regarded as **variable costs**.

a) **Return per factory hour**

$$\frac{\text{Sales} - \text{direct material costs}}{\text{Usage of bottleneck in hours (factory hours)}}$$

This enables businesses to take short-term decisions when a resource is in scarce supply.

b) **Throughput accounting ratio**

$$\frac{\text{Return per factory hour}}{\text{Total conversion cost per factory hour}}$$

Again factory hours are measured in terms of use of the bottleneck. Businesses should try to maximise the throughput accounting ratio by making process improvements or product specification changes.

This measure has the advantage of including the costs involved in running the factory. The higher the ratio, the more profitable the company. (If a product has a ratio of less than one, the organisation loses money every time the product is made.)

Here's an example.

	Product A	*Product B*
	RWF '000 per factory hour	RWF '000 per factory hour
Sales	100	150
Material cost	(40)	(50)
Conversion cost	(50)	(50)
Profit	10	50
TA ratio	$\frac{60}{50} = 1.2$	$\frac{100}{50} = 2.0$

Profit will be maximised by manufacturing as much of product B as possible.

THROUGHPUT AND DECISION MAKING

In a throughput environment, **production priority** must be given to the products best able to generate throughput, that is those **products that maximise throughput per unit of bottleneck.**

The TA ratio can be used to assess the **relative earning capabilities** of different products and hence can help with decision making.

Example: throughput accounting

Corrie produces three products, X, Y and Z. The capacity of Corrie's plant is restricted by process alpha. Process alpha is expected to be operational for eight hours per day and can produce 1,200 units of X per hour, 1,500 units of Y per hour, and 600 units of Z per hour.

Selling prices and material costs for each product are as follows.

Product	*Selling price*	*Material cost*	*Throughput contribution*
	per unit	per unit	per unit
X	150	80	70
Y	120	40	80
Z	300	100	200

Conversion costs are RWF720,000 per day.

Required

a) Calculate the profit per day if daily output achieved is 6,000 units of X, 4,500 units of Y and 1,200 units of Z.

b) Calculate the TA ratio for each product.

c) In the absence of demand restrictions for the three products, advise Corrie's management on the optimal production plan.

Solution

a) Profit per day = throughput contribution – conversion cost

= [(RWF70 × 6,000) + (RWF80 × 4,500) + (RWF200 × 1,200)] – RWF720,000

= RWF300,000

b) TA ratio = throughput contribution per factory hour/conversion cost per factory hour

Conversion cost per factory hour = Rwf720,000/8 = Rwf90,000

Product	*Throughput contribution per factory hour*	*Cost per factory hour*	*TA ratio*
X	RWF70 × 1,200 = Rwf84,000	RWF90,000	0.93
Y	RWF80 × 1,500 = Rwf120,000	RWF90,000	1.33
Z	RWF200 × 600 = Rwf120,000	RWF90,000	1.33

c) An attempt should be made to remove the restriction on output caused by process alpha's capacity. This will probably result in another bottleneck emerging elsewhere. The extra capacity required to remove the restriction could be obtained by working overtime, making process improvements or product specification changes. Until the volume of throughput can be increased, output should be concentrated upon products Y and Z (greatest TA ratios), unless there are good marketing reasons for continuing the current production mix.

Product X is losing money every time it is produced so, unless there are good reasons why it is being produced, for example it has only just been introduced and is expected to become more profitable, Corrie should consider ceasing production of X.

How can a business improve a throughput accounting ratio?

Measures	Consequences
• Increase sales price per unit	• Demand for the product may fall
• Reduce material costs per unit, eg change materials and/or suppliers	• Quality may fall and bulk discounts may be lost
• Reduce operating expenses	• Quality may fall and/or errors increase

Limitations of the throughput accounting ratio

As we have seen, the TA ratio can be used to decide which products should be produced. However, the huge majority of organisations cannot produce and market products based on short-term profit considerations alone. Strategic-level issues such as market developments, product developments and the stage reached in the product life cycle must also be taken into account.

Throughput and limiting factor analysis

The throughput approach is very similar to the approach of **maximising contribution per unit of scarce resource**, which you will have covered in your earlier studies.

Knowledge brought forward from previous studies

Limiting factor analysis

- An organisation might be faced with just one limiting factor (other than maximum sales demand) but there might also be several scarce resources, with two or more of them putting an effective limit on the level of activity that can be achieved.

- Examples of limiting factors include sales demand and production constraints.
  - Labour. The limit may be either in terms of total quantity or of particular skills.
  - Materials. There may be insufficient available materials to produce enough units to satisfy sales demand.
  - Manufacturing capacity. There may not be sufficient machine capacity for the production required to meet sales demand.

- It is assumed in limiting factor analysis that management would make a product mix decision or service mix decision based on the option that would maximise profit and that profit is maximised when contribution is maximised (given no change in fixed cost expenditure incurred). In other words, marginal costing ideas are applied.
  - Contribution will be maximised by earning the biggest possible contribution per unit of limiting factor. For example if grade A labour is the limiting factor, contribution will be maximised by earning the biggest contribution per hour of grade A labour worked.
  - The limiting factor decision therefore involves the determination of the contribution earned per unit of limiting factor by each different product.
  - If the sales demand is limited, the profit-maximising decision will be to produce the top-ranked product(s) up to the sales demand limit.

- In limiting factor decisions, we generally assume that fixed costs are the same whatever product or service mix is selected, so that the only relevant costs are variable costs.

- When there is just one limiting factor, the technique for establishing the contribution-maximising product mix or service mix is to rank the products or services in order of contribution-earning ability per unit of limiting factor.

Throughput is defined as sales less material costs whereas contribution is defined as sales less **all** variable costs. Throughput assumes that all costs except materials are fixed in the short run.

Example: throughput v limiting factor analysis

A company produces two products, Beano and Nutto, which have the following production costs.

	Beano	*Nutto*
	RWF	RWF
Direct material cost	12	12
Direct labour cost	6	10
Variable overhead	6	10
Fixed overhead	6	10
Total product cost	30	42

Fixed overheads are absorbed on the basis of direct labour cost. Beano and Nutto pass through two processes, grinding and pasting which incur direct labour time as follows.

	Time taken	
Process	*Beano*	*Nutto*
Grinding	15 mins	25 mins
Pasting	25 mins	20 mins

The current market price for Beano is RWF75 and for Nutto RWF60 and, at these prices, customers will buy as many units as are available.

The capacity of the two processes limits the amount of units of products that can be produced. Grinding can be carried out for 8 hours per day but pasting can only operate for 6 hours per day.

Required
What production plan should the company follow in order to maximise profits?

a) Using contribution per minute
b) Using throughput per minute

Solution

The constraint in this situation is the ability to process the product. The total daily processing time for the two processes is as follows.

Maximum grinding time	=	8×60 mins	=	480 mins
Maximum pasting time	=	6×60 mins	=	360 mins

The maximum number of each product that can be produced is therefore:

	Beano	*Nutto*
	Units	Units
Grinding	$\frac{480}{15} = 32$	$\frac{480}{25} = 19$
Pasting	$\frac{360}{25} = 14$	$\frac{360}{20} = 18$

The total number of units that can be processed is greater for grinding so pasting capacity is the binding constraint or limiting factor.

(a) **Maximising contribution per minute** *RWF in thousands*

Contribution of Beano	=	RWF(75 – 12 – 6 – 6)	=	RWF51
Contribution of Nutto	=	RWF(60 – 12 – 10 – 10)	=	RWF28

Contribution of Beano per minute in pasting process = $\frac{51}{25}$ = RWF2.04

Contribution of Nutto per minute in pasting process = $\frac{28}{20}$ = RWF1.04

The profit maximising solution is therefore to produce the maximum number of units of Beano, giving a contribution of 14 × RWF51 = RWF714

b) Maximising throughput per minute

Contribution of Beano = RWF(75 – 12) = RWF63

Contribution of Nutto = RWF(60 – 12) = RWF48

Throughput per minute of Beano in pasting process = $\frac{63}{25}$ = RWF2.52

Throughput per minute of Nutto in pasting process = $\frac{48}{20}$ = RWF2.40

The profit maximising approach is therefore again to produce the maximum number of units of Beano, but the result is not as clear cut.

CHAPTER ROUNDUP

- **Throughput accounting** is a product management system which aims to maximise throughput, and therefore cash generation from sales, rather than profit. A **just in time (JIT)** environment is operated, with buffer inventory kept only when there is a defined **bottleneck** .

- Performance measures in throughput accounting are based around the concept that only **direct materials** are regarded as **variable costs**.

- In a throughput environment, **production priority** must be given to the products best able to generate throughput, that is those **products that maximise throughput per unit of bottleneck.**

STUDY UNIT 8

Limiting Factor Analysis

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LIMITING FACTORS

A **scarce resource** is a resource of which there is a limited supply. Once a scarce resource affects the ability of an organisation to earn profits, a scarce resource becomes known as a **limiting factor**.

A **limiting factor** or **key factor** is 'Anything which limits the activity of an entity. An entity seeks to optimise the benefit it obtains from the limiting factor'.

Knowledge brought forward from earlier studies

Limiting factor analysis

- An organisation might be faced with just one limiting factor (other than maximum sales demand) but there might also be several scarce resources, with two or more of them putting an effective limit on the level of activity that can be achieved.
- Examples of limiting factors include sales demand and production constraints.
  - Labour. The limit may be either in terms of total quantity or of particular skills.
  - Materials. There may be insufficient available materials to produce enough units to satisfy sales demand.
  - Manufacturing capacity. There may not be sufficient machine capacity for the production required to meet sales demand.
- It is assumed in limiting factor analysis that management would make a product mix decision or service mix decision based on the option that would maximise profit and that profit is maximised when contribution is maximised (given no change in fixed cost expenditure incurred). **In other words, marginal costing ideas are applied.**
  - Contribution will be maximised by earning the biggest possible contribution per unit of limiting factor. For example if grade A labour is the limiting factor, contribution will be maximised by earning the biggest contribution per hour of grade A labour worked.
  - The limiting factor decision therefore involves the determination of the contribution earned per unit of limiting factor by each different product.
  - If the sales demand is limited, the profit-maximising decision will be to produce the top-ranked product(s) up to the sales demand limit.

- In limiting factor decisions, we generally assume that fixed costs are the same whatever product or service mix is selected, so that the only relevant costs are variable costs.
- When there is just one limiting factor, the technique for establishing the contribution-maximising product mix or service mix is to rank the products or services in order of contribution-earning ability per unit of limiting factor.

If resources are limiting factors, **contribution** will be **maximised** by earning the biggest possible contribution per unit of limiting factor.

Where there is just one limiting factor, the technique for establishing the contribution-maximising product or service mix is to rank the products or services in order of contribution-earning ability per unit of limiting factor.

Example: limiting factor decision

Sausages Ltd makes two products, the Mash and the Sauce. Unit variable costs are as follows.

	Mash	*Sauce*
	RWF '000	RWF'000
Direct materials	1	3
Direct labour (RWF3,000 per hour)	6	3
Variable overhead	1	1
	8	7

The sales price per unit is RWF14,000 for Mash and RWF11,000 for Sauce. During July the available direct labour is limited to 8,000 hours. Sales demand in July is expected to be as follows.

Mash	3,000 units
Sauce	5,000 units

Required

Determine the production budget that will maximise profit, assuming that fixed costs per month are RWF20m and that there is no opening inventory of finished goods or work in progress.

Solution

Step 1 Confirm that the limiting factor is something other than sales demand.

	Mash	*Sauces*	*Total*
Labour hours per unit	2 hrs	1 hr	
Sales demand	3,000 units	5,000 units	
Labour hours needed	6,000 hrs	5,000 hrs	11,000 hrs
Labour hours available			8,000 hrs
Shortfall			3,000 hrs

Labour is the limiting factor on production.

Step 2 Identify the contribution earned by each product per unit of scarce resource, that is, per labour hour worked.

	Mash	*Sauce*
	RWF '000	RWF '000
Sales price	14	11
Variable cost	8	7
Unit contribution	6	4
Labour hours per unit	2 hrs	1 hr
Contribution per labour hour (= per unit of limiting factor)	3	4

Although Mash has a higher unit contribution than Sauce, two Sauces can be made in the time it takes to make one Mash. Because labour is in short supply it is more profitable to make Sauces than Mashes.

Step 3 Determine the budgeted production and sales. Sufficient Sauces will be made to meet the full sales demand, and the remaining labour hours available will then be used to make Mashes.

(a)

Product	*Demand*	*Hours required*	*Hours available*	*Priority for manufacture*
Sauce	5,000	5,000	5,000	1st
Mashes	3,000	6,000	3,000 (bal)	2nd
		11,000	8,000	

(b)

Product	*Units*	*Hours needed*	*Contribution per unit*	*Total*
			RWF '000	RWF '000
Sauce	5,000	5,000	4	20,000
Mashes (balance)	1,500	3,000	6	9,000
		8,000		29,000
Less fixed costs				20,000
Profit				9,000

Conclusion

a) Unit contribution is *not* the correct way to decide priorities.
b) Labour hours are the scarce resource, therefore **contribution per labour hour** is the correct way to decide priorities.
c) The Sauce earns RWF4,000 contribution per labour hour, and the Mash earns RWF3,000 contribution per labour hour. Sauce therefore makes more profitable use of the scarce resource, and should be manufactured first.

Two potentially limiting factors

You may be asked to deal with situations where two limiting factors are **potentially** limiting (and there are also product/service demand limitations). The approach in these situations is to find out which factor (if any) prevents the business from fulfilling maximum demand.

Where there is a **maximum potential sales demand** for an organisation's products or services, they should still be ranked in order of contribution-earning ability per unit of the limiting factor. The contribution-maximising decision, however, will be to produce the top-ranked products (or to provide the top-ranked services) up to the sales demand limit.

Example: two potentially limiting factors

Lucky manufactures and sells three products - X, Y and Z, for which budgeted sales demand, unit selling prices and unit variable costs are as follows.

		X		*Y*		*Z*	
Budgeted sales demand		550 units		500 units		400 units	
		RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000
Unit sales price			16		18		14
Variable costs:	materials	8		6		2	
	labour	4		6		9	
			12		12		11

Unit contribution	4	6	3

The organisation has existing inventory of 250 units of X and 200 units of Z, which it is quite willing to use up to meet sales demand. All three products use the same direct materials and the same type of direct labour. In the next year, the available supply of materials will be restricted to RWF4,800,000 (at cost) and the available supply of labour to RWF6,600,000 (at cost).

Required

Determine what product mix and sales mix would maximise the organisation's profits in the next year.

Solution

There **appear to be two scarce resources**, direct materials and direct labour. This is not certain, however, and because there is a limited sales demand as well, either of the following might apply.

- There is **no limiting factor at all**, except sales demand.
- There is **only one scarce resource** that prevents the full potential sales demand being achieved.

Step 1 **Establish which of the resources, if any, is scarce.**

	X	*Y*	*Z*
	Units	Units	Units
Budgeted sales	550	500	400
Inventory in hand	250	0	200
Minimum production to meet demand	300	500	200

	Minimum production to meet sales demand	*Required materials at cost*	*Required labour at cost*
	Units	RWF'000	RWF'000
X	300	2,400	1,200
Y	500	3,000	3,000
Z	200	400	1,800
Total required		5,800	6,000
Total available		4,800	6,600
(Shortfall)/Surplus		(1,000)	600

Materials are a limiting factor, but labour is not.

Step 2 **Rank** X, Y and Z in order of contribution earned per Rwf1 of direct materials consumed.

	X	*Y*	*Z*
	RWF '000	RWF '000	RWF '000
Unit contribution	4	6	3
Cost of materials	8	6	2
Contribution per RWF1,000 materials	0.50	1.00	1.50
Ranking	3rd	2nd	1st

Step 3 **Determine a production plan.** Z should be manufactured up to the limit where units produced plus units held in inventory will meet sales demand, then Y second and X third, until all the available materials are used up.

Ranking	*Product*	*Sales demand less units held*	*Production quantity*		*Materials cost*
		Units	Units		RWF '000
1st	Z	200	200	(× 2)	400
2nd	Y	500	500	(× 6)	3,000
3rd	X	300	175	(× 8)	*1,400
		Total available			4,800

* Balancing amount using up total available.

Step 4 **Draw up a budget.** The profit-maximising budget is as follows.

	X	*Y*	*Z*
	Units	Units	Units
Opening inventory	250	0	200
Add production	175	500	200
Sales	425	500	400

	X	*Y*	*Z*	*Total*
	RWF '000	RWF '000	RWF '000	RWF '000
Revenue	6,800	9,000	5,600	21,400
Variable costs	5,100	6,000	4,400	15,500
Contribution	1,700	3,000	1,200	5,900

LIMITING FACTOR ANALYSIS AND RESTRICTED FREEDOM OF ACTION

In certain circumstances an organisation faced with a limiting factor on production and sales **might not be able to produce the profit-maximising product mix** because the mix and/or volume of products that can be produced and sold is also restricted by a factor other than a scarce resource.

a) A contract to **supply a certain number of products** to a customer
b) Production/sales of a minimum quantity of one or more products to **provide a complete product range and/or to maintain customer goodwill**
c) Maintenance of a **certain market share** of one or more products

In each of these cases, the organisation might have to **produce more of a particular product or products than the level established by ranking** according to contribution per unit of limiting factor.

If an organisation has to **produce more of a particular product or products than the level established by ranking** according to contribution per unit of limiting factor, the products should be ranked in the normal way but the optimum production plan must first take into account the minimum production requirements. The remaining resource must then be allocated according to the ranking.

Example: restricted freedom of action

Harvey is currently preparing its budget for the year ending 30 September 20X2. The company manufactures and sells three products, Beta, Delta and Gamma.

The unit selling price and cost structure of each product is budgeted as follows.

	Beta	*Delta*	*Gamma*
	RWF '000	RWF '000	RWF '000
Selling price	100	124	32
Variable costs:			
Labour	24	48	6
Materials	26	7	8
Overhead	10	5	6
	60	60	20

Direct labour rate is budgeted at RWF6,000 per hour, and fixed costs at RWF1,300m per annum. The company has a maximum production capacity of 228,000 direct labour hours.

A meeting of the board of directors has been convened to discuss the budget and to resolve the problem as to the quantity of each product which should be made and sold. The sales director presented the results of a recent market survey which reveals that market demand for the company's products will be as follows.

Product	*Units*
Beta	24,000
Delta	12,000
Gamma	60,000

The production director proposes that since Gamma only contributes RWF12,000 per unit, the product should no longer be produced, and the surplus capacity transferred to produce additional quantities of Beta and Delta. The sales director does not agree with the proposal. Gamma is considered necessary to complement the product range and to maintain customer goodwill. If Gamma is not offered, the sales director believes that sales of Beta and Delta will be seriously affected. After further discussion the board decided that a minimum of 10,000 units of each product should be produced. The remaining production capacity would then be allocated so as to achieve the maximum profit possible.

Required

Prepare a budget statement which clearly shows the maximum profit which could be achieved in the year ending 30 September 20X2.

Solution

Step 1 **Ascertain whether labour hours are a scarce resource.**

	Units demanded	*Labour hours per unit*	*Total labour hours*
Beta	24,000	4 (RWF24/RWF6)	96,000
Delta	12,000	8 (RWF48/RWF6)	96,000
Gamma	60,000	1 (RWF6/RWF6)	60,000
			252,000

Step 2 **Rank the products.**

Since only 228,000 hours are available we need to establish which product earns the greatest contribution per labour hour.

	Beta	*Delta*	*Gamma*
Contribution (RWF '000)	40	64	12
Labour hours	4	8	1
Contribution per labour hour – RWF'000	10	8	12
Ranking	2nd	3rd	1st

Step 3 **Determine a production plan.**

The optimum production plan must take into account the requirement that 10,000 units of each product are produced, and then allocate the remaining hours according to the above ranking.

		Hours
Beta	10,000 units × 4 hours	40,000
Delta	10,000 units × 8 hours	80,000
Gamma	10,000 units × 1 hour	10,000
		130,000
Gamma	50,000 units × 1 hour (full demand)	50,000
Beta	12,000 units × 4 hours (balance)	48,000
		228,000

Step 4 Draw up a budget.

BUDGET STATEMENT

Contribution	RWF '000
Beta (22,000 units × RWF40,000)	880,000
Delta (10,000 units × RWF64,000)	640,000
Gamma (60,000 units × RWF12,000)	720,000
	2,240,000
Fixed costs	1,300,000
Profit	940,000

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MAKE OR BUY DECISIONS AND SCARE RESOURCES

An organisation might **want to do more things than it has the resources for**, and so its alternatives would be as follows.

a) Make the best use of the available resources and ignore the opportunities to buy help from outside
b) Combine internal resources with buying externally so as to do more and increase profitability

Buying help from outside is justifiable if it adds to profits. A further decision is then required on how to split the work between internal and external effort. What parts of the work should be given to suppliers or sub-contractors so as to maximise profitability?

In a situation where a company must **sub-contract work to make up a shortfall in its own in-house capabilities**, its total costs will be minimised if those units bought have the lowest extra variable cost of buying per unit of scarce resource saved by buying.

Example: make or buy decision with scarce resources

MM manufactures three components, S, A and T using the same machines for each. The budget for the next year calls for the production and assembly of 4,000 of each component. The variable production cost per unit of the final product is as follows.

	Machine hours	*Variable cost*
		RWF '000
1 unit of S	3	20
1 unit of A	2	36
1 unit of T	4	24
Assembly		20
		100

Only 24,000 hours of machine time will be available during the year, and a sub-contractor has quoted the following unit prices for supplying components: S RWF29,000; A RWF40,000; T RWF34,000.

Required

Advise MM.

Solution

The organisation's budget calls for 36,000 hours of machine time, if all the components are to be produced in-house. Only 24,000 hours are available, and so there is a shortfall of 12,000 hours of machine time, which is therefore a limiting factor. The shortage can be overcome by subcontracting the equivalent of 12,000 machine hours' output to the subcontractor.

The assembly costs are not relevant costs because they are unaffected by the decision.

The decision rule is to **minimise the extra variable costs of sub-contracting per unit of scarce resource saved** (that is, per machine hour saved).

	S	A	T
	RWF '000	RWF '000	RWF '000
Variable cost of making	20	36	24
Variable cost of buying	29	40	34
Extra variable cost of buying	9	4	10
Machine hours saved by buying	3 hrs	2 hrs	4 hrs
Extra variable cost of buying per hour saved	3	2	2.50

This analysis shows that it is **cheaper to buy A than to buy T** and it is **most expensive to buy S**. The **priority for making** the components in-house will be in the **reverse order**: S, then T, then A. There are enough machine hours to make all 4,000 units of S (12,000 hours) and to produce 3,000 units of T (another 12,000 hours). 12,000 hours' production of T and A must be sub-contracted.

The cost-minimising and so profit-maximising make and buy schedule is as follows.

Component		*Machine hours used/saved*	*Number of units*	*Unit variable cost*	*Total variable cost*
				RWF ‘000	RWF ‘000
Make:	S	12,000	4,000	20	80,000
	T	12,000	3,000	24	72,000
		24,000			152,000
Buy:	T	4,000	1,000	34	34,000
	A	8,000	4,000	40	160,000
		12,000			346,000

Total variable cost of components, excluding assembly costs

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LIMITING FACTORS AND SHADOW PRICES

Whenever there are limiting factors, there will be **opportunity costs**. As you know, these are the **benefits forgone by using a limiting factor in one way instead of in the next most profitable way.**

For example, suppose that an organisation provides two services X and Y, which earn a contribution of RWF24,000 and RWF18,000 per unit respectively. Service X requires 4 labour hours, and service Y 2 hours. Only 5,000 labour hours are available, and potential demand is for 1,000 of each of X and Y.

Labour hours would be a limiting factor, and with X earning RWF6,000 per hour and Y earning RWF9,000 per hour, the profit-maximising decision would be as follows.

	Services	Hours	*Contribution* RWF'000
Y	1,000	2,000	18,000
X (balance)	750	3,000	18,000
		5,000	36,000

Priority is given to Y because the **opportunity cost** of providing Y instead of more of X is RWF6,000 per hour (X's contribution per labour hour), and since Y earns RWF9,000 per hour, the incremental benefit of providing Y instead of X would be RWF3,000 per hour.

If extra labour hours could be made available, more X (up to 1,000) would be provided, and an extra contribution of RWF6,000 per hour could be earned. Similarly, if fewer labour hours were available, the decision would be to provide fewer X and to keep provision of Y at 1,000, and so the loss of labour hours would cost the organisation RWF6,000 per hour in lost contribution. This RWF6,000 per hour, the **marginal contribution-earning potential of the limiting factor at the profit-maximising output level**, is referred to as the **shadow price** (or **dual price)** of the limiting factor.

The **shadow price** or **dual price** of a limiting factor is the increase in value which would be created by having one additional unit of the limiting factor at the original cost.

A **shadow price** is 'An increase in value which would be created by having available one additional unit of a limiting resource at the original cost'.

Note that the shadow price only applies while the extra unit of resource can be obtained at its normal variable cost. The shadow price also indicates the amount by which contribution could fall if an organisation is deprived of one unit of the resource.

The shadow price of a resource is its **internal opportunity cost.** This is the marginal contribution towards fixed costs and profit that can be earned for each unit of the limiting factor that is available. A knowledge of the shadow price of a resource will help managers to decide how much it is worth paying to acquire another unit of the resource.

USING LIMITING FACTOR ANALYSIS

Don't ignore this wordy session – if you were to get a full limiting factor analysis question in the exam there would undoubtedly be marks for discussion of pertinent non-quantifiable issues.

Limiting factor analysis provides us with a profit-maximising product mix, within the assumptions made. It is important to remember, however, that other considerations, so far not fully considered in our examples, might entirely alter the decision reached.

Non-quantifiable factors

Non-quantifiable factors, such as effect on customer goodwill, ability to restart production and reasons for a resource being a limiting factor, should also be borne in mind in product mix decisions.

Factor	Examples
Demand	Will the decision reached (perhaps to make and sell just one product rather than two) have a harmful effect on customer loyalty and sales demand? For example, a manufacturer of knives and forks could not expect to cease production of knives without affecting sales demand for the forks.
Long-term effects	Is the decision going to affect the long-term as well as the short-term plans of the organisation? If a particular product is not produced, or produced at a level below sales demand, is it likely that competitors will take over vacated markets? Labour skilled in the manufacture of the product may be lost and a decision to reopen or expand production of the product in the future may not be possible.
Labour	If labour is a limiting factor, is it because the skills required are difficult to obtain, perhaps because the organisation is using very old-fashioned production methods, or is the organisation a high-tech newcomer in a low-tech area? Or perhaps the conditions of work are so unappealing that people simply do not want to work for the organisation.
Other limiting factors	The same sort of questions should be asked whatever the limiting factor. If machine hours are in short supply is this because more machines are needed, or newer, more reliable and efficient machines? If materials are in short supply, what are competitors doing? Have they found an equivalent or better substitute? Is it time to redesign the product?

Assumptions in limiting factor analysis

Various **assumptions** are made in limiting factor analysis.

- Fixed costs remain the same regardless of the decision taken.
- Unit variable cost is constant regardless of the decision taken.
- Estimates of sales demand and resources required are known with certainty.
- Units of output are divisible.

In the examples covered in the chapter, certain assumptions were made. If any of the assumptions are not valid, then the profit-maximising decision might be different. These assumptions are as follows.

a) **Fixed costs will be the same** regardless of the decision that is taken, and so the profit-maximising and contribution-maximising output level will be the same.

This will not necessarily be true, since some fixed costs might be directly attributable to a product or service. A decision to reduce or cease altogether activity on a product or service might therefore result in some fixed cost savings, which would have to be taken into account.

b) **The unit variable cost is constant,** regardless of the output quantity of a product or service. This implies the following.

(i) The price of resources will be unchanged regardless of quantity; for example, there will be no bulk purchase discount of raw materials.

(ii) Efficiency and productivity levels will be unchanged; regardless of output quantity the direct labour productivity, the machine time per unit, and the materials consumption per unit will remain the same.

c) **The estimates of sales demand** for each product, and the **resources required** to make each product, **are known with certainty**.

In the example in Section 1.2.1, there were estimates of the budgeted sales demand for each of three products, and these estimates were used to establish the profit-maximising product mix. Suppose the estimates were wrong? The product mix finally chosen would then either mean that some sales demand of the most profitable item would be unsatisfied, or that production would exceed sales demand, leaving some inventory unsold. Clearly, once a profit-maximising output decision is reached, management will have to keep their decision under continual review, and adjust their decision as appropriate in the light of actual results.

d) **Units of output are divisible**, and a profit-maximising solution might include fractions of units as the optimum output level.

Where fractional answers are not realistic, some rounding of the figures will be necessary.

Exam Focus Point

An examination problem might present you with a situation in which there is a limiting factor, without specifically stating that this is so, and you will have the task of recognising what the situation is. You may be given a hint with the wording of the question.

a) 'It is possible that the main raw material used in manufacturing the products will be difficult to obtain in the next year.'
b) 'The company employs a fixed number of employees who work a maximum overtime of eight hours on top of the basic 36 hour week. The company has also agreed that no more staff will be recruited next year.'
c)

In (a) there is a hint that raw materials might be a limiting factor. In (b), perhaps less obviously, a maximum limit is placed on the available labour hours, and so the possibility should occur to you that perhaps labour is a limiting factor.

If you suspect the existence of a limiting factor, some quick computations should confirm your suspicions.

a) Calculate the amount of the scarce resource (material quantities, labour hours, machine hours and so on) needed to meet the potential sales demand.
b) Calculate the amount of the scarce resource available (for example number of employees multiplied by maximum working hours per employee).
c) Compare the two figures. Obviously, if the resources needed exceed the resources available, there is a limiting factor on output and sales.

CHAPTER ROUNDUP

- A **scarce resource** is a resource of which there is a limited supply. Once a scarce resource affects the ability of an organisation to earn profits, a scarce resource becomes known as **a limiting factor**.

- If resources are limiting factors, **contribution** will be **maximised** by earning the biggest possible contribution per unit of limiting factor.

- **Where there is just one limiting factor**, the technique for establishing the contribution-maximising product or service mix is to rank the products or services in order of contribution-earning ability per unit of limiting factor.

- Where there is a **maximum potential sales demand** for an organisation's products or services, they should still be ranked in order of contribution-earning ability per unit of the limiting factor. The contribution-maximising decision, however, will be to produce the top-ranked products (or to provide the top-ranked services) up to the sales demand limit.

- If an organisation has to **produce more of a particular product or products than the level established by ranking** according to contribution per unit of limiting factor, the products should be ranked in the normal way but the optimum production plan must first take into account the minimum production requirements. The remaining resource must then be allocated according to the ranking.

- In a situation where an organisation must **subcontract work to make up a shortfall in its own in-house capabilities**, its total costs will be minimised if the units bought have the lowest extra variable cost of buying per unit of scarce resource saved by buying.

- The **shadow price** or **dual price** of a limiting factor is the increase in value which would be created by having one additional unit of the limiting factor at the original cost.

- **Non-quantifiable factors**, such as the effect on customer goodwill, ability to restart production and reasons for a resource being a limiting factor, should also be borne in mind in product mix decisions.

- Various **assumptions** are made in limiting factor analysis.

  - Fixed costs remain the same regardless of the decision taken.
  - Unit variable cost is constant regardless of the decision taken.
  - Estimates of sales demand and resources required are known with certainty.

- Units of output are divisible

STUDY UNIT 9

Linear Programming: The Graphical Method

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THE GRAPHICAL METHOD

The **graphical method** of linear programming is used for problems involving two products.

Formulating the problem

Let us suppose that WX manufactures two products, A and B. Both products pass through two production departments, mixing and shaping. The organisation's objective is to maximise contribution to fixed costs.

Product A is sold for RWF1,500 whereas product B is priced at RWF2,000. There is unlimited demand for product A but demand for B is limited to 13,000 units per annum. The machine hours available in each department are restricted to 2,400 per annum. Other relevant data are as follows.

Machine hours required	*Mixing*	*Shaping*
	Hrs	Hrs
Product A	0.06	0.04
Product B	0.08	0.12

Variable cost per unit	RWF '000
Product A	1.30
Product B	1.70

Before we work through the steps involved in solving this constraints problem using the graphical approach to linear programming, it is worth reading the CIMA *Official Terminology* definition of linear programming to get a glimpse of what we will be doing.

Linear programming is 'The use of a series of linear equations to construct a mathematical model. The objective is to obtain an optimal solution to a complex operational problem, which may involve the production of a number of products in an environment in which there are many constraints'.

Example

What are the constraints in the situation facing WX?

(i) Machine hours in each department
(ii) Labour hours in each department
(iii) Sales demand for product B
(iv) Selling price of product A

A (i) and (iii)
B (i) only
C (ii) and (iv)
D (i), (ii) and (iii)

Soultion

The correct answer is A. There is no restriction on the availability of labour hours. Selling price cannot be a constraint.

The **steps in the graphical method** are as follows.

- Define variables.
- Establish objective function.
- Establish constraints.
- Draw a graph of the constraints.
- Establish the feasible region.
- Determine the optimal product mix.

Let's start solving WX's problem.

Step 1 **Define variables**

What are the **quantities that WX can vary**? Obviously not the number of machine hours or the demand for product B. The only things which it can vary are the **number of units of each type of product produced**. It is those numbers which the company has to determine in such a way as to obtain the maximum possible profit. Our variables (which are usually products being produced) will therefore be as follows.

Let x = number of units of product A produced.

Let y = number of units of product B produced.

Step 2 **Establish objective function**

The **objective function** is a quantified statement of the aim of a resource allocation decision.

We now need to introduce the question of contribution or profit. We know that the **contribution on each type of product** is as follows.

		RWFper unit
Product A	RWF(1.50 – 1.30) =	0.20
Product B	RWF(2.00 – 1.70) =	0.30

The **objective of the company is to maximise contribution** and so the **objective function to be maximised** is as follows.

Contribution (C) = 0.2x + 0.3y

Step 3 **Establish constraints**

A **constraint** is 'An activity, resource or policy that limits the ability to achieve objectives'.

The **value of the objective function** (the maximum contribution achievable from producing products A and B) is **limited by the constraints** facing WX, however. To incorporate this into the problem we need to **translate the constraints into inequalities involving the variables** defined in Step 1. An inequality is an equation taking the form 'greater than or equal to' or 'less than or equal to'.

a) Consider the **mixing department machine hours** constraint.

(i) **Each unit of product A** requires 0.06 hours of machine time. Producing five units therefore requires 5×0.06 hours of machine time and, more generally, **producing x units will require 0.06x hours**.

(ii) Likewise producing **y units of product B will require 0.08y hours.**

(iii) The total machine hours needed in the mixing department to make x units of product A and y units of product B is 0.06x + 0.08y.

(iv) We know that this **cannot be greater than 2,400 hours** and so we arrive at the following inequality.

$$\mathbf{0.06x + 0.08y \leq 2,400}$$

Example

How can the constraint facing the shaping department be written as an inequality?

A $0.4x + 0.012y \geq 2,400$
B $0.04x + 0.12y \leq 2,400$
C $0.4x + 0.012y \leq 2,400$
D $0.04x + 0.12y \geq 2,400$

Solution

The correct answer is B. The constraint has to be a 'less than equal to' inequality, because the amount of resource used (0.04x + 0.12y) has to be 'less than equal to' the amount available of 2,400 hours.

b) The final inequality is easier to obtain. The **number of units of product B produced and sold is y** but this has to be **less than or equal to 13,000**. Our inequality is therefore as follows.

$$\mathbf{y \leq 13,000}$$

c) We also need to add **non-negativity constraints** ($x \geq 0$, $y \geq 0$) since negative numbers of products cannot be produced. (Linear programming is simply a mathematical tool and so there is nothing in this method which guarantees that the answer will 'make sense'. An unprofitable product may produce an answer which is negative. This is mathematically correct but nonsense in operational terms. Always remember to include the non-negativity constraints. The examiner will not appreciate 'impossible' solutions.)

The **problem** has now been **reduced** to the following **four inequalities** and **one equation**.

Maximise contribution (C) = $0.2x + 0.3y$, subject to the following constraints:

$$0.06x + 0.08y \leq 2{,}400$$

$$0.04x + 0.12y \leq 2{,}400$$

$$0 \leq y \leq 13{,}000$$

$$0 \leq x$$

Example

An organisation makes two products, X and Y. Product X has a contribution of RWF124 per unit and product Y RWF80 per unit. Both products pass through two departments for processing and the times in minutes per unit are as follows.

	Product X	*Product Y*
Department 1	150	90
Department 2	100	120

Currently there is a maximum of 225 hours per week available in department 1 and 200 hours in department 2. The organisation can sell all it can produce of X but EAC quotas restrict the sale of Y to a maximum of 75 units per week. The organisation, which wishes to maximise contribution, currently makes and sells 30 units of X and 75 units of Y per week.

Required

Assume x and y are the number of units of X and Y produced per week. Formulate a linear programming model of this problem, filling in the blanks in (a) and (b) below.

a) The objective function is to maximise weekly contribution, given by C = …………………... .

b) The constraints are:

Department 1 ……………………. EU quota …………………….

Department 2 ……………………. Non-negativity ………………

Solution

a) The objective function is to maximise weekly contribution, given by C = 124x + 80y.

b) The constraints are:

Department 1:	150x + 90y	$\leq$	225 × 60 minutes
Department 2:	100x + 120y	$\leq$	200 × 60 minutes
	EAC quota y	$\leq$	75
Non-negativity	x, y	$\geq$	0

These constraints can be simplified to:

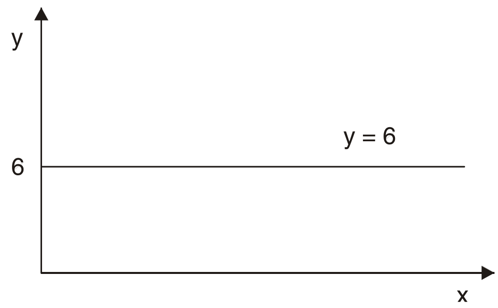
Department 1:	15x + 9y	$\leq$	1,350
Department 2:	10x + 12y	$\leq$	1,200
EAC quota	y	$\leq$	75
Non-negativity	x, y	$\geq$	0

Graphing the problem

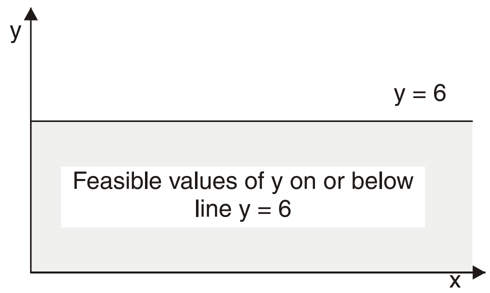
A **graphical solution** is **only possible** when there are **two variables** in the problem. One variable is represented by the **x axis** of the graph and one by the **y axis**. Since non-negative values are not usually allowed, the graph shows **only zero and positive values of x and y**.

Graphing equations and constraints

A **linear equation with one or two variables** is shown as a **straight line on a graph**. Thus y = 6 would be shown as follows.



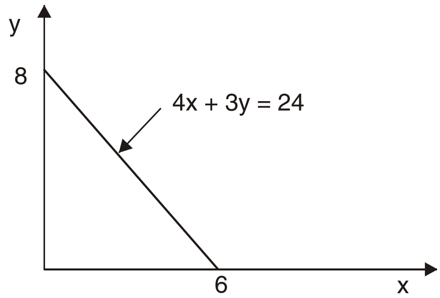
If the problem included a **constraint that y could not exceed 6**, the **inequality y ≤ 6** would be represented by the **shaded area of the graph below**.



The equation 4x + 3y = 24 is also a straight line on a graph. To **draw any straight line**, we **need only to plot two points and join them up**. The easiest points to plot are the following.

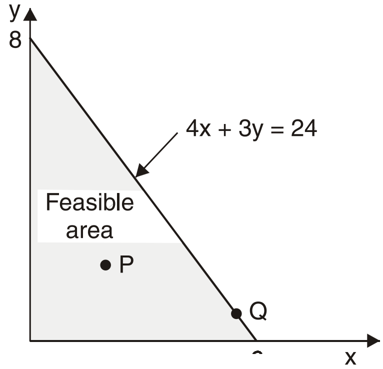
- x = 0 (in this example, if x = 0, 3y = 24, y = 8)
- y = 0 (in this example, if y = 0, 4x = 24, x = 6)

By plotting the points, (0, 8) and (6, 0) on a graph, and joining them up, we have the line for 4x + 3y = 24.



Any combination of values for x and y on the line satisfies the equation. Thus at a point where x = 3 and y = 4, 4x + 3y = 24. Similarly, at a point where x = 4.5 and y = 2, 4x + 3y = 24.

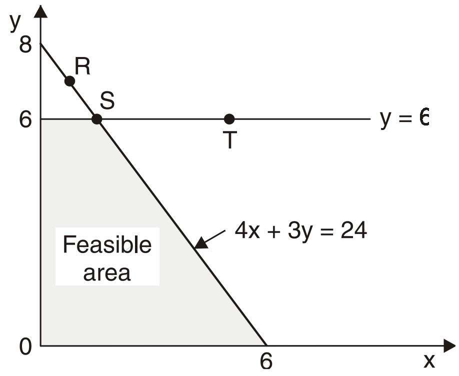
If we had a **constraint 4x + 3y ≤ 24, any combined value of x and y within the shaded area below (on or below the line) would satisfy the constraint.**



Consider point P which has coordinates of (2, 2). Here 4x + 3y = 14, which is less than 24; and at point Q where x = 5½, y = 2/3, 4x + 3y = 24. **Both P and Q lie within the feasible area** or **feasible region. A feasible area enclosed on all sides may also be called a feasible polygon.**

A **feasible region** is 'The area contained within all of the constraint lines shown on a graphical depiction of a linear programming problem. All feasible combinations of output are contained within or located on the boundaries of the feasible region'.

When there are **several constraints**, the **feasible area** of combinations of values of x and y must be an area **where all the inequalities are satisfied**. Thus, if **y ≤ 6 and 4x + 3y ≤ 24** the **feasible area** would be the **shaded area** in the following graph.

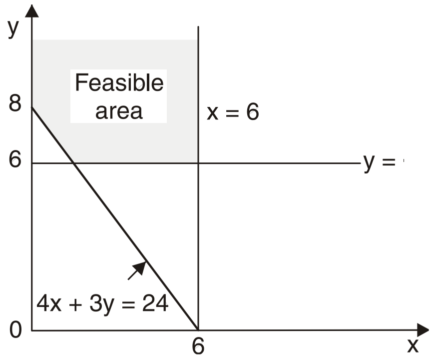


a) Point R (x = 0.75, y = 7) is not in the feasible area because although it satisfies the inequality 4x + 3y ≤ 24, it does not satisfy y ≤ 6.

b) Point T (x = 5, y = 6) is not in the feasible area, because although it satisfies the inequality y ≤ 6, it does not satisfy 4x + 3y ≤ 24.

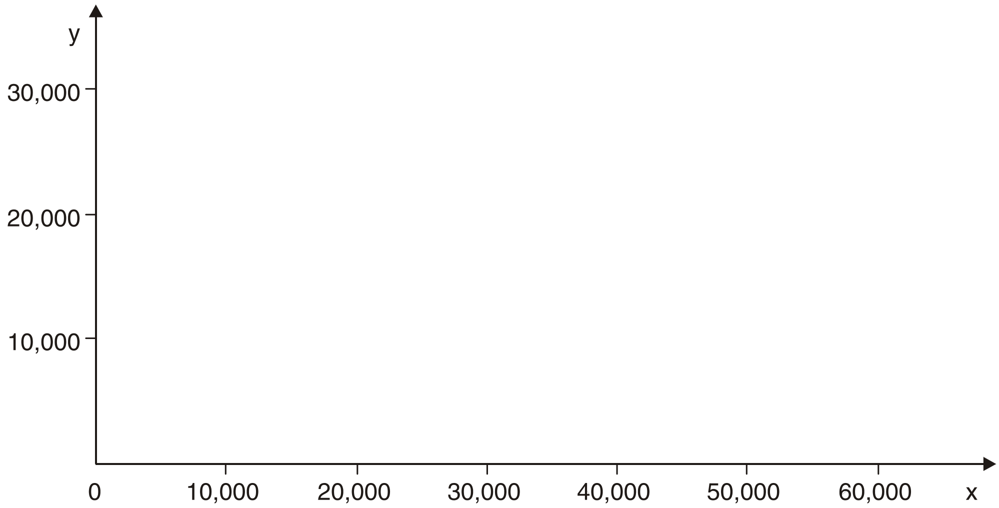
c) Point S (x = 1.5, y = 6) satisfies both inequalities and lies just on the boundary of the feasible area since y = 6 exactly, and 4x + 3y = 24. Point S is thus at the intersection of the two lines.

Similarly, if y ≥ 6 and 4x + 3y ≥ 24 but x is ≤ 6, the feasible area would be the shaded area in the graph below.



Example

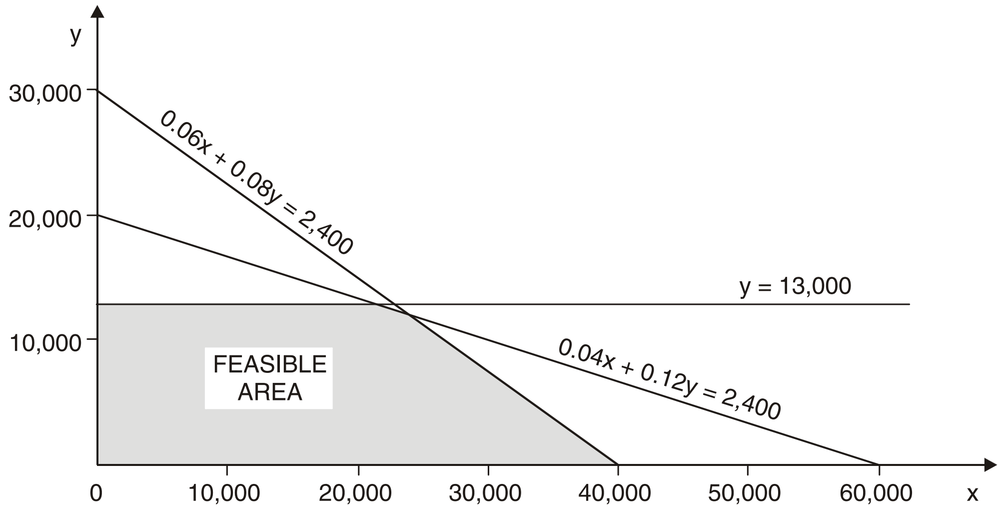
Draw the feasible region which arises from the constraints facing WX on the graph below.



Solution

If 0.06x + 0.08y = 2,400, then if x = 0, y = 30,000 and if y = 0, x = 40,000.

If 0.04x + 0.12y = 2,400, then if x = 0, y = 20,000 and if y = 0, x = 60,000.



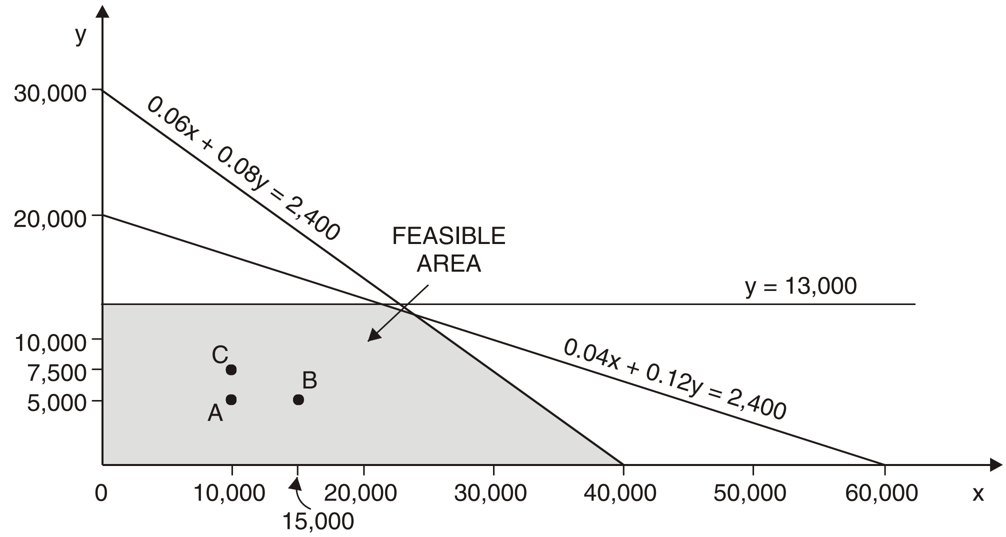
Finding the optimum allocation of resources

The **optimal solution** can be found by 'sliding the iso-contribution (or profit) line out'.

Having found the feasible region (which includes all the possible solutions to the problem) we need to **find which of these possible solutions is 'best'** or **optimal** in the sense that it yields the maximum possible contribution.

Look at the feasible region of the problem faced by WX (see the solution to the question above). Even in such a simple problem as this, there are a **great many possible solution points within the feasible area.** Even to write them all down would be a time-consuming process and also an unnecessary one, as we shall see.

Here is the graph of WX's problem.



a) Consider point A at which 10,000 units of product A and 5,000 units of product B are being manufactured. This will yield a contribution of (1,000 × RWF0.20) + (5,000 × RWF0.30) = RWF3,500.

b) We would clearly get more contribution at point B, where the same number of units of product B are being produced but where the number of units of product A has increased by 5,000.

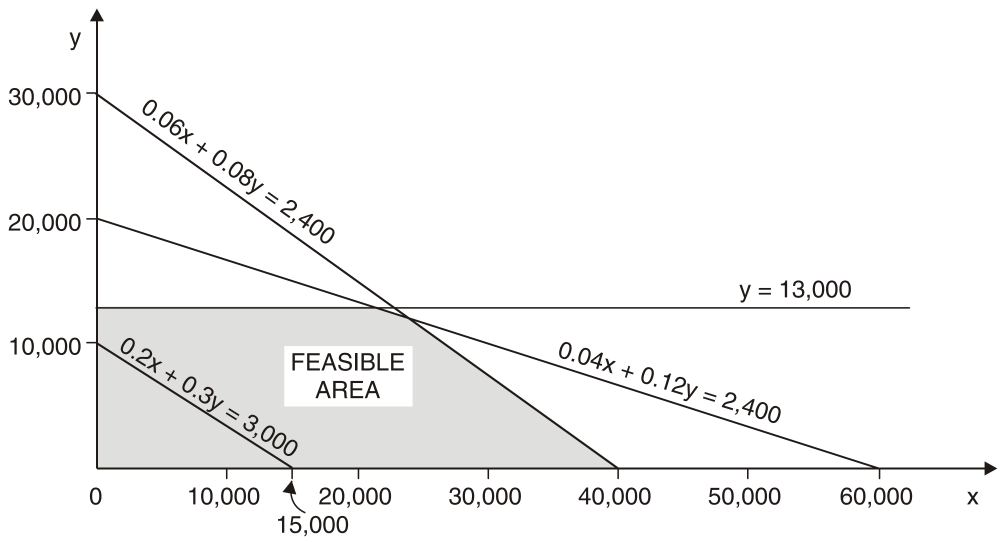
c) We would also get more contribution at point C where the number of units of product A is the same but 2,500 more units of product B are being produced.

This argument suggests that the **'best' solution** is going to be at a **point on the edge of the feasible area** rather than in the middle of it.

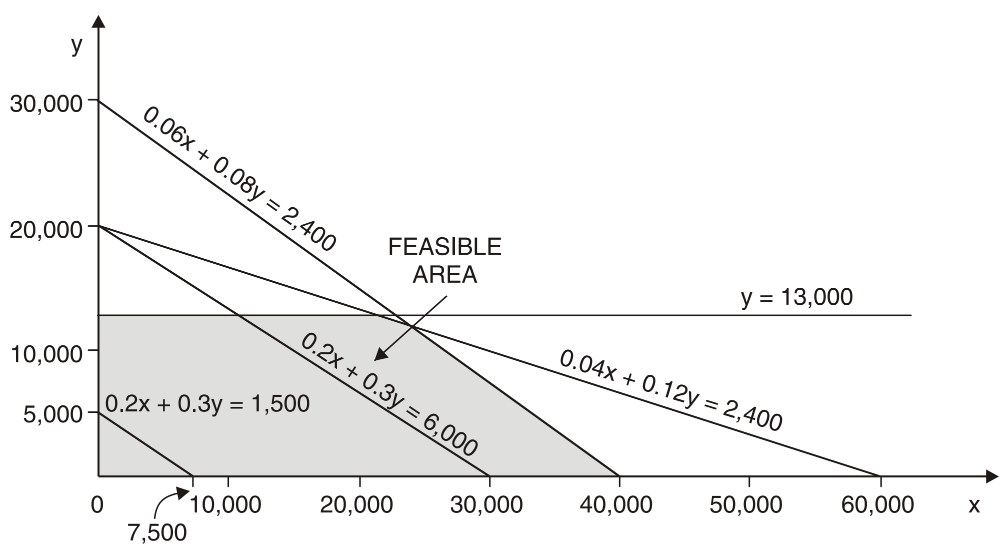
This still leaves us with quite a few points to look at but there is a way in which we can **narrow down still further the likely points at which the best solution will be found.** Suppose that WX wishes to earn contribution of RWF3,000. The company could sell the following combinations of the two products.

a) 15,000 units of A, no B.
b) No A, 10,000 units of B.
c) A suitable mix of the two, such as 7,500 A and 5,000 B.

The **possible combinations required to earn contribution of RWF3,000** could be **shown by the straight line 0.2x + 0.3y = 3,000.**



Likewise for profits of RWF6,000 and RWF1,500, lines of 0.2x + 0.3y = 6,000 and 0.2x + 0.3y = 1,500 could be drawn **showing the combination of the two products** which would **achieve contribution of RWF6,000 or RWF1,500.**



The **contribution lines are all parallel**. (They are called **iso-contribution lines**, 'iso' meaning equal.) A similar line drawn for any other total contribution would also be parallel to the three lines shown here. **Bigger contribution is shown by lines further from the origin** ($0.2x + 0.3y = 6,000$), smaller contribution by lines closer to the origin ($0.2x + 0.3y = 1,500$). As WX tries to increase possible contribution, we need to 'slide' any contribution line outwards from the origin, while always keeping it parallel to the other contribution lines.

As we do this there will come a point at which, if we were to **move the contribution line out any further, it would cease to lie in the feasible region**. Greater contribution could not be achieved, because of the constraints. In our example concerning WX this will happen, as you should test for yourself, where the contribution line just passes through the intersection of $0.06x + 0.08y = 2,400$ and $0.04x + 0.12y = 2,400$ (at coordinates (24,000, 12,000)). The point (24,000, 12,000) will therefore give us the optimal allocation of resources (to produce 24,000 units of A and 12,000 units of B).

We can usefully summarise the graphical approach to linear programming as follows.

Step 1	Define variables.	*Step 4*	Graph the problem.
Step 2	Establish objective function.	*Step 5*	Define feasible area.
Step 3	Establish constraints.	*Step 6*	Determine optimal solution.

Example: the graphical solution with a twist

This example shows that it is not always necessarily easy to identify the decision variables in a problem.

DCC operates a small plant for the manufacture of two joint chemical products X and Y. The production of these chemicals requires two raw materials, A and B, which cost RWF5,000 and RWF8,000 per litre respectively. The maximum available supply per week is 2,700 litres of A and 2,000 litres of B.

The plant can operate using either of two processes, which have differing operating costs and raw materials requirements for the production of X and Y, as follows.

	Process 1		Process 2		
Process	*Raw materials consumed*		*Output*		*Cost*
	Litres per processing hour		Litres per hour		RWF ‘000 per hour
	A	*B*	*X*	*Y*	
1	20	10	15	20	500
2	30	20	20	10	230

The plant can run for 120 hours per week in total, but for safety reasons, process 2 cannot be operated for more than 80 hours per week.

X sells for RWF18,000 per litre, Y for RWF24,000 per litre.

Required

Formulate a linear programming model, and then solve it, to determine how the plant should be operated each week.

Solution

Step 1 **Define variables**

You might decide that there are two decision variables in the problem, the quantity of X and the quantity of Y to make each week. If so, begin by letting these be x and y respectively.

You might also readily recognise that the aim should be to maximise the total weekly contribution, and so the objective function should be expressed in terms of maximising the total contribution from X and Y.

The contribution per litre from X and Y cannot be calculated because the operating costs are expressed in terms of processing hours.

	RWF '000 per hour	RWF '000 per hour		RWF '000 per hour	RWF '000 per hour
Costs:					
Material A		100			150
Material B		80			160
Operating cost		500			230
		680			540
Revenue:					
X (15 ×RWF k18)	270		(20 × 18,000)	360	
Y (20 × RWF k24)	480		(10 × 24,000)	240	
		750			600
Contribution		70			60

The **decision variables** should be **processing hours in each process**, rather than litres of X and Y. If we let the processing hours per week for process 1 be P1 and the processing hours per week for process 2 be P2 we can now formulate an objective function, and constraints, as follows.

Step 2 **Establish objective function**

Maximise $70P_1 + 60P_2$ (total contribution) subject to the constraints below

Step 3 **Establish constraints**

$20P_1 + 30P_2 \leq 2{,}700$ (material A supply)

$10P_1 + 20P_2 \leq 2{,}000$ (material B supply)

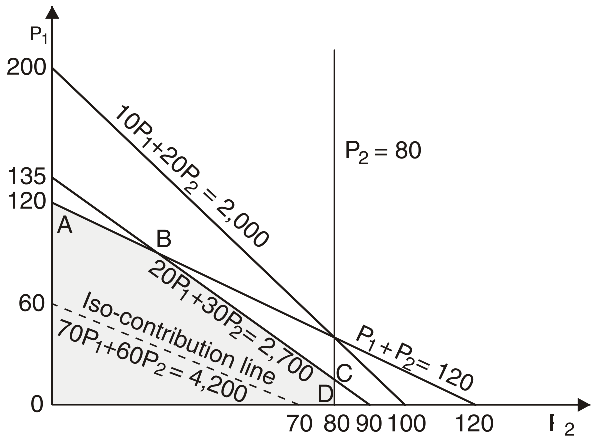
$P_2 \leq 80$ (maximum time for P_2)

$P_1 + P_2 \leq 120$ (total maximum time)

$P_1, P_2 \geq 0$

Step 4 **Graph the problem**

The graphical solution looks like this.



Step 5 **Define feasible area**

The material B constraint is not critical, and the feasible area for a solution is shown as ABCDO on the graph.

Step 6 **Determine optimal solution**

The optimal solution, determined using the iso-contribution line $70P_1 + 60P_2 = 4{,}200$, is at point A, where $P_1 = 120$ and $P_2 = 0$.

Production would be (120×15) 1,800 litres of X and (120×20) 2,400 litres of Y.

Total contribution would be ($120 \times$ RWF k70) = RWF k8,400 per week.

Example

On 20 days of every month GS makes two products, the Crete and the Corfu. Production is carried out in three departments – tanning, plunging and watering. Relevant information is as follows.

Note: All RWFvalues are in thousands

	Crete	*Corfu*
Contribution per unit	RWF75	RWF50
Minutes in tanning department per unit	10	12
Minutes in plunging department per unit	15	10
Minutes in watering department per unit	6	15
Maximum monthly sales (due to government quota restrictions)	3,500	4,000

	Tanning	*Plunging*	*Watering*
Number of employees	7	10	5
Hours at work per day per employee	7	6	10
Number of idle hours per day per employee	0.5	1	0.25

Due to various restrictions, employees cannot be at work for longer than the hours detailed above.

Required

Use the graphical method of linear programming to determine the optimum monthly production of Cretes and Corfus and the monthly contribution if GS's objective is to maximise contribution.

Solution

Calculate the number of productive hours worked in each department each month

Number of employees x number of productive hours worked each day x number of days each month.

Tanning = 7 x (7 – 0.5) × 20 = 910 hours

Plunging = 10 x (6 – 1) × 20 = 1,000 hours

Watering = 5 x (10 – 0.25) × 20 = 975 hours

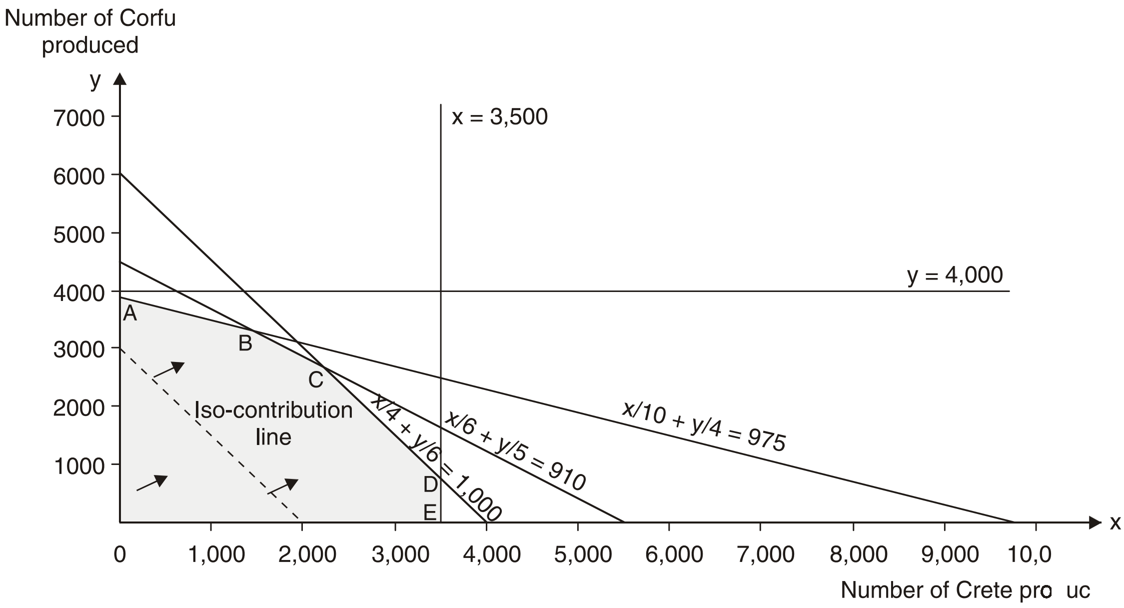
Step 1 **Define variables**
Let the number of Cretes produced each month = x and the number of Corfus produced each month = y.

Step 2 **Establish objective function**
The contribution is Rwf75 per Crete and Rwf50 per Corfu. The objective function is therefore maximise C = 75x + 50y subject to the constraints below.

Step 3 **Establish constraints**

Tanning	$x/6 + y/5$	$\leq$	910
Plunging	$x/4 + y/6$	$\leq$	1,000
Watering	$x/10 + y/4$	$\leq$	975
Monthly sales units	$x \leq 3{,}500$, $y \leq 4{,}000$		
Non negativity	$x \geq 0$,	$y \geq 0$	

Step 4 **Graph the problem**
The problem can be solved using the following graph which includes a sample contribution line 75x + 50y = 150,000.



Step 5 **Define the feasible area**

The feasible region for a solution is OABCDE.

Step 6 **Determine the optimal solution**

Moving the sample contribution line across the feasible region it can be seen that the optimum solution is at any point along the line x/4 + y/6 = 1,000 between C and D (as the sample contribution line has the same gradient as the plunging constraint). The coordinates of point C are (2,175, 2,737.5) while those of point D are (3,500, 750).

The contribution from any of these solutions is RWF((75 × 3,500) + (50 × 750)) = RWF300,000 (using the coordinates of D).

THE GRAPHICAL METHOD USING SIMULTANEOUS EQUATIONS

Instead of a 'sliding the contribution line out' approach, **simultaneous equations** can be used to determine the optimal allocation of resources, as shown in the following example.

The optimal solution can also be found using **simultaneous equations**.

Example: using simultaneous equations

An organisation manufactures plastic-covered steel fencing in two qualities: standard and heavy gauge. Both products pass through the same processes involving steel forming and plastic bonding.

The standard gauge sells at RWF15,000 a roll and the heavy gauge at RWF20,000 a roll. There is an unlimited market for the standard gauge but outlets for the heavy gauge are limited to 13,000 rolls a year. The factory operations of each process are limited to 2,400 hours a year. Other relevant data is given below.

Variable costs per roll

	Direct material	*Direct wages*	*Direct expense*
	RWF '000	RWF'000	RWF '000
Standard	5	7	1
Heavy	7	8	2

Processing hours per 100 rolls

	Steel forming	*Plastic bonding*
	Hours	Hours
Standard	6	4
Heavy	8	12

Required

Calculate the allocation of resources and hence the production mix which will maximise total contribution.

Solution

Step 1 **Define variables**

Let the number of rolls of standard gauge to be produced be x and the number of rolls of heavy gauge be y.

Step 2 **Establish objective function**

Standard gauge produces a contribution of RWF2,000 per roll RWFk15 – RWF k(5 + 7 + 1)) and heavy gauge a contribution of RWFk3 (RWF k20 – RWF k(7 + 8 + 2)).

Therefore the objective is to maximise contribution (C) = 2x + 3y subject to the constraints below.

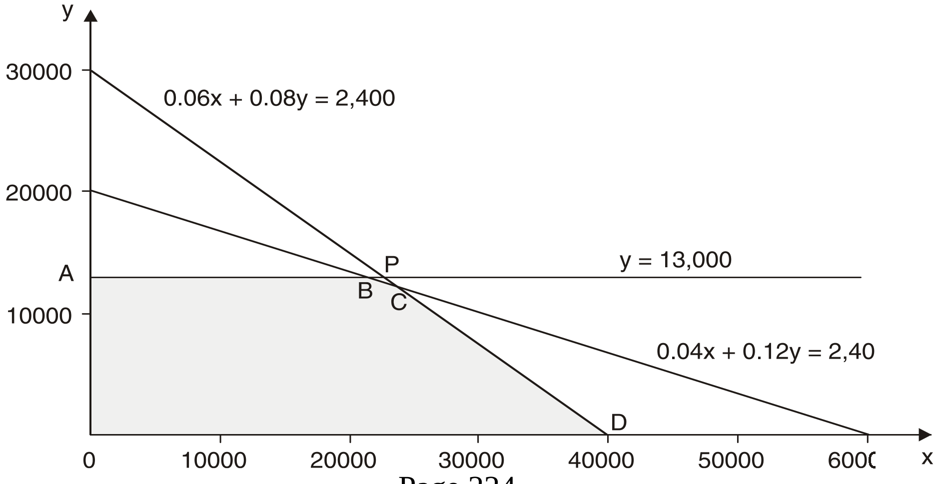
Step 3 **Establish constraints**

The constraints are as follows.

$0.06x + 0.08y$	$\leq$	2,400	(steel forming hours)
$0.04x + 0.12y$	$\leq$	2,400	(plastic bonding hours)
y	$\leq$	13,000	(demand for heavy gauge)
x, y	$\geq$	0	(non-negativity)

Step 4 **Graph problem**

The graph of the problem can now be drawn.



Step 5 **Define feasible area**

The combinations of x and y that satisfy all three constraints are represented by the area OABCD.

Step 6 **Determine optimal solution**

Which combination will maximise contribution? Obviously, the more units of x and y, the bigger the contribution will be, and the optimal solution will be at point B, C or D. It will not be at A, since at A, y = 13,000 and x = 0, whereas at B, y = 13,000 (the same) and x is greater than zero.

Using simultaneous equations to calculate the value of x and y at each of points B, C and D, and then working out total contribution at each point from this, we can establish the contribution-maximising product mix.

Point B

y	=	13,000	(1)
0.04x + 0.12y	=	2,400	(2)
0.12y	=	1,560	(3) ((1) × 0.12)
0.04x	=	840	(4) ((2) – (3))
x	=	21,000	(5)

Total contribution = (21,000 × RWF2,000) + (13,000 × RWF3,000) = RWF81,000,000.

Point C

0.06x + 0.08y	=	2,400	(1)
0.04x + 0.12y	=	2,400	(2)
0.12x + 0.16y	=	4,800	(3) ((1) × 2)
0.12x + 0.36y	=	7,200	(4) ((2) × 3)
0.2y	=	2,400	(5) ((4) – (3))
y	=	12,000	(6)
0.06x + 960	=	2,400	(7) (substitute in (1))
x	=	24,000	(8)

Total contribution = (24,000 × RWF2,000) + (12,000 × RWF3,000) = RWF84,000,000.

Point D

Total contribution = 40,000 × RWF2,000 = RWF80,000,000.

Comparing B, C and D, we can see that contribution is maximised at C, by making 24,000 rolls of standard gauge and 12,000 rolls of heavy gauge, to earn a contribution of RWF k84,000.

Slack and surplus

Slack occurs when maximum availability of a resource is not used. **Surplus** occurs when more than a minimum requirement is used.

If, at the optimal solution, the resource used equals the resource available there is **no spare capacity** of a resource and so there is **no slack.**

If a resource which has a **maximum availability** is **not binding** at the optimal solution, there will be **slack**.

In the example above, the optimal solution is x = 24,000, y = 12,000.

If we substitute these values into the inequalities representing the constraints, we can determine whether the constraints are binding or whether there is slack.

Steel forming hours:	(0.06 × 24,000) + (0.08 × 12,000) = 2,400 = availability
	Constraint is **binding.**
Plastic bonding hours:	(0.04 × 24,000) + (0.12 × 12,000) = 2,400 = availability
	Constraint is **binding.**
Demand:	Demand of 12,000 ≤ maximum demand of 13,000
	There is **slack**.

Note that because we had already determined the optimal solution to be at the intersection of the steel forming hours and plastic bonding hours constraints, we knew that they were binding!

If a minimum quantity of a resource must be used and, at the optimal solution, **more than that quantity is used**, there is a **surplus** on the minimum requirement.

For example, suppose in a particular scenario a minimum of 8,000 grade A labour hours had to be worked in the production of products x and y, such that (say) $3x + 2y \geq 8{,}000$. If 10,000 hours are used to produce the optimal solution, there is a **surplus** of 2,000 hours.

We will be looking at this form of constraint in the next section.

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SENSITIVITY ANALYSIS

Once a graphical linear programming solution has been found, it should be possible to provide further information by interpreting the graph more fully to see what would happen if certain values in the scenario were to change.

a) What if the contribution from one product was Rwf1 lower than expected?
b) What if the sales price of another product was raised byRwf2?
c) What would happen if less or more of a limiting factor were available, such as material?

Sensitivity analysis with linear programming can be carried out in one of two ways.

a) By **considering the value of each limiting factor or binding resource constraint**
b) By **considering sale prices (or the contribution per unit)**

Limiting factor sensitivity analysis

We use the shadow price to carry out sensitivity analysis on the availability of a limiting factor.

Shadow prices

The **shadow price** of a resource which is a limiting factor on production is the amount by which total contribution would fall if the organisation were deprived of one unit of the resource. The shadow price also indicates the amount by which total contribution would rise if the organisation were able to obtain one extra unit of the resource, provided that the resource remains an effective constraint on production and provided also that the extra unit of resource can be obtained at its normal variable cost.

So in terms of linear programming, the shadow price is the **extra contribution or profit that may be earned by relaxing by one unit a binding resource constraint**.

Suppose the availability of materials is a binding constraint. If one extra kilogram becomes available so that an alternative production mix becomes optimal, with a resulting increase over the original production mix contribution of RWF2, the shadow price of a kilogram of material is RWF.

Note, however, that this increase in contribution of RWF2 per extra kilogram of material made available is calculated on the **assumption** that the **extra kilogram would cost the normal variable amount**.

Note the following points.

a) The shadow price therefore represents the maximum **premium** above the basic rate that an organisation should be **willing to pay for one extra unit** of a resource.

b) Since shadow prices indicate the effect of a one unit change in a constraint, they provide a measure of the **sensitivity** of the result.

c) The **shadow price** of a constraint that is **not binding** at the optimal solution is **zero**.

d) Shadow prices are **only valid for a small range** before the constraint becomes non-binding or different resources become critical.

Depending on the resource in question, shadow prices enable management to make **better informed decisions** about the payment of overtime premiums, bonuses, premiums on small orders of raw materials and so on.

Calculating shadow prices

In the earlier example of WX, the availability of time in both departments are limiting factors because both are used up fully in the optimal product mix. Let us therefore calculate the effect if **one extra hour of shaping department machine time** was made available so that 2,401 hours were available.

The **new optimal product mix would be at the intersection of the two constraint lines** $0.06x + 0.08y = 2{,}400$ and $0.04x + 0.12y = 2{,}401$.

Solution by simultaneous equations gives $x = 23{,}980$ and $y = 12{,}015$.

(You should solve the problem yourself if you are doubtful about the derivation of the solution.)

Product	Units	*Contribution per unit* RWF	*Total contribution* RWF
A	23,980	0.20	4,796.0
B	12,015	0.30	3,604.5
			8,400.5
Contribution in original problem			
((24,000 × RWF0.20) + (12,000 × RWF0.30))			8,400.0
			0.5

Increase in contribution from one extra hour of shaping time

The **shadow price of an hour of machining time in the shaping department is therefore RWF0.50.**

The **shadow price** of a limiting factor also shows by **how much contribution would fall if the availability of a limiting resource fell by one unit**. The **shadow price** (also called **dual price**) of an hour of machine time in the shaping department would again be calculated as RWF0.50. This is the **opportunity cost** of deciding to put an hour of shaping department time to an alternative use.

We can now make the following points.

a) The management of WX should be prepared to **pay up to RWF0.50 extra per hour** (i.e. RWF0.50 over and above the normal price) of shaping department machine time to obtain more machine hours.

b) This **value** of machine time **only applies as long as shaping machine time is a limiting factor.** If more and more machine hours become available, there will eventually be so much machine time that it is no longer a limiting factor.

Example

What is the shadow price of one hour of machine time in the mixing department?

A RWF3
B RWF7
C RWF10.50
D RWF1,193

Solution

The correct answer is A.

If we assume one **less** hour of machine time in the mixing department is available, the new optimal solution is at the intersection of 0.06x + 0.08y = 2,399 and 0.04x + 0.12y = 2,400

Solution by simultaneous equations gives x = 23,970, y = 12,010

Product		*Contribution per unit*	*Total contribution*
	Units	RWF	RWF
A	23,970	0.20	4,794
B	12,010	0.30	3,603
			8,397
Contribution in original problem			8,400
Reduction in contribution			3

∴ Shadow price of one hour of machine time in the mixing department is RWF3.

Ranges for limiting factors

We can calculate **how many hours will be available before machine time in the shaping department ceases to be a limiting factor.**

Look back at the third graph in Section 1.3. As more hours become available the constraint line moves out away from the origin. It ceases to be a limiting factor when it passes through the intersection of the sales constraint and the mixing department machine time constraint which is at the point (22,667, 13,000).

So, if x = 22,667 and y = 13,000, our new constraint would be $0.04x + 0.12y = H$ (hours) where $H = (0.04 \times 22{,}667) + (0.12 \times 13{,}000) = 2{,}466.68$ hours.

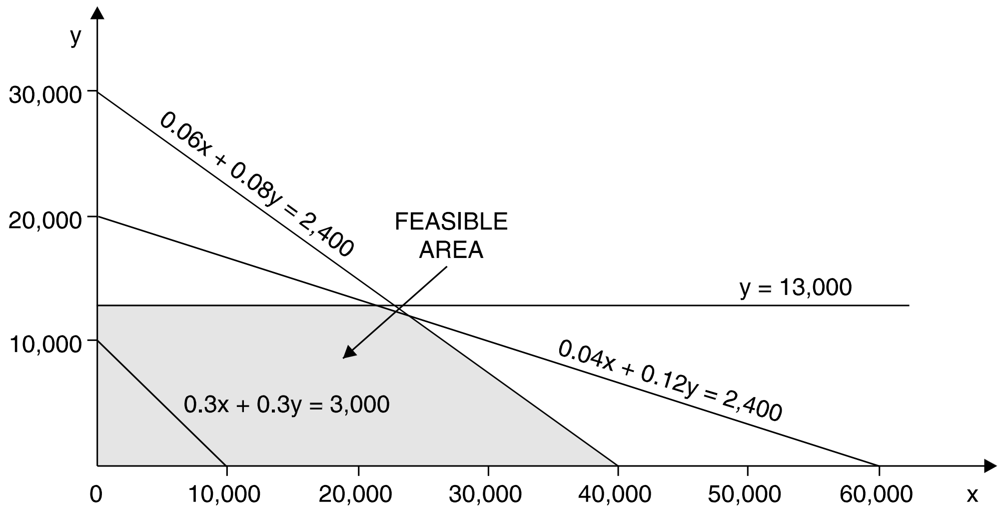
The shadow price of shaping department machine time is therefore RWF0.50 but only up to a maximum supply of 2,466.68 hours (that is 66.68 hours more than the original 2,400 hours). Extra availability of machine time above 2,466.68 hours would not have any use, and the two limiting factors would become sales demand for product B and machine time in the mixing department.

Sales price sensitivity analysis

Sales price sensitivity analysis is carried out by changing the slope of the 'iso-contribution' line.

The optimal solution in our WX example was to make 24,000 units of product A and 12,000 units of product B. Would this solution change if the **unit sales price of A increased by 10p?**

The **contribution would increase** to $0.3x + 0.3y$ (in place of $0.2x + 0.3y$). The **iso-contribution lines would now have a steeper slope** than previously, parallel (for example) to $0.3x + 0.3y = 3{,}000$.



If you were to place a ruler along the iso-contribution line and move it away from the origin as usual, you would find its **last point within the feasible region** was the point (40,000, 0).

Therefore if the sales price of A is raised by RWF 0.10, WX's contribution-maximising product mix would be to produce 40,000 units of A and none of B.

Example: sensitivity analysis

SW makes two products, X and Y, which each earn a contribution of RWF8 per unit. Each unit of X requires four labour hours and three machine hours. Each unit of Y requires three labour hours and five machine hours.

Total weekly capacity is 1,200 labour hours and 1,725 machine hours. There is a standing weekly order for 100 units of X which must be met. In addition, for technical reasons, it is necessary to produce at least twice as many units of Y as units of X.

Required

a) Determine the contribution-maximising production plan each week.

b) Calculate the shadow price of the following.

(i) Machine hours
(ii) Labour hours
(iii) The minimum weekly demand for X of 100 units

Solution (a): production plan

The linear programming problem may be formulated as follows.

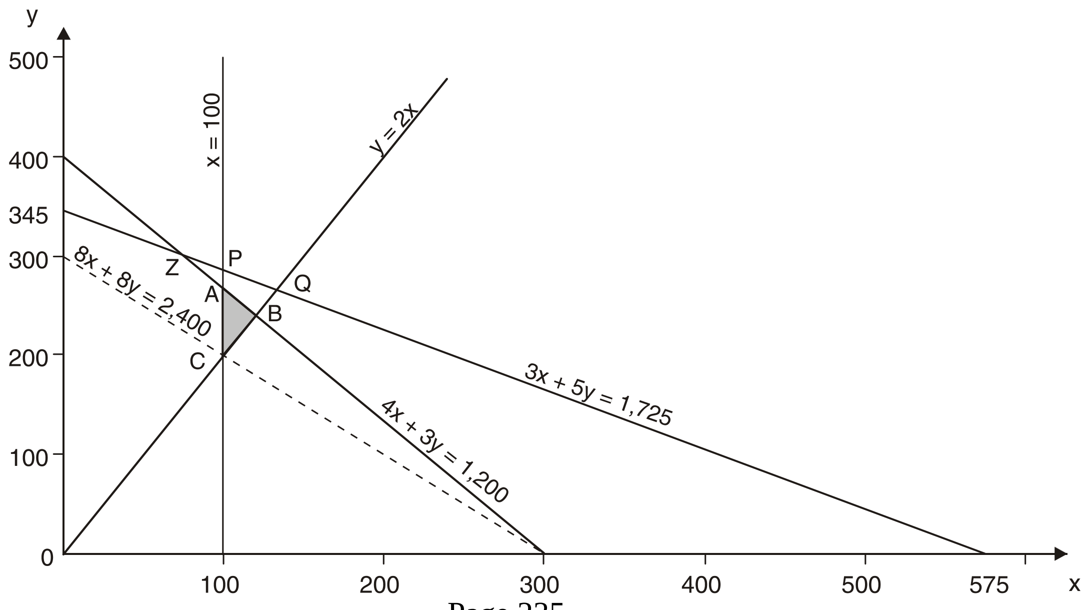
Step 1 **Define variables**
Let x = number of units of X produced and y = number of units of Y produced.

Step 2 **Establish objective function**
Maximise contribution (c) = 8x + 8y subject to the constraints below.

Step 3 **Establish constraints**

$4x + 3y$	$\leq$	1,200	(labour hours)
$3x + 5y$	$\leq$	1,725	(machine hours)
x	$\geq$	100	(minimum demand)
y	$\geq$	$2x$	(technical constraint)
y	$\geq$	0	(non-negativity)

Step 4 **Graph the problem**
The graph of this problem would be drawn as follows, using 8x + 8y = 2,400 as an iso-contribution line.



Step 5 **Establish feasible polygon**

The feasible polygon is ABC. Using the slope of the iso-contribution line, we can measure that the contribution-maximising point is point A.

Step 6 **Determine optimal solution**

At point A, the effective constraints are x = 100 and 4x + 3y = 1,200.

$\therefore$ If x = 100, (4 × 100) + 3y = 1,200

$\therefore$ 3y = 1,200 – 400 and so y = $266^2/_3$

It is important to be aware that in linear programming, the optimal solution is likely to give values to the decision variables which are in fractions of a unit. In this example, contribution will be maximised by making $266^2/_3$ units of Y.

	Contribution
	RWF
Make 100 units of X	800.00
$266^2/_3$ units of Y	2,133.33
Total weekly contribution	2,933.33

Solution (b): sensitivity analysis

(i) **Machine hours** are not fully utilised in the optimal solution. 100 units of X and $266^2/_3$ units of Y need (300 + 1,333.33) = 1,633.33 machine hours, leaving 91.67 **machine hours unused**. Machine hours, not being an effective constraint in the optimal solution, have a **shadow price of RWF0**. Obtaining one extra machine hour would add nothing to the contribution.

(ii) The shadow price of **labour hours** would be obtained by calculating the total weekly contribution if the labour hours constraint were 1,201 hours. It should be possible to see fairly easily that the **new optimal solution** would be where x = 100 and 4x + 3y = 1,201. Therefore x = 100, y = 267 and total weekly contribution would be (100 + 267) × RWF8 =RWF2,936.

Since contribution with 1,200 labour hours as the constraint was RWF2,933.33, the shadow price of labour hours is RWF(2,936 – 2,933.33) = RWF2.67 per hour. This is the amount by which total contribution would rise if one extra labour hour per week were made available.

Note that there is a limitation to the number of extra labour hours that could be used to earn extra contribution. As more and more labour hours are added, the constraint line will move further and further away from the origin. For example if we added 800 labour hours capacity each week, the constraint $4x + 3y \leq (1,200 + 800)$ (i.e. $4x + 3y \leq 2,000$) would be so much further away from the origin that it would no longer be an effective constraint. Machine hours would now help to impose limitations on production, and the profit-maximising output would be at point P on the graph.

Labour hours could only be added to earn more contribution up to point P, after which they would cease to be an effective constraint. At point P, $x = 100$ and $3x + 5y = 1,725$. Therefore $y = 285$.

The labour hours required to make 100 units of X and 285 units of Y are $(4 \times 100) + (3 \times 285) = 1,255$ hours, which is 55 hours more than the initial constraint limit.

Total contribution at point P = (100 + 285) × RWF8 = RWF3,080. Since total contribution at point A, where labour hours were limited to 1,200 hours, was RWF2,933.33, the extra contribution from the 55 extra labour hours would be RWF(3,080 – 2,933.33)/55 = RWF2.67 per hour (as calculated previously).

Thus, the shadow price of labour hours is RWF2.67 per hour, for a maximum of 55 extra hours per week, after which additional labour hours would add nothing to the weekly contribution.

(iii) The shadow price of the **minimum weekly demand for X** may be obtained by calculating the weekly contribution if the minimum demand is reduced by one unit to 99, so that $x \geq 99$, given no change in the other original constraints in the problem.

The new optimal solution would occur where $x = 99$ and $4x + 3y = 1,200$. Therefore $y = 268$.

Total contribution per week when $x = 99$ and $y = 268$ is (99 + 268) × RWF8 = RWF2,936. Since the contribution when $x \geq 100$ was RWF2,933.33, the **shadow price** of the minimum demand for X is RWF(2,936 – 2,933.33) = **RWF2.67 per unit**. In other words, by reducing the minimum demand for X, the weekly contribution can be raised by RWF2.67 for each unit by which the minimum demand is reduced below 100 per week.

As with the constraint on labour hours, this shadow price is **only applicable up to a certain amount.** If you refer back to the graph of the problem, you should be able to see that if the minimum constraint on X is reduced beyond point Z, it will cease to be an effective constraint in the optimal solution, because at point Z the machine hours limitation will begin to apply.

Example

By how many units per week can the minimum demand be reduced before the shadow price of RWF2.67 per unit referred to above ceases to apply?

A 300 units
B 100 units
C 75 units
D 25 units

Solution

The correct answer is D.

At point Z:	4x + 3y = 1,200	……. (1)
	3x + 5y = 1,725	……. (2)
Multiply (1) by 3	12x + 9y = 3,600	……. (3)
Multiply (2) by 4	12x + 20y = 6,900	……. (4)
Subtract (3) from (4)	11y = 3,300	
	y = 300	
Substituting in (1)	4x + 900 = 1,200	
	4x = 300	
	x = 75	

The shadow price of the minimum demand for X is RWF2.67 per unit demanded, but only up to a total reduction in the minimum demand of (100 – 75) = 25 units per week.

CHAPTER ROUNDUP

- The **graphical method** of linear programming is used for problems involving two products.

- The **steps in the graphical method** are as follows.

  - Define variables.
  - Establish objective function.
  - Establish constraints.
  - Draw a graph of the constraints.
  - Establish the feasible region.
  - Determine the optimal product mix.

- The **optimal solution** can be found by 'sliding the iso-contribution (or profit) line out'.

- The optimal solution can also be found using **simultaneous equations**.

- **Slack** occurs when maximum availability of a resource is not used. **Surplus** occurs when more than a minimum requirement is used.

- The **shadow price** of a resource which is a limiting factor on production is the amount by which total contribution would fall if the organisation were deprived of one unit of the resource. The shadow price also indicates the amount by which total contribution would rise if the organisation were able to obtain one extra unit of the resource, provided that the resource remains an effective constraint on production and provided also that the extra unit of resource can be obtained at its normal variable cost.

- **Sales price sensitivity analysis** is carried out by changing the slope of the 'iso-contribution' line.

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STUDY UNIT 10

Linear Programming: The Simplex Method

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THE PRINCIPLES OF THE SIMPLEX METHOD

The **simplex method** is a method of solving linear programming problems with two or more decision variables.

The formulation of the problem using the **simplex method** is similar to that required when the graphical method is used but **slack variables** must be incorporated into the constraints and the objective function.

General points about the simplex method

A **slack variable** represents the amount of a constraint that is unused.

In any feasible solution, if a problem involves n constraints and m variables (decision plus slack), n variables will have a positive value and (m–n) variables will have a value of zero.

Feasible solutions to a problem are shown in a **table**.

Before introducing an example to explain the technique, we will make a few introductory points. Don't worry if you get confused, working through the example will make things clearer.

a) The simplex method involves **testing one feasible solution after another**, in a **succession of tables, until the optimal solution is found**. It can be used for problems with **any number of decision variables, from two upwards**.

b) In addition to the decision variables, the method introduces additional variables, known as **slack variables** or **surplus variables**. There will be **one slack (or surplus) variable for each constraint in the problem (excluding non-negativity constraints)**.

   For example, if a linear programming problem has three decision variables and four constraints, there will be four slack variables. With the three decision variables, there will therefore be a total of seven variables and four constraints in the problem.

c) The technique is iterative (a **repetitive, step-by-step process)**, with each iteration (step) having the following **purposes**.

(i) To **establish a feasible solution** (in other words, a feasible combination of decision variable values and slack variable values) and the **value of the objective function** for that solution.

(ii) To **establish** whether that particular **solution** is one that **optimises** the value of the objective function.

d) Each feasible solution is tested by drawing up a **matrix**with the following rows and columns.

(i) **One row per constraint, plus a solution row**

(ii) **One column per decision variable and per slack variable, plus a solution column**

e) **Every variable**, whether a decision variable, slack variable or surplus variable, **must be ≥ 0 in any feasible solution**.

f) A feature of the simplex method is that if there are **n constraints**, there will be **n variables with a value greater than 0 in any feasible solution**. Thus, if there are seven variables in a problem, and four constraints, there will be four variables with a positive value in the solution, and three variables with a value equal to 0.

Keep these points in mind as we work through an example.

Example: the simplex method

An organisation produces and sells two products, X and Y. Relevant information is as follows.

	Materials	*Labour*	*Machine time*	*Contribution per unit*
	units	hours	hours	RWF
X, per unit	5	1	3	20
Y, per unit	2	3	2	16
Total available, each week	3,000	1,750	2,100	

Required

Use the simplex method to determine the profit-maximising product mix.

Formulating the problem

We have just two decision variables in this problem, but we can still use the simplex method to solve it.

Step 1 **Define variables**
Let x be the number of units of X that should be produced and sold.

Let y be the number of units of Y that should be produced and sold.

Step 2 **Establish objective function**
Maximum contribution (C) = 20x + 16y subject to the constraints below.

Step 3 **Establish constraints**
The constraints are as follows.

Materials $5x + 2y \leq 3{,}000$ Machine time $3x + 2y \leq 2{,}100$

Labour $x + 3y \leq 1{,}750$ Non-negativity $x \geq 0$, $y \geq 0$

Step 4 **Introduce slack variables**
Begin by turning each constraint (ignoring the non-negativity constraints now) into an equation. This is done by introducing slack variables.

Let a be the quantity of unused materials, b be the number of unused labour hours and c be the number of unused machine hours.

Slack variable. ‘Amount of each resource which will be unused if a specific linear programming solution is implemented.’

Example

A problem to be solved using linear programming has three decision variables, six constraints (including two non-negativity constraints) and one objective function.

How many slack variables will be required if the simplex method is used?

A 3
B 4
C 5
D 6

Answer

The correct answer is B.

A slack variable is required for each constraint (ignoring non-negativity constraints). There are 6 – 2 = 4 such constraints.

We can now express the original constraints as equations.

$5x + 2y + a = 3,000$

$x + 3y + b = 1,750$

$3x + 2y + c = 2,100$

The slack variables a, b and c will be equal to 0 in the final solution only if the combined production of X and Y uses up all the available materials, labour hours and machine hours.

Step 5 **Values of variables – non-negative or zero?**
In this example, there are **five variables** (x, y, a, b and c) and **three equations**, and so in any **feasible solution** that is tested, **three variables** will have a **non-negative value** (since there are three equations) which means that **two variables** will have a value of **zero.**

Example

A problem to be solved using linear programming has seven variables and four equations based on the original constraints.

How many variables will have a value of zero in any feasible solution determined using the simplex method?

A 7
B 5
C 4
D 3

Answer

The correct answer is D.

Four variables will have a non-negative value (since there are four equations), which means that 7 – 4 = 3 variables will have a value of zero.

Step 6 **Express objective function as an equation**

It is usual to express the objective function as an equation with the right hand side equal to zero. In order to keep the problem consistent, the slack (or surplus) variables are inserted into the objective function equation, but as the quantities they represent should have no effect on the objective function they are given zero coefficients. In our example, the objective function will be expressed as follows.

Maximise contribution (C) given by $C - 20x - 16y + 0a + 0b + 0c = 0$.

Drawing up the initial table and testing the initial feasible solution

You will not be required to do this in the exam but seeing how the initial table is drawn up will give you additional insight into the technique.

We begin by testing a solution that **all the decision variables have a zero value**, and **all the slack variables have a non-negative value.**

Obviously, this is **not going to be the optimum solution**, but it gives us a starting point from which we can develop other feasible solutions.

Simplex tables can be **drawn in several different ways,** and if you are asked to interpret a given table in an examination question, you may need to adapt your understanding of the table format in this Study Text to the format in the question. The following points apply to all tables, however.

a) There should be a **column for each variable** and also a **solution column**.
b) It helps to add a **further column on the left**, to **indicate the variable which is in the solution to which the corresponding value in the solution column relates**.
c) There is a **row for each equation** in the problem, and a **solution row**.

Here is the initial matrix for our problem. Information on how it has been derived is given below.

Variables in solution	*x*	*y*	*a*	*b*	*c*	*Solution*
A materials	5	2	1	0	0	3,000
B Labour hours	1	3	0	1	0	1,750
C Machine hours	3	2	0	0	1	2,100
Solution	–20	–16	0	0	0	0

a) The **figures in each** row correspond with the **coefficients of the variables in each of the initial constraints**. The bottom row or **solution row** holds the **coefficients of the objective function**. For example the materials constraint 5x + 2y + a = 3,000 gives us the first row, 5 (number of x's), 2 (number of y's), 1 (number of a's), then zeros in the b and c columns (since these do not feature in the constraint equation) and finally 3,000 in the solution column.

b) The **variables in the solution are a, b and c** (the unused resources).

(i) The **value of each variable is shown in the solution column.** We are testing a solution that all decision variables have a zero value, so there is no production and hence no resources are used. The total resource available is therefore unused.

(ii) The **column values** for each variable in the solution are as follows.

– 1 in the variable's own solution row
– 0 in every other row, including the solution row.

c) The **contribution per unit obtainable from x and y** is given in the **solution row.** These are the **dual prices** or **shadow prices** of the products X and Y. The minus signs are of no particular significance, except that in the solution given here they have the following meanings.

(i) A **minus shadow price** indicates that the **value of the objective function can be increased by the amount of the shadow price per unit** of the variable that is introduced into the solution, given no change in the current objective function or existing constraints.

(ii) A **positive shadow price** indicates the amount by which the **value of the objective function would be decreased** per unit of the variable introduced into the solution, given no change in the current objective function or the existing constraints.

Interpreting the table and testing for improvement

We can see that the **solution is testing a = 3,000, b = 1,750 and c = 2,100, contribution = 0. The co-efficients for the variables not in this solution, x and y, are the dual prices or shadow prices** of these variables, given the solution being tested. A **negative value** to a dual price means that the **objective function can be increased;** therefore the **solution in the table is not the optimal solution.**

The **shadow prices** in the initial solution (table) **indicate** the following.

a) The profit would be increased by RWF20 for every extra unit of x produced (because the shadow price of x is RWF20 per unit).

b) Similarly, the profit would be increased by RWF16 for every extra unit of y produced (because its shadow price is RWF16 per unit).

Since the **solution is not optimal,** the **contribution may be improved by introducing either x or y into the solution.**

The next step

The next step is to **test another feasible solution.** We do this by **introducing one variable into the solution, in the place of one variable that is now removed.** In our example, we **introduce x or y in place of a, b or c.**

The simplex technique continues in this way, producing a feasible solution in each successive table, until the optimal solution is reached.

Interpreting the final table

If the **shadow prices** on the bottom (solution) row of a table are all positive, the table shows the optimal solution.

- The solution column shows the optimal production levels and the units of unused resource.
- The figure at the bottom of the solution column/right-hand side of the solution row shows the value of the objective function.
- The figures in the solution row indicate the shadow prices of resources.

After a number of iterations, the following table is produced.

Variables in solution	*x*	*y*	*a*	*b*	*c*	*Solution column*
X	1	0	0	– 0.2857	0.4286	400
A	0	0	1	0.5714	– 1.8571	100
y	0	1	0	0.4286	– 0.1429	450
Solution row	0	0	0	1.1428	6.2858	15,200

This can be interpreted as follows.

a) The solution in this table is the **optimum** one, because the **shadow prices on the bottom row are all positive.**

b) The optimal solution is to **make and sell 400 units of X** and **450 units of Y, to earn a contribution of RWF15,200.**

c) The solution will leave **100 units of material unused,** but will use up all available labour and machine time.

d) The **shadow price of labour time (b) is RWF1.1428 per hour**, which **indicates the amount by which contribution could be increased if more labour time could be made available at its normal variable cost.**

e) The **shadow price of machine time (c) is RWF6.2858 per hour**, which **indicates the amount by which contribution could be increased if more machine time could be made available, at its normal variable cost.**

f) The **shadow price of materials is nil**, because there are 100 units of **unused** materials in the solution.

Question

TDS manufactures two products, X and Y, which earn a contribution of RWF8 and RWF14 per unit respectively. At current selling prices, there is no limit to sales demand for Y, but maximum demand for X would be 1,200 units. The company aims to maximise its annual profits, and fixed costs are RWF15,000 per annum.

In the year to 30 June 2012, the company expects to have a limited availability of resources and estimates of availability are as follows.

Skilled labour	maximum 9,000 hours
Machine time	maximum 4,000 hours
Material M	maximum 1,000 tonnes

The usage of these resources per unit of product are as follows.

	X	*Y*
Skilled labour time	3 hours	4 hours
Machine time	1 hour	2 hours
Material M	½ tonne	¼ tonne

Required

a) Formulate the problem using the simplex method of linear programming.
b) Determine how many variables will have a positive value and how many a value of zero in any feasible solution.

Solution

a) The linear programming problem would be formulated as follows.

Define variables

Let x and y be the number of units made and sold of product X and product Y respectively.

Establish objective function

Maximise contribution (C) = 8x + 14y subject to the constraints below.

Establish constraints

$$3x + 4y \leq 9{,}000 \quad \text{(skilled labour)*}$$

$$x + 2y \leq 4{,}000 \quad \text{(machine time)}$$

$$0.5x + 0.25y \leq 1{,}000 \quad \text{(material M)}$$

$$x \leq 1{,}200 \quad \text{(demand for X)}$$

$$x, y \geq 0$$

* This constraint is that skilled labour hours cannot exceed 9,000 hours, and since a unit of X needs 3 hours and a unit of Y needs 4 hours, 3x + 4y cannot exceed 9,000. The other constraints are formulated in a similar way.

Introduce slack variables

Introduce a slack variable into each constraint, to turn the inequality into an equation.

Let a = the number of unused skilled labour hours

b = the number of unused machine hours

c = the number of unused tonnes of material M

d = the amount by which demand for X falls short of 1,200 units

Then

$$3x + 4y + a = 9{,}000 \quad \text{(labour hours)}$$

$$x + 2y + b = 4{,}000 \quad \text{(machine hours)}$$

$$0.5x + 0.25y + c = 1{,}000 \quad \text{(tonnes of M)}$$

$$x + d = 1{,}200 \qquad \text{(demand for X)}$$

and maximise contribution (C) given by C – 8x – 14y + 0a + 0b + 0c + 0d = 0

b) There are six variables (x, y, a, b, c, d) and four equations. In any feasible solution four variables will have a non-negative value (as there are four equations), while two variables will have a value of zero.

Example

The final table to the problem in **Question: formulation of problem** is shown below.

Required

Interpret the table.

Variables in the solution	*x*	*y*	*a*	*b*	*c*	*d*	*Solution column*
x	1	0	0	–2	0	0	1,000
y	0	1	–0.5	1.5	0	0	1,500
c	0	0	–0.375	0.625	1	0	125
d	0	0	–1	2	0	1	200
Solution row	0	0	1	5	0	0	29,000

Answer

There is a column in the table for every variable, including the slack variables, but the important parts of the table are the 'Variables in the solution' column, the Solution row, and the Solution column. These tell us a number of things.

Identifying the variables in the solution

The variables in the solution are x, y, c and d. It follows that a and b have zero values. To be the variable in the solution on a particular row of the table, a value of 1 must appear in the **column** for that variable, with zero values in every other row of that column. For example, x is the variable in the solution for the row which has 1 in the x column. There are zeros in every other row in the x column.

The value of the variables

The solution **column** gives the value of each variable.

x	1,000	(units made of X)
y	1,500	(units made of Y)
c	125	(unused material M)
d	200	(amount below the 1,200 maximum of demand for X)

This means that contribution will be maximised by making and selling 1,000 units of X and 1,500 units of Y. This will leave 125 unused tonnes of material M, and production and sales of X will be 200 units below the limit of sales demand. Since a and b are both zero, there is no unused labour and machine time; in other words, all the available labour and machine hours will be fully utilised.

The total contribution

The value of the objective function – here, the total contribution – is in both the solution row and the solution column. Here it is RWF29,000.

Shadow prices

The solution **row** gives the **shadow prices** of each variable. Here, the shadow price of a is RWF1 per labour hour and that for b is RWF5 per machine hour.

This means that if more labour hours could be made available **at their normal variable cost per hour**, total contribution could be increased by RWF1 per extra labour hour. Similarly, if more machine time could be made available, **at its normal variable cost**, total contribution could be increased by RWF5 per extra machine hour. Here is the final table of a problem involving the production of products X and Y solved using the simplex method of linear programming.

Variables in solution	*x*	*y*	*a*	*b*	*c*	*d*	*e*	*Solution column*
x	1	0	–2.0	0	3.0	0	0	550
y	0	1	–0.8	0	0.5	0	0	720
b	0	0	1.5	1	1.0	0	0	95
d	0	0	0.7	0	–1.1	1	0	50
e	0	0	2.0	0	1.8	0	1	104
Solution row	0	0	7.0	0	4.0	0	0	14,110

SENSITIVITY ANALYSIS

You might be asked to carry out some **sensitivity analysis** on a simplex matrix giving the optimal solution to a linear programming problem. This could involve the following.

a) Testing **how the optimal solution** would change if there were either **more or less of a scarce resource**.

b) Testing whether it would be **worthwhile obtaining more of a scarce resource by paying a premium** for the additional resources, for example by paying an overtime premium for extra labour hours, or by paying a supplier a higher price for extra raw materials.

The effect of having more or less of a scarce resource

Sensitivity analysis can be applied to the final matrix to determine the effect of having more or less of a scarce resource (indicated by figures in the column for the resource's slack variable).

The optimal solution to a linear programming problem is based on the assumption that the constraints are known with certainty, and fixed in quantity. Sensitivity analysis enables us to test how the solution would alter if the quantity of a scarce resource (the size of a constraint) were to change.

Example: the effect of having more or less of a scarce resource

Return to our previous example, and the optimal solution in section named ‘Interpreting the final tableau’ , in which both labour hours and machine hours are fully used. How would the solution change if more labour hours (variable b) were available?

Solution

The simplex matrix, and in particular the **figures in the b column,** provide the following information for each extra labour hour that is available.

a) The **contribution** would **increase** by RWF1.1428

b) The value of **x** would **fall by 0.2857 units**
c) The value of **a** (unused materials) would **increase by 0.5714 units**
d) The value of **y** would **increase by 0.4286 units**

In other words, we would be able to make 0.4286 units of Y extra, to earn contribution of (× RWF16) RWF6.8576, but we would make 0.2857 units less of X and so lose contribution of (× RWF20) RWF5.714, leaving a net increase in contribution of RWF(6.8576 – 5.714) =RWF1.1436. Allowing for rounding errors of RWF0.0008, this is the figure already given above for the increase in contribution.

Since x = 400 in the optimal table, and extra labour hours would lead to a reduction of 0.2857 units of x, there is a **limit to the number of extra labour hours that would earn an extra RWF1.1428**. This limit is calculated as 400/0.2857 = 1,400 extra labour hours.

In other words, the **shadow price** of RWF1.1428 per hour for labour is **only valid for about 1,400 extra labour hours** on top of the given constraint in the initial problem, which was 1,750 hours, (that is up to a **total limit of 3,150 hours**).

If there were **fewer labour hours available**, the same sort of analysis would apply, but in reverse.

a) The contribution would fall by RWF1.1428 per hour unavailable
b) The value of x would increase by 0.2857 units
c) The value of a would fall by 0.5714 units
d) The value of y would fall by 0.4286 units

Example: obtaining extra resources at a premium on cost

Sensitivity analysis can also be applied to test whether or not it would be **worthwhile to obtain more of a scarce resource** by paying a premium for additional supplies (only if the shadow price is greater than the additional cost).

Suppose we are given the following additional information about our example.

a) The normal variable cost of labour hours (variable b) isRwf4 per hour, but extra labour hours could be worked in overtime, when the rate of pay would be time-and-a-half.

b) The normal variable cost of machine time is RWF1.50 per hour, but some extra machine time could be made available by renting another machine for 40 hours per week, at a rental cost of RWF160. Variable running costs of this machine would be RWF1.50 per hour.

Would it be worth obtaining the extra resources?

Solution

We know that the shadow price of labour hours is RWF1.1428 and of machine hours is RWF6.2858. We can therefore deduce the following.

a) **Paying an overtime premium** of RWF2 per hour for labour **would not be worthwhile**, because the extra contribution of RWF1.1428 per hour would be more than offset by the cost of the premium, leaving the company worse off by RWF0.8572 per hour worked in overtime.

b) **Renting the extra machine would be worthwhile**, but only by RWF91.43 (which is perhaps too small an amount to bother with).

c)

	RWF
Extra contribution from 40 hours of machine time (×RWF6.2858)	251.43
Rental cost	160.00
Net increase in profit	91.43

Note that the variable running costs do not enter into this calculation since they are identical to the normal variable costs of machine time. We are **concerned here only with the additional costs.**

Example

An organisation manufactures three products, tanks, trays and tubs, each of which passes through three processes, X, Y and Z.

	Process hours per unit			*Total process*
Process	*Tanks*	*Trays*	*Tubs*	*hours available*
X	5	2	4	12,000
Y	4	5	6	24,000
Z	3	5	4	18,000

The contribution to profit of each product is RWF2 for each tank, RWF3 per tray and RWF4 per tub.

Required

Fill in the blanks in (a) and (b) below, which relate to the formulation of the above data into a simplex linear programming model. Use the following notation.

Let a be the number of units of tanks produced

b be the number of units of trays produced

c be the number of units of tubs produced

x = quantity of unused process X hours

y = quantity of unused process Y hours

z = quantity of unused process Z hours

a) Maximise contribution (C) given by …………………………. subject to the following constraints in (b).

b) …………………………. (process X hours)

…………………………. (process Y hours)

…………………………. (process Z hours)

Answer

a) C is given by C – 2a – 3b – 4c + 0x + 0y + 0z

b) Constraint for process X hours: 5a + 2b + 4c + x = 12,000

Constraint for process Y hours: 4a + 5b + 6c + y = 24,000

Constraint for process Z hours: 3a + 5b + 4c + z = 18,000

Example

The final simplex table, based on the data in the question above, look like this.

Variables in solution	*a*	*b*	*c*	*x*	*y*	*z*	*Solution column*
c	1.583	0	1	0.417	0	–0.167	2,000
y	–2.167	0	0	–0.833	1	–0.667	2,000
b	–0.667	1	0	–0.333	0	0.333	2,000
Solution row	2.333	0	0	0.667	0	0.333	14,000

Required

a) Determine how many of each product should be produced and the maximum contribution. Calculate how much slack time, if any, is available in the processes.

b) Explain how your solution would vary if an extra 3,000 hours of process X time could be made available.

c) Describe what would happen to the production schedule and budgeted contribution if an order were received for 300 units of tanks which the company felt that it had to accept, because of the importance of the customer. **Ignore** the increase of process X time in part (b) above.

Solution

a) **Contribution is maximised at RWF14,000** by making **2,000 units of tubs** and **2,000 units of trays**. **No tanks** would be made.

There will be **2,000 slack hours in process Y.** Process X and process Z hours will be fully utilised.

b) The shadow price of process X time is RWF0.667 per hour, and for every extra hour of process X time that can be made available (at its normal variable cost), the production quantities could be altered in such a way that the following would happen.

(i) **Contribution would go up by Rwf0.667 per extra process X** hour used.

(ii) **c** (the quantity of tubs) would **go up by 0.417 units**.

(iii) **b** (the quantity of trays) would **go down by 0.333 units**.

(iv) **y** (unused process Y time) would **fall by 0.833 hours**.

This is **only true up to the point** where so many extra process X hours have been made available that either b or y reaches 0 in value. This will be at the following points.

(i) For y, after $\frac{2,000}{0.833}$ = 2,400 extra process X hours

(ii) For b, after $\frac{2,000}{0.333}$ = 6,000 extra process X hours

2,400 is the lowest of these two limits.

The shadow price is therefore **valid only for up to 2,400 extra process X hours,** so that the full 3,000 available would not be required.

The **new optimal solution** would therefore be to make and sell the following.

c 2,000 + (2,400 × 0.417) = 3,000 units

b 2,000 – (2,400 × 0.333) = 1,200 units

These would require a total of 14,400 hours in process X, 24,000 hours in process Y and 18,000 hours in process Z.

Contribution would be as follows.

	RWF
Tubs 3,000 × RWF4	12,000
Trays 1,200 × RWF3	3,600
	15,600
Contribution in initial solution	14,000
Increase in contribution (2,400 × RWF0.667)	1,600

c) Going back to the original solution, if an order is received for 300 units of tanks, the production schedule would be re-arranged so that **for each unit of tank made the following would happen.**

(i) **Contribution would fall** by RWF2.333.

(ii) 1.583 **units less of tubs** (variable c) would be made.

(iii) 0.667 **units more of trays** (variable b) would be made.

(iv) **Unused process Y time would increase** by 2.167 hours.

The new production and contribution budget would be as follows.

Product		Units	*Process X time* Hours	*Process Y time* Hours	*Process Z time* Hours	*Contribution* RWF
Tanks	(a)	300	1,500	1,200	900	600
Trays	(b)	2,200*	4,400	11,000	11,000	6,600
Tubs	(c)	1,525**	6,100	9,150	6,100	6,100
			12,000	21,350	18,000	13,300

*   2,000 + (300 × 0.667)

**   2,000 – (300 × 1.583)

The contribution is RWF700 lower than in the original optimal solution (which represents 300 tanks × RWF2.333).

Unused process Y time is 2,650 hours, which is 650 more than in the original solution (which represents 300 × 2.167)

USING COMPUTER PACKAGES

Spreadsheet packages can be used to solve linear programming problems.

- The **slack/surplus** columns provide information about the slack values of ≤ constraints and the surplus values of any ≥ constraints.
- The **worth** column shows the positive shadow price of resources.
- The **relative loss** shows by how much contribution (usually) would fall if extra units of particular decision variables were produced.

Nowadays, modern spreadsheet packages can be used to solve linear programming problems.

Suppose an organisation produces three products, X and Y and Z, subject to four constraints (1, 2, 3, 4).

a) **Constraints 1 and 2** are **'less than or equal to' resource constraints**.
b) **Constraint 3 provides a limit on the number of X** that can be produced.
c) **Constraint 4** is a **'greater than or equal to' constraint** and provides for a **minimum number of Z** to be produced (400).

The organisation wishes to maximise contribution.

Typical output from a spreadsheet package for such a problem is shown below.

Objective function (c)		137,500
Variable	*Value*	*Relative loss*
x	475.000	0.000
y	0.000	105.000
z	610.000	0.000
Constraint	*Slack/surplus*	*Worth*
1	17.000	0.000
2	0.000	290.000
3	0.000	1,150.000
4	210.000	0.000

Interpretation

a) Total optimal **contribution (c)** will be RWF137,500.

b) The **variable** and **value columns** mean that x = 475, y = 0 and z = 610.

To maximise contribution, 475 units of X and 610 units of Z should therefore be produced. No units of Y should be produced.

c) The **constraint** and **slack/surplus** columns provide information about the slack values of 'less than or equal to' constraints and the surplus values for any 'greater than or equal to' constraints.

(i) **Constraint 1** is a 'less than or equal to' resource constraint. The slack is 17 and so 17 units of resource 1 will be unused in the optimal solution.

(ii) **Constraint 2** is a 'less than or equal to' resource constraint. The slack is zero, indicating that all available resource 2 will be used in the optimal solution.

(iii) **Constraint 3** provides a limit on x. The slack is zero, showing that the limit has been met.

(iv) **Constraint 4** provides for a minimum z. The surplus is 210, meaning 400 + 210 = 610 units of Z are made.

d) **Worth**. This column shows the positive shadow price of resources (the amount that contribution (or, in general terms, c) alters if the availability of the resource is changed by one unit).

(i) Contribution would increase by RWF290 if one extra unit of resource 2 were made available.

(ii) Contribution would increase by RWF1,150 if the limit on the minimum number of Z to be produced altered by 1.

(iii) Resource 1 has a worth of 0 because 17 units of the resource are unused in the optimal solution.

In general, any constraint with a slack of zero has a positive worth figure, while any constraint with a positive slack figure will have a worth of zero.

e) **Relative loss.** This indicates that if one unit of Y were produced, total contribution (or generally c) would fall by RWF105. A relative loss of RWF105 would therefore be made for every unit of Y made. Units of Y should only be made if unit contribution of Y increases by RWF105.

X and Z have relative losses of zero, indicating that they should be made.

In general, only those decision variables with a relative loss of zero will have a positive value in the optimal solution.

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USING LINEAR PROGRAMMING

There are a number of **assumptions** and **practical difficulties** in the use of linear programming.

The considerations, non-quantifiable factors and assumptions in limiting factor analysis that we looked at in Chapter 8 apply equally to linear programming.

Further assumptions

In addition, there are **further assumptions** if we are dealing with product mix decisions involving several limiting factors.

a) The **total amount available of each scarce resource is known with accuracy**.
b) There is **no interdependence between the demand** for the different products or services, so that there is a completely free choice in the product or service mix without having to consider the consequences for demand or selling prices per unit.

In spite of these assumptions, linear programming is a useful technique in practice. Some statistical studies have been carried out suggesting that linear cost functions do apply over fairly wide ranges of output, and so the assumptions underlying linear programming may be valid.

Uses of linear programming

a) **Budgeting**. If scarce resources are ignored when a budget is prepared, the budget is unattainable and is of little use for planning and control. When there is more than one scarce resource, linear programming can be used to identify the most profitable use of resources.

b) **Calculation of relevant costs**. The calculation of relevant costs is essential for decision making. The **relevant cost** of a **scarce resource** is calculated as **acquisition cost of the resource plus opportunity cost**. When **more than one scarce resource** exists, the **opportunity cost** (or **shadow price**) should be established using linear programming techniques.

c) **Selling different products.** Suppose that an organisation faced with resource constraints manufactures products X and Y and linear programming has been used to determine the shadow prices of the scarce resources. If the organisation now wishes to manufacture and sell a modified version of product X (Z), requiring inputs of the scarce resources, the relevant costs of these scarce resources can be determined (see above) to ascertain whether the production of X and Y should be restricted in order to produce Z.

d) **Maximum payment for additional scarce resources**. This use of shadow prices has been covered in this chapter.

e) **Control.** Opportunity costs are also important for cost control: standard costing can be improved by incorporating opportunity costs into variance calculations. For example, adverse material usage variances can be an indication of material wastage. Such variances should be valued at the standard cost of the material plus the opportunity cost of the loss of one scarce unit of material. Such an approach highlights the true cost of the inefficient use of scarce resources and encourages managers of responsibility centres to pay special attention to the control of scarce factors of production. For organisations using an optimised production technology (OPT) strategy, this approach is particularly useful because variances arising from bottleneck operations will be reported in terms of opportunity cost rather than purchase cost.

f) **Capital budgeting**. Linear programming can be used to determine the combination of investment proposals that should be selected if investment funds are restricted in more than one period.

Practical difficulties with using linear programming

Difficulties with applying the linear programming technique in practice include the following.

a) It may be **difficult to identify** which **resources** are likely to be **in short supply** and **what the amount of their availability will be**.

With linear programming, the profit-maximising product mix and the shadow price of each limiting factor depend on the total estimated availability of each scarce resource. So it is not sufficient to know that labour hours and machine hours will be in short supply, it is also necessary to guess how many labour hours and machine hours will be available. Estimates of future availability will inevitably be prone to inaccuracy and any such inaccuracies will invalidate the profit-maximising product mix derived from the use of linear programming.

b) Management may **not make product mix decisions which are profit-maximising**. They may be more concerned to develop a production/sales plan which has the following features.

   (i) Realistic
   (ii) Acceptable to the individual managers throughout the organisation
   (iii) Acceptable to the rest of the workforce
   (iv) Promises a 'satisfactory' profit and accounting return

   In other words, management might look for a **satisfactory product mix** which achieves a satisfactory return, sales revenue and market share whilst at the same time plans operations and targets of achievement which employees can accept as realistic, not too demanding or unreasonable, and not too threatening to their job security.

   If a 'satisfactory' output decision is adopted, the product mix or service mix **recommended by the linear programming** (profit-maximising) technique will inevitably be **'watered down', amended or ignored**.

c) The **assumption of linearity may be totally invalid except over smaller ranges**. For example, in a profit maximisation problem, it may well be found that there are substantial changes in unit variable costs arising from increasing or decreasing returns to scale.

d) The linear programming model is essentially **static** and is therefore not really suitable for analysing in detail the effects of changes in the various parameters, for example over time.

e) In some circumstances, a practical solution derived from a linear programming model may be of **limited use** as, for example, where the variables may only take on **integer values**. A solution must then be found by a combination of rounding up and trial and error.

f) The **shadow price** of a scarce resource **only applies up to a certain limit**.

CHAPTER ROUNDUP

- The formulation of the problem using the **simplex method** is similar to that required when the graphical method is used but **slack variables** must be incorporated into the constraints and the objective function.

- A **slack variable** represents the amount of a constraint that is unused.

- In any feasible solution, if a problem involves n constraints and m variables (decision plus slack), n variables will have a positive value and (m–n) variables will have a value of zero.

- Feasible solutions to a problem are shown in a **matrix table**.

- If the **shadow prices** on the bottom (solution) row of a table are all positive, the table shows the optimal solution.

  – The solution column shows the optimal production levels and the units of unused resource.
  – The figure at the bottom of the solution column/right-hand side of the solution row shows the value of the objective function.
  – The figures in the solution row indicate the shadow prices of resources.

- **Sensitivity analysis** can be applied to the final matrix to determine the effect of having more or less of a scarce resource (indicated by figures in the column for the resource's slack variable).

- Sensitivity analysis can also be applied to test whether or not it would be **worthwhile to obtain more of a scarce resource** by paying a premium for additional supplies (only if the shadow price is greater than the additional cost).

- **Spreadsheet packages** can be used to solve linear programming problems.

  – The **slack/surplus** columns provide information about the slack values of ≤ constraints and the surplus values of any ≥ constraints.
  – The **worth** column shows the positive shadow price of resources.
  – The **relative loss** shows by how much contribution (usually) would fall if extra units of particular decision variables were produced.

- There are a number of **assumptions** and **practical difficulties** in the use of linear programming.

STUDY UNIT 11

Risk And Uncertainty

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EXAM GUIDE

Management accounting exams have increasingly expected candidates to have a good understanding of risk. Questions are likely to be a mixture of calculations and explanation.

RISK AND UNCERTAINTY

An example of a **risky situation** is one in which we can say that there is a 70% probability that returns from a project will be in excess of RWF100 million but a 30% probability that returns will be less than RWF100 million. If we cannot predict an outcome or assign probabilities, we are faced with an **uncertain** situation.

Risk involves situations or events which may or may not occur, but whose probability of occurrence can be calculated statistically and the frequency of their occurrence predicted from past records. Thus insurance deals with risk.

Uncertain events are those whose outcome cannot be predicted with statistical confidence.

In everyday usage the terms risk and uncertainty are not clearly distinguished. If you are asked for a definition, do not make the mistake of believing that the latter is a more extreme version of the former. It is not a question of degree, it is a question of whether or not sufficient information is available to allow the lack of certainty to be quantified. As a rule, however, the terms are used interchangeably.

Risk preference

People may be **risk seekers**, **risk neutral** or **risk averse**.

A **risk seeker** is a decision maker who is interested in the best outcomes no matter how small the chance that they may occur.

A decision maker is **risk neutral** if s/he is concerned with what will be the most likely outcome.

A **risk averse** decision maker acts on the assumption that the worst outcome might occur.

This has clear implications for managers and organisations. A **risk seeking manager** working for an **organisation** that is characteristically **risk averse** is likely to make decisions that are **not congruent with the goals of the organisation**. There may be a role for the management accountant here, who could be instructed to present decision-making information in such a way as to ensure that the manager considers *all* the possibilities, including the worst.

ALLOWING FOR UNCERTAINTY

Management accounting directs its attention towards the **future** and the future is **uncertain**. For this reason a number of methods of taking **uncertainty** into consideration have evolved.

Research techniques to reduce uncertainty

Market research can be used to reduce uncertainty.

Market research is the systematic process of gathering, analysing and reporting data about markets to investigate, describe, measure, understand or explain a situation or problem facing a company or organisation.

Market research involves **tackling problems**. The assumption is that these problems can be solved, no matter how complex the issues are, if the researcher follows a line of enquiry in a **systematic** way, without losing sight of the main objectives. Gathering and analysing all the facts will ultimately lead to **better decision making.**

The role of market research

In the last 20 years or so market research has become a much more widespread activity. Organisations – in the private sector, the public sector and the not-for-profit sector – rely on research to inform and improve their **planning and decision making**.

Market research enables organisations to understand the needs and opinions of their customers and other stakeholders. Armed with this knowledge they are able to make better quality decisions and provide better products and better services.

Thus, research influences what is provided and the way it is provided. It **reduces uncertainty and monitors performance.** A management team which possesses accurate information relating to the marketplace will be in a strong position to make the best decisions in an increasingly competitive world.

Decision-makers need data to reduce **uncertainty** and **risk** when planning for the future and to monitor business performance. Market researchers provide the data that help them to do this.

Types of data collected

Data can be either **primary** (collected at first hand from a sample of respondents), or **secondary** (collected from previous surveys, other published facts and opinions, or from experts). Secondary research is also known as **desk research**, because it can be carried out from one's desk.

More importantly for research practice and analysis, data can be either quantitative or qualitative.

Quantitative data usually deal with numbers and typically provide the decision maker with information about **how many** customers, competitors etc act in a certain way. Quantitative data can, for example, tell the researcher **what** people need or consume, or **where**, **when** and **how** people buy goods or consumer services.

Qualitative data tell us **why** consumers think/buy or act the way they do. Qualitative data are used in **consumer insight** (eg understanding what makes consumers prefer one brand to another), **media awareness** (eg how much of an advertisement is noticed by the public), **new product development** studies and for many other reasons.

Qualitative research has as its specific purpose the uncovering and understanding of thought and opinion. It is carried out on relatively small samples and unstructured or semi-structured techniques, such as individual in depth interviews and group discussions (also known as **focus groups**), are used.

Conservatism

This approach simply involves estimating outcomes in a conservative manner in order to provide a built-in safety factor.

However, the method fails to consider explicitly a **range** of outcomes and, by concentrating only on conservative figures, may also fail to consider the **expected** or most likely outcomes.

Conservatism is associated with **risk aversion** and prudence (in the general sense of the word). In spite of its shortcomings it is probably the **most widely used** method in practice.

Worst/most likely/best outcome estimates

A more scientific version of conservatism is to measure the most likely outcome from a decision, and the worst and best possible outcomes. This will show the **full range of possible outcomes** from a decision, and might help managers to reject certain alternatives because the worst possible outcome might involve an unacceptable amount of loss. This requires the preparation of **pay-off tables.**

Pay-off tables

Pay-off tables **identify and record all possible outcomes (or pay-offs)** in situations where the action taken affects the outcomes.

Example: worst/best possible outcomes

Omelette Ltd is trying to set the sales price for one of its products. Three prices are under consideration, and expected sales volumes and costs are as follows.

Price per unit	*RWF 4,000*	*RWF 4,300*	*RWF 4,400*
Expected sales volume (units)			
Best possible	16,000	14,000	12,500
Most likely	14,000	12,500	12,000
Worst possible	10,000	8,000	6,000

Fixed costs are RWF20,000,000 and variable costs of sales are RWF2,000 per unit.

Which price should be chosen?

Solution

Here we need to prepare a pay-off table showing **pay-offs** (contribution) **dependant on different levels of demand and different selling prices.**

Price per unit	*RWFk4*	*RWFk4.30*	*RWFk4.40*
Contribution per unit	RWFk2	RWFk2.30	RWFk2.40
Total contribution towards fixed costs	RWF k	RWF k	RWF k
Best possible	32,000	32,200	30,000
Most likely	28,000	28,750	28,800
Worst possible	20,000	18,400	14,400

a) The highest contribution based on **most likely** sales volume would be at a price of RWF4,400 but arguably a price of RWF4,300 would be much better than RWF4,400, since the most likely profit is almost as good, the worst possible profit is not as bad, and the best possible profit is better.

b) However, only a price of RWFk4 guarantees that the company would **not make a loss,** even if the worst possible outcome occurs. (Fixed costs of RWF20,000,000 would just be covered.) A risk averse management might therefore prefer a price of RWF4,000 to either of the other two prices.

PROBABILITIES AND EXPECTED VALUES

Expected values indicate what an outcome is likely to be in the long term with repetition. Fortunately, many business transactions do occur over and over again.

Although the outcome of a decision may not be certain, there is some likelihood that probabilities could be assigned to the various possible outcomes from an analysis of previous experience.

Expected values

Where probabilities are assigned to different outcomes we can evaluate the worth of a decision as the **expected value**, or weighted average, of these outcomes. The principle is that when there are a number of alternative decisions, each with a range of possible outcomes, the optimum decision will be the one which gives the highest expected value.

Example: expected values

Suppose a manager has to choose between mutually exclusive options A and B, and the probable outcomes of each option are as follows.

Option A		*Option B*	
Probability	*Profit*	*Probability*	*Profit*
	RWF '000		RWF '000
0.8	5,000	0.1	(2,000)
0.2	6,000	0.2	5,000
		0.6	7,000
		0.1	8,000

The expected value (EV) of profit of each option would be measured as follows.

Option A					*Option B*				
Prob		*Profit*		*EV of profit*	*Prob*		*Profit*		*EV of profit*
		RWF '000		RWF '000			RWF '000		RWF '000
0.8	x	5,000	=	4,000	0.1	x	(2,000)	=	(200)
0.2	x	6,000	=	1,200	0.2	x	5,000	=	1,000
		EV	=	5,200	0.6	x	7,000	=	4,200
					0.1	x	8,000	=	800
							EV	=	5,800

In this example, since it offers a higher EV of profit, option B would be selected in preference to A, unless further risk analysis is carried out.

Example

A manager has to choose between mutually exclusive options C and D and the probable outcomes of each option are as follows.

Option C		*Option D*	
Probability	*Cost*	*Probability*	*Cost*
	RWF '000		RWF'000
0.29	15,000	0.03	14,000
0.54	20,000	0.30	17,000
0.17	30,000	0.35	21,000
		0.32	24,000

Both options will produce an income of RWF30,000,000. Which should be chosen?

Answer

Option C. Do the workings yourself in the way illustrated above. Note that the probabilities are for *costs* not profits.

Limitations of expected values

The preference for B over A on the basis of expected value is marred by the fact that A's **worst possible** outcome is a profit of RWF5,000, whereas B might incur a loss of RWF2,000 (although there is a 70% chance that profits would be RWF7,000 or more, which would be more than the best profits from option A).

Since the decision must be made **once only** between A and B, the expected value of profit (which is **merely a weighted average** of all possible outcomes) has severe limitations as a decision rule by which to judge preference. The expected value will almost **never actually occur**.

Expected values are used to support a **risk-neutral attitude**. A risk-neutral decision maker will ignore any variability in the range of possible outcomes and be concerned only with the expected value of outcomes.

Expected values are more valuable as a guide to decision making where they refer to outcomes which will occur **many times over**. Examples would include the probability that so many customers per day will buy a can of baked beans, the probability that a customer services assistant will receive so many phone calls per hour, and so on.

DECISION RULES

The 'play it safe' basis for decision making is referred to as the **maximin basis**. This is short for '**maximise the minimum achievable profit**'.

A basis for making decisions by looking for the best outcome is known as the **maximax basis**, short for **'maximise the maximum achievable profit'**.

The 'opportunity loss' basis for decision making is known as **minimax regret**.

The maximin decision rule

The **maximin decision rule** suggests that a decision maker should select the alternative that offers the least unattractive of the worst outcomes. This would mean choosing the alternative that *maximises* the *minimum* profits.

Suppose a businessman is trying to decide which of three mutually exclusive projects to undertake. Each of the projects could lead to varying net profit under three possible scenarios.

			Profits	
			Project	
		D	*E*	*F*
	I	100	80	60
Scenarios	II	90	120	85
	III	(20)	10	85

The maximin decision rule suggests that he should select the 'smallest worst result' that could happen. This is the decision criterion that managers should 'play safe' and either minimise their losses or costs, or else go for the decision which gives the higher minimum profits. If he selects project D the worst result is a loss of 20. The worst results for E and F are profits of

10 and 60 respectively. The best worst outcome is 60 and project F would therefore be selected (because this is a better 'worst possible' than either D or E).

Criticisms of maximin

a) It is **defensive** and **conservative**, being a safety first principle of avoiding the worst outcomes without taking into account opportunities for maximising profits.

b) It ignores the **probability** of each different outcome taking place.

Maximax

The **maximax criterion** looks at the best possible results. Maximax means 'maximise the maximum profit'.

Using the information above, the maximum profit for D is 100, for E is 120 and for F is 85.

Project E would be chosen if the maximax rule is followed.

Criticisms of maximax

a) It ignores probabilities.
b) It is **over-optimistic**.

Example

A company is considering which one of three alternative courses of action, A, B and C to take. The profit or loss from each choice depends on which one of four economic circumstances, I, II, III or IV will apply. The possible profits and losses, in millions of francs, are given in the following payoff table. Losses are shown as negative figures.

		A	*B*	*C*
		Action		
	I	70	60	70
Circumstance	II	–10	20	–5
	III	80	0	50
	IV	60	100	115

Required

State which action would be selected using each of the maximax and maximin criteria.

Answer

a) The **best possible outcomes** are as follows.

A (circumstance III): 80

B (circumstance IV): 100

C (circumstance IV): 115

As 115 is the highest of these three figures, action C would be chosen using the maximax criterion.

b) The **worst possible outcomes** are as follows.

A (circumstance II): –10

B (circumstance III): 0

C (circumstance II): –5

The best of these figures is 0 (neither a profit nor a loss), so action B would be chosen using the maximin criterion.

Minimax regret rule

The **minimax regret rule** aims to minimise the regret from making the wrong decision. **Regret** is the opportunity lost through making the wrong decision.

We first consider the extreme to which we might come to regret an action we had chosen.

Regret for any combination of action and circumstances	=	Profit for best action in those circumstances	–	Profit for the action actually chosen in those circumstances

The minimax regret decision rule is that the decision option selected should be the one which **minimises the maximum potential regret** for any of the possible outcomes.

Using the example above, a table of regrets can be compiled as follows.

		Project		
		D	*E*	*F*
	I	0	20*	40**
Scenario	II	30***	0	35
	III	105	75	0
Maximum regret		105	75	40

* 100 – 80 ** 100 – 60 *** 120 – 90

The **lowest** of maximum regrets is 40 with project F so project F would be selected if the minimax regret rule is used.

Contribution tables

Questions requiring application of the decision rules often incorporate a **number of variables, each with a range of possible values**. For example these variables might be:

- Unit price and associated level of demand
- Unit variable cost

Each variable might have, for example, three possible values.

Before being asked to use the decision rules, exam questions could ask you to **work out contribution** for each of the possible outcomes. (Alternatively profit figures could be required if you are given information about fixed costs.)

The **number of possible outcomes =** number of values of variable 1 × number of values of variable 2 × number of values of variable 3 etc

So, for example, if there are **two** variables, each with **three** possible values**,** there are **3 × 3 = 9 outcomes.**

Perhaps the easiest way to see how to draw up contribution tables is to look at an example.

Example: contribution tables and the decision rules

Suppose the budgeted demand for product X will be 11,500 units if the price is Rwf10,000 8,500 units if the price is Rwf12,000 and 5,000 units if the price is rwf14,000. Variable costs are estimated at either Rwf4000, 5,000, or6,000 per unit. A decision needs to be made on the **price** to be charged.

Here is a contribution table showing the budgeted contribution for each of the nine possible outcomes.

Demand	*Price*	*Variable cost*	*Unit contribution*	*Total contribution*
	RWF '000	RWF '000	RWF '000	RWF m
11,500	10	4	6	69.0
11,500	10	5	5	57.5
11,500	10	6	4	46.0
8,500	12	4	8	68.0
8,500	12	5	7	59.5
8,500	12	6	6	51.0
5,000	14	4	10	50.0
5,000	14	5	9	45.0
5,000	14	6	8	40.0

Once the table has been drawn up, the decision rules can be applied.

Solution

Maximin

We need to maximise the minimum contribution.

Demand/price	*Minimum contribution*
Units/RWF '000	RWF 000
11,500/10	46,000
8,500/12	51,000
5,000/14	40,000

Set a price of RWF12,000.

Maximax

We need to maximise the maximum contribution.

Demand/price	*Maximum contribution*
Units/RWF '000	RWF'000
11,50010	69,000
8,000/12	68,000
5,000/14	50,000

Set a price of RWF10,000.

Minimax regret

We need to minimise the maximum regret (lost contribution) of making the wrong decision.

Variable cost		Price RWF '000	
RWF '000	*10*	*12*	*14*
4	–	1,000	19,000
5	2,000	–	14,500
6	5,000	–	11,000
Minimax regret	5,000	1,000	19,000

Minimax regret strategy (**price of RWF12,000**) is that which minimises the maximum regret (rwf1,000,000).

Sample working

At a variable cost of RWF4,000, the best strategy would be a price of RWF10,000. Choosing a price of RWF12,000 would mean lost contribution of RWF69m – RWF68m, while choosing a price of RWF14,000 would mean lost contribution of RWFm69 – 50.

DECISION TREES

Decision trees are diagrams which illustrate the choices and possible outcomes of a decision.

Rollback analysis evaluates the EV of each decision option. You have to work from right to left and calculate Evs at each outcome point.

A probability problem such as ‘what is the probability of throwing a six with one throw of a die? Is fairly straightforward and can be solved using the basic principles of probability.

More complex probability questions, although solvable using the basic principles, require a clear logical approach to ensure that all possible choices and outcomes of a decision are taken into consideration.

Decision trees are a useful means of interpreting such probability problems.

A **decision tree** is a pictorial method of showing a sequence of interrelated decisions and their expected outcomes. Decision trees can incorporate both the probabilities of, and values of, expected outcomes, and are used in decision-making

Exactly how does the use of a decision tree permit a clear and logical approach?

- All the possible **choices** that can be made are shown as **branches** on the tree.
- All the possible **outcomes** of each choice are shown as **subsidiary branches** on the tree.

Constructing a decision tree.

There are two stages in preparing a decision tree.

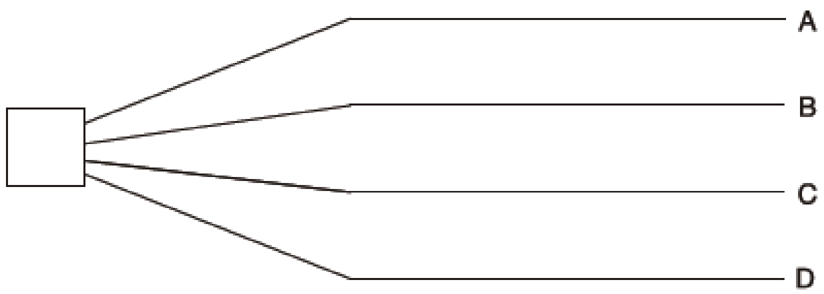
- Drawing the tree itself to show all the choices and outcomes
- Putting in the numbers (the probabilities, outcome values and EVs)

Every **decision tree starts** from a **decision point** with the **decision options** that are currently being considered.

a) It helps to identify the **decision point**, and any subsequent decision points in the tree, with a symbol. Here, we shall use a **square shape**.

b) There should be a **line**, or **branc**h, for each **option** or **alternative**

It is conventional to draw decision trees from left to right ,and so a decision tree will start as follows.



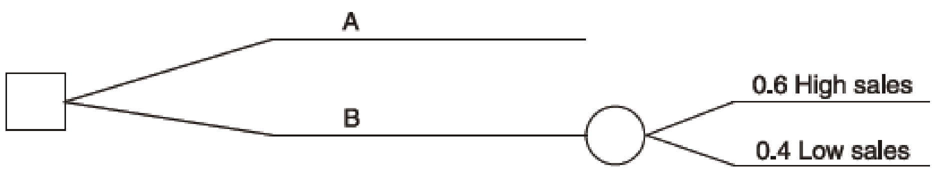
The **square** is the **decision point**, and A, B, C, and D represent **four alternatives** from which a choice must be made (such as buy a new machine with cash, hire a machine, continue to use existing machine, raise a loan to buy a machine).

If the outcome from any choice is certain, the branch of the decision tree for that alternative is complete.

If the outcome of a particular choice is uncertain, the various possible outcomes must be shown.

We show the various possible outcomes on a decision tree by inserting an **outcome point** on the **branch** of the tree. Each possible outcome is then shown as a **subsidiary branch,** coming out form the outcome point. The probability of each outcome occurring should be written on the branch of the tree which represents that outcome.

To distinguish decision points from outcome points, **a circle will be used as the symbol for an outcome point.**



In the example above, there are two choices facing the decision-maker, A and B. The outcome if A is chosen is known with certainly, but if B is chosen, there are two possible outcomes, high sales (0.6 probability) or low sales (0.4 probability).

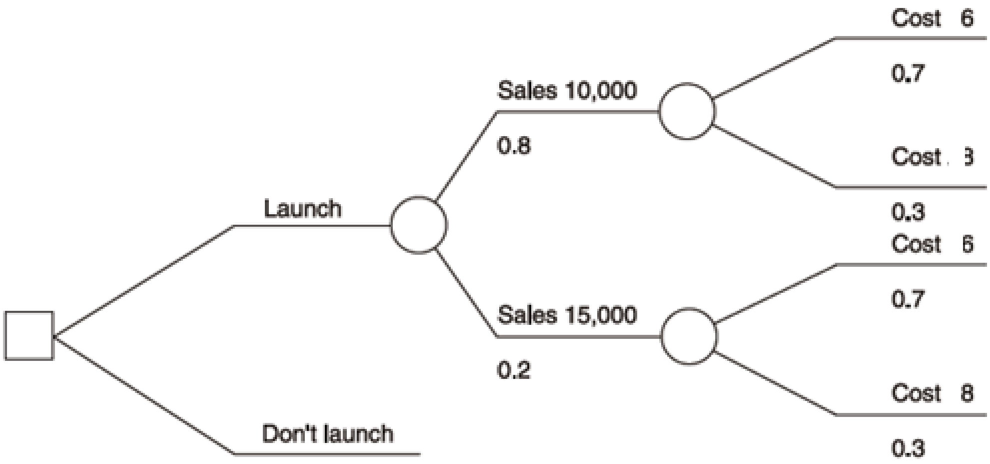
When several outcomes are possible, it is usually simpler to show two or more stage of outcome points on the decision tree.

Example: Several possible outcomes

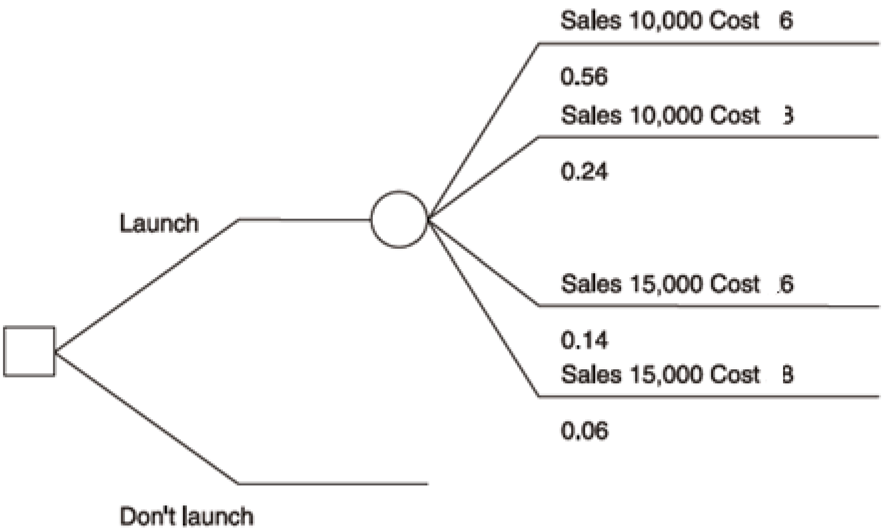
A company can choose to launch a new product XYZ or not. If the product is launched, expected sales and expected unit costs might be as follows.

Sales		Units costs	
Units	Probability	RWF	Probability
10,000	0.8	6	0.7
15,000	0.2	8	0.3

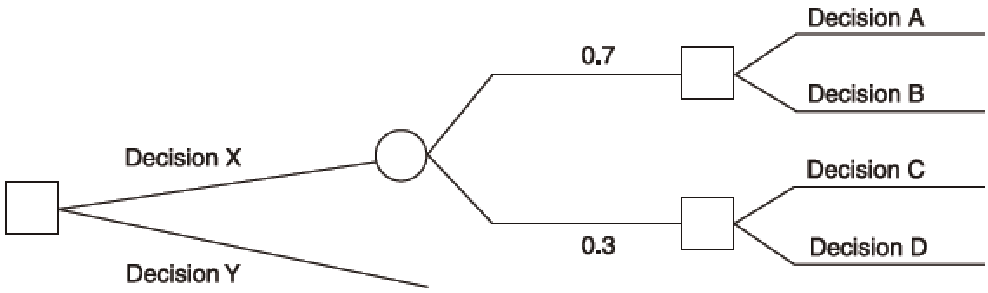
a) The decision tree could be drawn as follows



b) The layout shown above will usually be easier to use than the alternative way of drawing the tree, which is as follows.



Sometimes, a **decision taken now** will lead to **other decisions to be taken in the future.** When this situation arises, the decision tree can be drawn as a **two –stage tree,** as follows.



In this tree, either a choice between A and B or else a choice between C and D will be made, depending on the outcome which occurs after choosing X.

The decision tree should be in **chronological order** from **left to right.** When there are two-stage decision trees, the first decision in time should be drawn on the left.

Example: A decision tree

Beethoven has a new wonder product, the vylin, of which it expects great things. At the moment the company has two courses of action open to it, to test market the product or abandon it.

If the company test markets it, the cost will be RWF100,000 and the market response could be positive or negative with probabilities of 0.060 and 0.40.

If the response is positive the company could either abandon the product or market if full scale.

If it markets the vylin full scale, the outcome might be low, medium or high demand, and the respective net gains/(losses) would be (200) , 200 or 1,000 in units of RWF1,000 (the result could range from a net loss of RWF200,000 to a gain of RWF1,000,000). These outcomes have probabilities of 0.20, 0.50 and 0.30 respectively.

If the result of the test marketing is negative and the company goes ahead and markets the product estimated losses would be RWF600,000.

If , at any point, the company abandon the product, there would be a net gain of RWF50,000 from the sale of scrap 0. All the financial values have been discounted to the present.

Required

a) Draw a decision tree

b) Include figures for cost, loss or profit on the appropriate branches of the tree.

Solution

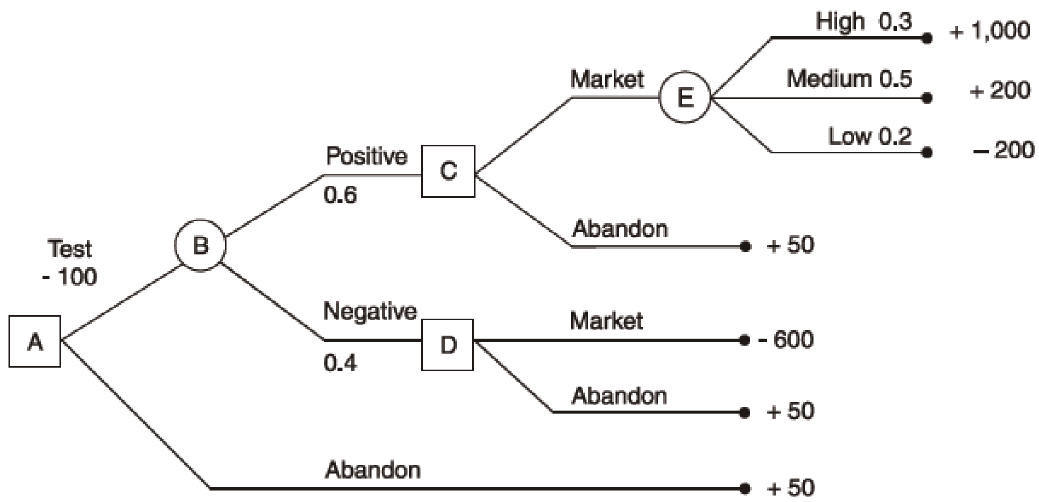
The starting point for the tree is to **establish what decision has to be made now.** What are the options?

a) To test market

b) To abandon

The outcome of the 'abandon' option is known with certainty. There are two possible outcomes of the option to test market, positive response and negative response.

Depending on the outcome of the test marketing, another decision will then be made, to abandon the product or to go ahead.



Exam Focus Point

In an examination, remember to draw decision trees (and all diagrams) neatly, using a pen and ruler. Remember also to label decision points and branches as clearly as possible.

Evaluating the decision with a decision tree

Rollback analysis evaluates the V or each decision option. You have to work from right to left and calculate EVs at each outcome point.

The EV of each decision option can be evaluated, using the decision tree to help with keeping the logic on track. The basic rules are as follows.

a) We start on the **right hand side** of the tree and **work back** towards the left hand side and the current decision under consideration . This is sometimes known as the **'rollback' technique** or **'rollback analysis'**

b) Working from **right to left,** we calculate the **EV of revenue**, cost **contribution or profit** at each outcome point on the tree

In the above example, the right-hand-most outcome point is pint E, and EV is as follows.

	Profit	*Probability*	
	x	*p*	*px*
	RWF '000		RWF'000
High	1,000	0.3	300
Medium	200	0.5	100
Low	(200)	0.2	(40)
		EV	**360**

This is the EV of the decision to market the product if the test shows positive response. It may help you to write the EV on the decision tree itself, at the appropriate outcome point (point E).

a) **At decision point C,** the **choice** is as follows.

(i) Market, EV = +360 (the EV at point E)

(ii) Abandon, value = + 50

The choice would be to market the product, and so the V at decision point C is +360

b) **At decision point D,** the **choice** is as follows.

(i) Market, value = -600

(ii) Abandon , value =+ 50

The choice would be to abandon, and so the EV at decision point D is +50

The second stage decisions have therefore been made. If the original decision is to test market, the company will market the product if the test shows positive customer response, and will abandon the product if the test results are negative.

The evaluation of the decision tree is completed as follows.

a) **Calculate the EV at outcome point B.**

	0.6 x 360	(Ev at C)
+	0.4 x 50	(EV at D)
=	216 + 20 =236	

b) **Compare the options at point A,** which are as follows

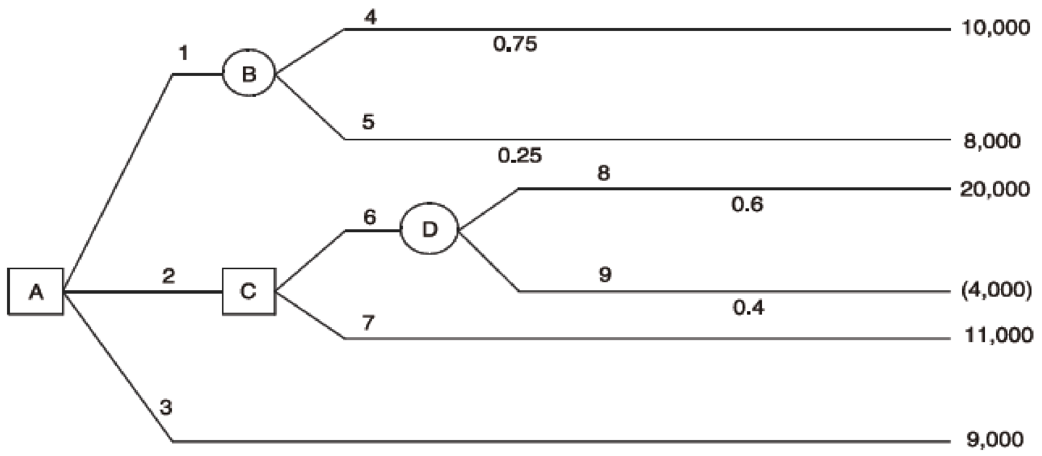
(i) Test: EV =EV at B minus test marketing cost = 236 -100=136

(ii) Abandon: Value = 50

The choice would be to test market the product, because it has a **higher EV of profit**

Question

Consider the following diagram



If a decision maker wished to maximise the value of the outcome, which options should be selected?

A Option 2 and option 7

B Option 3

C Option 1 and option 4

D Option 2, option 6 and option 8

Answer

The correct answer is A.

The various outcomes must be evaluated using expected values.

EV at point B: (0.75x 10,000) + (0.25x8,000) = 9,500

EV at point D: (0.6 x 20,000) + (0.4 x (-4,000) = 10,400

EV at point C: choice between 10,400 and 11,000

EV at point A : Choice between B (9,500), C (10,400 or 11,000) and choice 3 (9,000).

If we are trying to maximise the figure, option 2 and the option 7 are chosen to give 11,000.

Evaluating decisions by using **decision trees has a number of limitations.**

a) The time value of money may not be taken into account.

b) Decision trees are not very suitable for use in complex situations.

c) The outcome with the highest EV may have the greatest risks attached to it. Managers may be reluctant to take risks which may lead to loses.

d) The probabilities associated with different branches of he ‘tree’ are likely to be estimates, and possibly unreliable or inaccurate.

THE VALUE OF INFORMATION

Perfect information is guaranteed to predict the future with 100% accuracy. Imperfect information is better than no information at all but could be wrong in its prediction of the future.

The value of perfect information is the difference between the EV of profit with perfect information and the EV of profit without perfect information.

Perfect information removes all doubt and uncertainty from a decision, and enables managers to make decisions with complete confidence that they have selected the optimum course of action.

The value of perfect information.

Step 1 If we **do not have perfect information** and we must choose between two or more decision options we would select the decision option which offers the **highest EV** of profit. This option will not be the best decision under all circumstances. There will be some probability that what was really the best option will not have been selected, given the way actual events turn out.

Step 2 With **perfect information,** the best decision option will always be selected. The profits from the decision will depend on the future circumstances which are predicted by the information nevertheless, the EV of profit with perfect information should be higher than the EV of profit without the information.

Step 3 The **value of perfect information** is **the difference between these two EVs**

Example : the value of perfect information

The management of Ivor Ore must choose whether to go ahead with either of two mutually exclusive projects, A and B. The expected profits are as follows.

	Profit if there is strong demand	*Profit/(loss) if there is weak demand*
Option A	RWF4,000	RWF(1,000)
Option B	RWF1,500	RWF500
Probability of demand	0.3	0.7

Required

Ascertain what the decision would be, based on expected values, if no information about demand were available.

Calculate the value of perfect information about demand.

Solution

Step 1 If there was no information to help with the decision, the project with the higher EV of profit would be selected.

Probability	*Project A*		*Project B*	
	Profit	EV	Profit	EV
	RWF	RWF	RWF	RWF
0.3	4,000	1,200	1,500	450
0.7	(1,000)	(700)	500	350
		500		800

Project B would be selected

This is clearly the better option if demand turns out to be weak. However, if demand were to turn out to be strong, project A would be more profitable. There is a 30% chance that this could happen.

Step 2 **Perfect information** will indicate for certain whether demand will be weak or strong. If demand is forecast ‘weak’ project B would be selected. If demand is forecast as ‘strong’ , project A would be selected, and perfect information would improve the profit from RWF1,500, which would have been earned by selecting B, to RWF4,000

Forecast demand	*Probability*	*Project chosen*	*Profit*	*EV of profit*
			RWF	*RWF*
Weak	0.7	B	500	350
Strong	0.3	A	4,000	1,200
	EV of profit with perfect information			1,550

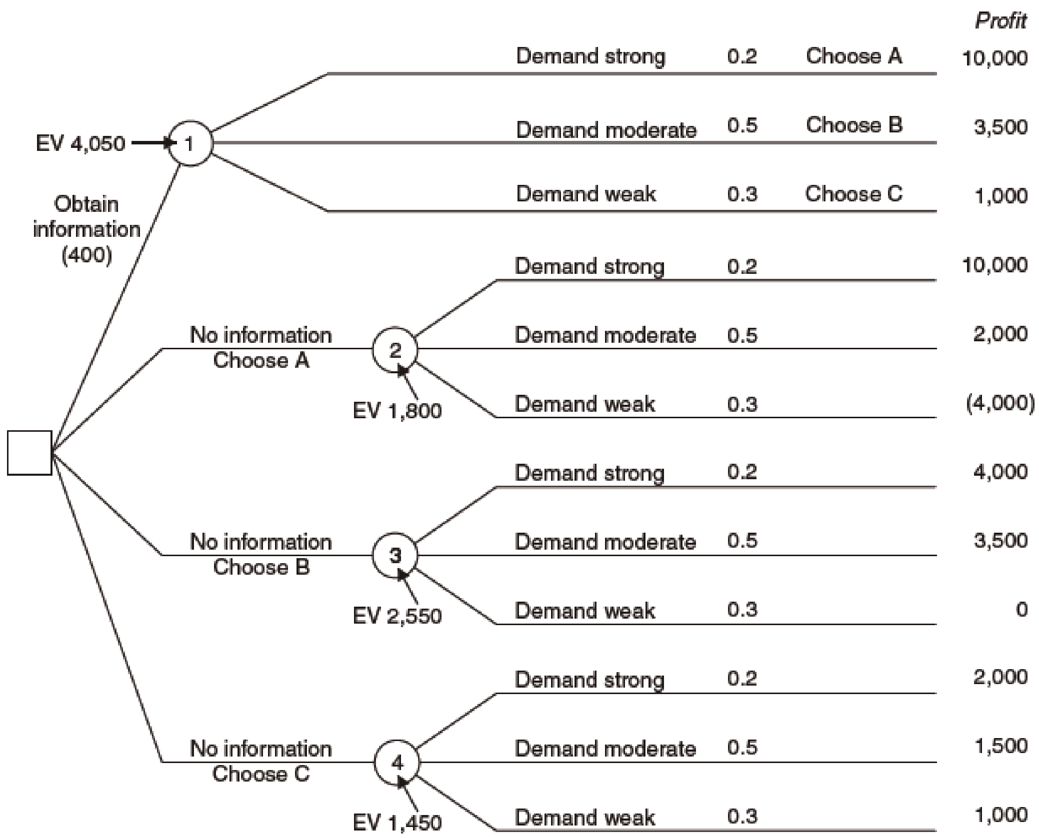
Step 3

	RWF
EV of profit without perfect information (i.e. if project B is always chosen)	800
EV of profit with perfect information	1,550
	750

Provided that the information does not cost more than RWF750 to collect, it would be worth having.

Perfect information and decision trees

When the option exists to obtain information, the decision can be shown, like any other decision, in the form of a decision tree, as follows. We will suppose, for illustration, that the cost of obtaining perfect information is RWF400.



The decision would be to obtain perfect information, since the EV of profit is RWF4,050 - RWF400 = RWF3,650.

You should check carefully that you understand the logic of this decision and that you can identify how the EVs at outcome boxes 1, 2, 3 and 4 have been calculated.

The value of imperfect information

There is one serious drawback to the technique we have just looked at: in practice, useful information is never perfect unless the person providing it is the sole source of the uncertainty. Market research findings or information from pilot tests and so on are likely to be reasonably accurate, but they can still be wrong: they provide imperfect information. It is possible, however, to arrive at an assessment of **how much it would be worth paying for such imperfect information, given that we have a rough indication of how right or wrong it is likely to be.**

Suppose we are considering the sex and hair colour of people in a given group or population consisting of 70% men and 30% women. We have established the probabilities of hair colourings as follows:

	Men	*Women*
Brown	0.60	0.35
Blonde	0.35	0.55
Red	0.05	0.10

This shows, for example, that 5% of men in such a sample have red hair. These probabilities of sex and hair colouring might be referred to as prior probabilities.

Posterior probabilities consider the situation in reverse or retrospect, so that we can ask the question: ‘Given that a person taken at random from the population is brown-haired what is the probability that the person is male (or female)?’

The information can be presented in a table. Let's suppose that the population consists of 1,000 people.

	Male	*Female*	*Total*
Brown	420 (W3)	105 (W4)	525 (W5)
Blonde	245	165	410
Red	35	30	65
	700 (W1)	300 (W2)	1,000

Workings

1 1,000 x 70%

2 1,000 – 700

3 700 x 60% (the other two values in the column being calculated in a similar way)

4 300 x 35% (the other two values in the column being calculated in a similar way)

5 420 +105 (the other two values in the column being calculated in a similar way)

∴ P (Person selected is a male, given that that person is brown-haired) = 420/525 = 0.8

Example: The value of imperfect information

Suppose that the Small Oil Company (SOC) is trying to decide whether or not to drill on a particular site. The chief engineer has assessed the probability that there will be oil, based on vast experience, as 20% and the probability that there won't be oil as 80%.

It is possible for the SOC to hire a firm of international consultants to carry out a complete survey of the site. SOC has used the firm many times before and has estimated that if there really is oil, there is a 95% chance that the report will be favourable, but if there is no oil, there is only a 10% chance that the report will indicate there is oil.

Required

Determine whether drilling should occur.

Solution

Read the information given carefully. We are given three sets of probabilities.

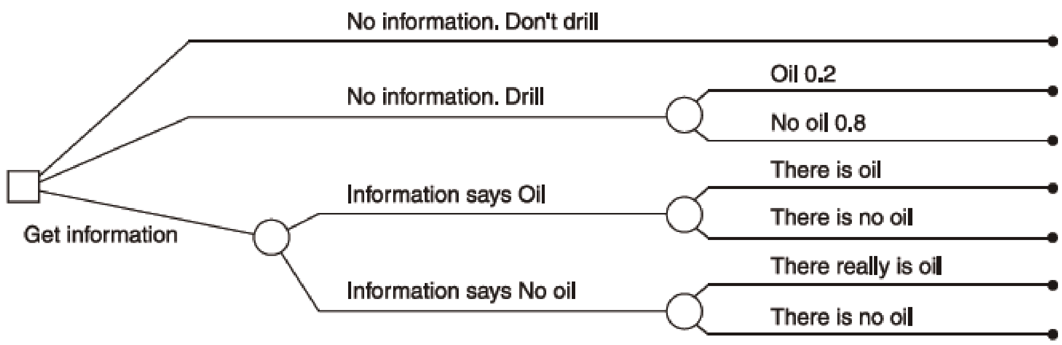
a) The probability that there will be oil (0.2) or there will not be (0.8). These outcomes are mutually exclusive.

b) The probability that, If there is oil, the report will say there is oil (0.95) or say there is no oil (0.05)

c) The probability that, if there is no oil, the report will say there is oil (0.1) or say there is no oil (0.9).

Both (b) and (c) describe conditional events, since the existence of oil or otherwise influences the chances of the survey report being correct.

SOC, meanwhile faces a number of choices which we can show as a decision tree.



We must now calculate the probabilities of the following outcomes.

- The information will say 'oil' or 'no oil'
- The information will be right or wrong if it says 'oil'
- The information will be right or wrong if it says 'no oil'

If you check the information given in the problem, you will find that these probabilities are not given.

a) We are told that the engineer has assessed that there is a 20% chance of oil and an 80% chance of no oil (ignoring information entirely). These are the **prior probabilities** of future possible outcomes.

b) The **probabilities that there will be oil or no oil once the information has been obtained are "posterior" probabilities.**

Step 1

We can tabulate the various probabilities as percentages.

Actual outcome

		Oil		No Oil		Total	
Survey	Oil	19	(w2)	8	(w3)	27	(w4)
Result:	No oil	1		72		73	
Total		20	(w1)	80		100	

Workings

1 The engineer estimates 20% probability of oil and 80% of no oil.

2. If there is oil, i.e. in 20 cases out of 100, the survey will say so in 95% of these cases, i.e. in 20 x0.95 =19 cases. The 1 below the 19 is obtained by subtraction.

3. In the 80 per 100 cases where there is in fact no oil, the survey will wrongly say that there is oil 10% of the time; i.e. 80x 0.10 = 8 cases. The 72 below the 8 is obtained by subtraction.

4. The horizontal totals are given by addition.

Step 2

We can now provide all the probabilities needed to complete the tree.

P (survey will say there is oil)	=	27/100	=	0.27
P (survey will say there is no oil)	=	73/100	=	0.73
If survey says oil P (there is oil)	=	19/27	=	0.704
P (there is no oil)	=	8/27	=	0.296 (or 1-0.704)
If survey says no oil P (there is oil)	=	1/73	=	0.014
P (there is no oil)	=	72/73	=	0.986 (or 1-0.014)

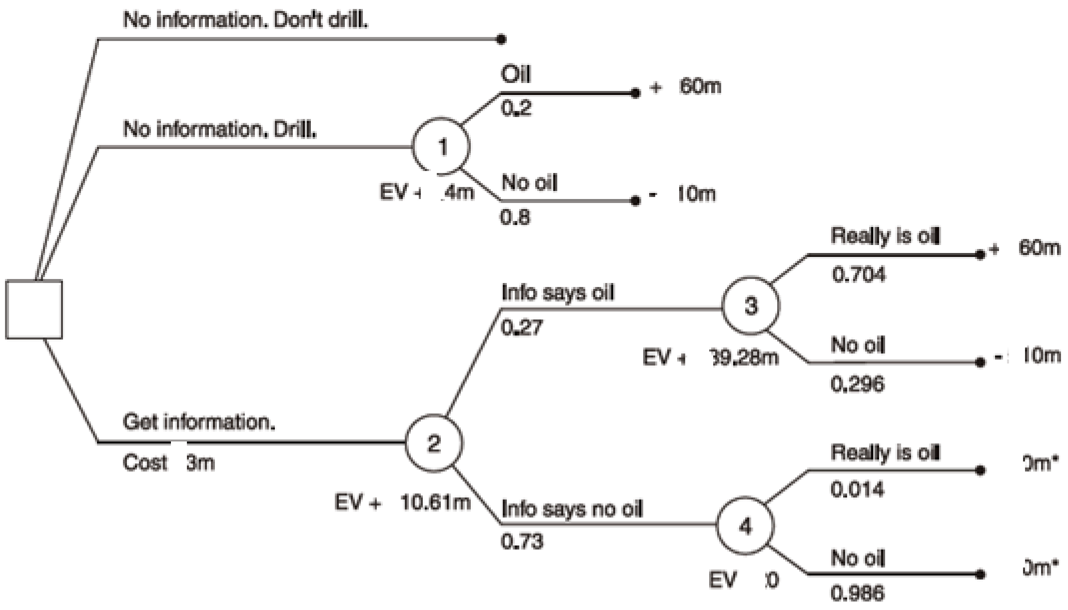
Step 3

We can now go on to complete the decision tree. Let us make the following assumptions.

(In an exam question such information would have been given to you from the start)

- The cost of drilling is RWF10m.
- The value of the benefits if oil is found is RWF70m, giving a net 'profit' of RWF60m
- The cost of obtaining information from the consultants would be RWF3m.

An assumption is made that the decision maker will take whichever decision the information indicates is the best. If the information says 'oil', the company will drill and if the information says 'no oil' it will not drill.



*The information is ‘no oil’@ 4, so the company won’t drill, regardless of whether there really is oil or not.

Step 4

We can now perform rollback analysis.

		RWFm
EV at point 2 =	0.704 x RWF60m	42.24
	0.296x (RWF10m)	(2.96)
		+39.28

		RWFm
EV at point 2 =	0.27xRWF39.28m	10.61
	0.73xRWF0	0.00
		+10.61

Step 5

There are three choices	EV
a) Do not obtain information and do not drill	RWFO
b) Do not obtain information and drill	+RWF4million
c) Obtain information first, decide about drilling later	(RWF(10.61m – 3m)
	+7.61million

The decision should be to obtain the information from a survey first.

Step 6

The value of the imperfect information is the difference between (b) and (c) , Rwf3.61 million.

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SENSITIVITY ANALYSIS

Sensitivity analysis can be used in any situation so long as the relationships between the key variables can be established. Typically this involves changing the value of a variable and seeing how the results are affected.

Approaches to sensitivity analysis

Sensitivity analysis is a term used to describe any technique whereby decision options are tested for their vulnerability to changes in any 'variable' such as expected sales volume, sales price per unit, material costs, or labour costs.

Here are three useful approaches to sensitivity analysis**.**

a) To estimate by **how much costs and revenues would need to differ** from their estimated values before the decision would change.

b) To estimate whether a decision would change if estimated costs were **x% higher** than estimated, or estimated revenues **y% lower** than estimated.

c) To estimate by how much costs and/or revenues would need to differ from their estimated values before the decision maker would be **indifferent** between two options.

The essence of the approach, therefore, is to carry out the calculations with one set of values for the variables and then substitute other possible values for the variables to see how this affects the overall outcome.

a) From your studies of information technology you may recognise this as **what if analysis** that can be carried out using a **spreadsheet**.

b) From your studies of **linear programming** you may remember that sensitivity analysis can be carried out to determine over which ranges the various constraints have an impact on the optimum solution.

c) **Flexible budgeting** can also be a form of sensitivity analysis.

Example: sensitivity analysis

SVT Ltd has estimated the following sales and profits for a new product which it may launch on to the market.

		RWF	RWF
Sales	(2,000 units)		4,000
Variable costs:	materials	2,000	
	labour	1,000	
			3,000
Contribution			1,000
Less incremental fixed costs			800
Profit			200

Required

Analyse the sensitivity of the project.

Solution

a) If incremental **fixed costs** are more than 25% above estimate, the project would make a loss.

b) If **unit costs of materials** are more than 10% above estimate, the project would make a loss.

c) Similarly, the project would be sensitive to an **increase in unit labour costs** of more than RWF200, which is 20% above estimate, or else to a drop in the **unit selling price** of more than 5%.

d) The **margin of safety**, given a breakeven point of 1,600 units, is (400/2,000) × 100% = 20%.

Management would then be able to judge more clearly whether the product is likely to be profitable. The items to which profitability is most sensitive in this example are the selling price (5%) and material costs (10%). Sensitivity analysis can help to **concentrate management attention** on the most important factors.

SIMULATION MODELS

Simulation models can be used to deal with decision problems involving a number of uncertain variables. **Random numbers** are used to assign values to the variables.

One of the chief problems encountered in decision making is the uncertainty of the future. Where only a few factors are involved, probability analysis and expected value calculations can be used to find the most likely outcome of a decision. Often, however, in real life, there are so **many uncertain variables** that this approach does not give a true impression of possible variations in outcome.

To get an idea of what will happen in real life one possibility is to use a **simulation model** in which the **values and the variables are selected at random**. Obviously this is a situation **ideally suited to a computer** (large volume of data, random number generation).

The term 'simulation' model is often used more specifically to refer to modelling which **makes use of random numbers**. This is the **'Monte Carlo'** method of simulation. In the business environment it can, for example, be used to examine inventory, queuing, scheduling and forecasting problems.

Random numbers are allocated to each possible value of the uncertain variable in proportion to the probabilities, so that a probability of 0.1 gets 10% of the total numbers to be assigned. These random numbers are used to assign values to the variables.

Exam Focus Point

You will **not** be required to develop a simulation model in your exam. The following example is provided so that you can **understand** how simulation models are developed.

Example: simulation and spreadsheets

A supermarket sells a product for which the daily demand varies. An analysis of daily demand over a period of about a year shows the following probability distribution.

Demand per day	*Probability*
Units	
35	0.10
36	0.20
37	0.25
38	0.30
39	0.08
40	0.07
	1.00

To develop a simulation model in which one of the variables is daily demand, we would **assign a group of numbers to each value for daily demand**. The probabilities are stated to two decimal places, and so there must be 100 random numbers in total, 00 – 99 (we use 00-99 rather than 1-100 so that we can use two-digit random numbers.) Random numbers are assigned in proportion to the **probabilities**, so that a probability of 0.1 gets 10% of the total numbers to be assigned, that is 10 numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

The assignments would therefore be as follows.

Demand per day	**Probability**	**Numbers assigned**
Units		
35	0.10	00 – 09
36	0.20	10 – 29
37	0.25	30 – 54
38	0.30	55 – 84
39	0.08	85 – 92
40	0.07	93 – 99

When the simulation model is run, random numbers will be generated to derive values for daily demand. For example, if the model is used to simulate demand over a ten day period, the random numbers generated might be as follows.

19007174604721296802

The model would then **assign values** to the demand per day as follows.

Day	*Random number*	*Demand*
		Units
1	19	36
2	00	35
3	71	38
4	74	38
5	60	38
6	47	37
7	21	36
8	29	36
9	68	38
10	02	35

You might notice that on none of the ten days is the demand 39 or 40 units, because the random numbers generated did not include any value in the range 85 – 99. When a simulation model is used, there must be a long enough run to give a good representation of the system and all its potential variations.

Uses of simulation

In the supermarket example above, the supermarket would use the information to minimise stock holding without risking running out of the product. This will reduce costs but avoid lost sales and profit.

A supermarket can also use this technique to estimate queues with predicted length of waiting time and so determine the number of staff required.

CHAPTER ROUNDUP

- An example of a **risky situation** is one in which we can say that there is a 70% probability that returns from a project will be in excess of RWF100m but a 30% probability that returns will be less than RWF100m. If we cannot predict an outcome or assign probabilities, we are faced with an **uncertain** situation.
- People may be **risk seekers**, **risk neutral** or **risk averse**.
- Management accounting directs its attention towards the **future** and the future is **uncertain**. For this reason a number of methods of taking **uncertainty** into consideration have evolved.
- **Market research** can be used to reduce uncertainty.
- **Expected values** indicate what an outcome is likely to be in the long term with repetition. Fortunately, many business transactions do occur over and over again.
- The 'play it safe' basis for decision making is referred to as the **maximin basis**. This is short for '**maximise the minimum achievable profit**'.
- A basis for making decisions by looking for the best outcome is known as the **maximax basis**, short for **'maximise the maximum achievable profit'**.
- The ‘opportunity loss’ basis for decision making is known as **minimax regret**.
- **Decision trees** are diagrams which illustrate the choices and possible outcomes of a decision.
- **Rollback analysis** evaluates the EV of each decision option. You have to work from right to left and calculate EVs at each outcome point.
- **Perfect information** is guaranteed to predict the future with 100% accuracy. Imperfect information is better than no information at all but could be wrong in its prediction of the future.
- The **value of perfect information** is the difference between the EV of profit with perfect information and the EV of profit without perfect information.
- **Sensitivity analysis** can be used in any situation so long as the relationships between the key variables can be established. Typically this involves changing the value of a variable and seeing how the results are affected.
- **Simulation models** can be used to deal with decision problems involving a number of uncertain variables. **Random numbers** are used to assign values to the variables.

STUDY UNIT 12

Objectives Of Budgetary Control

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EXAM GUIDE

The topics covered in this chapter may form the discussion part of a budget question or may form an entire narrative question. Much of the material is common sense and you should always try to relate it to your own experience.

OBJECTIVES

Corporate objectives concern the firm as a whole. **Unit objectives** are specific to individual units, divisions or functions of an organisation.

Corporate objectives are set as part of the **corporate planning process** which is concerned with the selection of **strategies** which will achieve the corporate objectives of the organisation.

Corporate objectives versus unit objectives

Corporate objectives should relate to the **key factors for business success.**

- Profitability
- Market share
- Growth
- Cash flow
- Return on capital employed
- Risk
- Customer satisfaction
- Quality
- Industrial relations
- Added value
- Earnings per share

Unit objectives, on the other hand, **are specific to individual business units, divisions or functions of an organisation**.

Types	Examples
Commercial	• Increase the number of customers by x% (an objective of a sales department) • Reduce the number of rejects by 50% (an objective of a production department) • Produce monthly reports more quickly, within 5 working days of the end of each month (an objective of the finance & management accounting departments)
Public sector	• Introduce x% more places at nursery schools (an objective of a district education department) • Respond more quickly to calls (an objective of a local police station, fire department or even a telephone-banking help-line)
General	• Resources (e.g. cheaper raw materials, lower borrowing costs, 'top-quality' accountants) • Market (e.g. market share, market standing) • Employee development (e.g. training, promotion, safety) • Innovation in products or processes • Productivity (the amount of output from resource inputs) • Technology

Primary and secondary objectives

Primary corporate objectives are supported by **secondary objectives**, for example for product development or market share. In practice there may be a trade off between different objectives.

An organisation has many objectives. It has been argued that there is a **limit** to the **number of objectives** that a manager can **pursue effectively**. Too many and the manager cannot give adequate attention to each and/or the focus may inadvertently be placed on minor ones. Some objectives are more important than others. It has therefore been suggested that there should be one **primary corporate objective** (restricted by certain constraints on corporate activity) and other **secondary objectives**. These are **strategic objectives** which should **combine to ensure the achievement of the primary corporate objective**.

a) For example, if a company sets itself a **primary objective** of **growth in profits**, it will then have to develop strategies by which this primary objective can be achieved.

b) **Secondary objectives** might then be concerned with sales growth, continual technological innovation, customer service, product quality, efficient resource management (e.g. labour productivity) or reducing the company's reliance on debt capital.

Conflicting objectives

Corporate objectives may **conflict** with divisional objectives in large organisations. A danger is that the organisation will divide into a number of **self-interested** segments, each acting at times against the wishes and interests of other segments. Decisions might be taken by a divisional manager in the best interests of his **own part** of the business, but possibly against the interests of the organisation as a whole. The **setting** of objectives is very much a **political process**: objectives are formulated following **bargaining** by the various interested parties whose requirements may conflict. Such conflict may be resolved via **prioritisation**, **compromise**, **negotiation** and **satisficing (satisfy and suffice)**.

a) **Prioritisation** is where certain goals get priority over others. This is usually determined by senior managers but there can be quite complicated systems to rank goals and strategies according to certain criteria.

b) **Negotiation** is the bargaining process that occurs at each stage of the budgeting process. This allows full participation to take place by all budget holders. Any revisions to the budget must be after giving full consideration to arguments for including any of the budgeted items.

c) **Compromise** is the central aspect of any process of negotiation where there is disagreement. It can be seen as positive where both parties win something but also negative where both parties give something away.

d) **Satisficing** occurs when a satisfactory and sufficient solution rather than an optimum solution is found. Organisations may not aim to maximise performance in one area if this leads to poor performance elsewhere. Rather they will accept satisfactory, if not excellent performance in a number of areas.

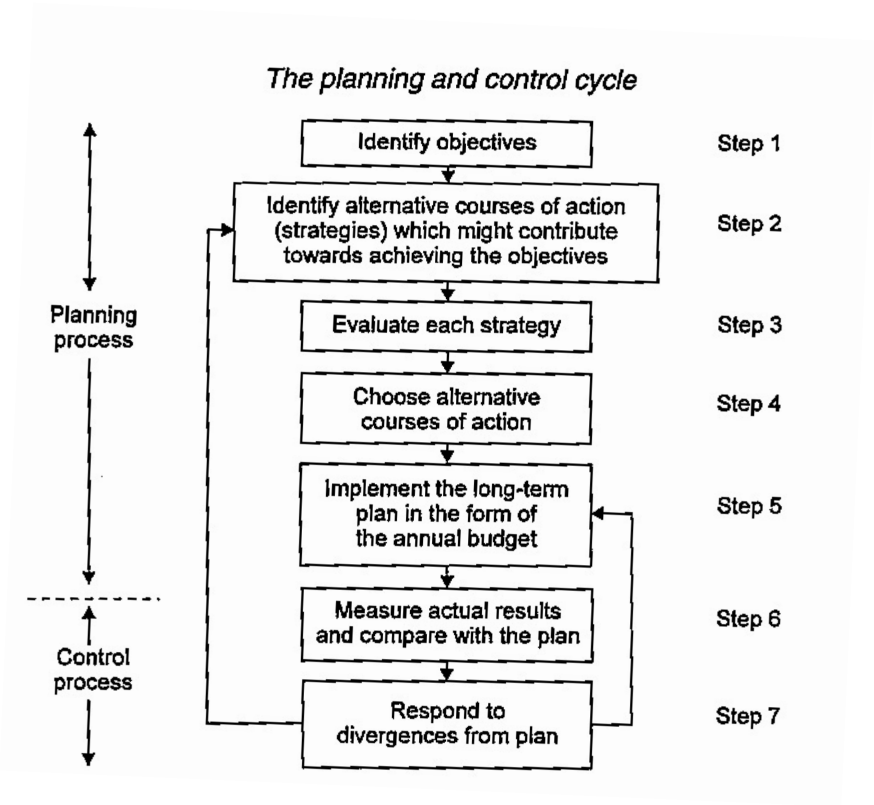
Goal congruence exists when managers working in their best interests also act in harmony with the goals of the organisation as a whole. This is not easy to achieve and a budgetary control system needs to be designed to evoke the required behaviour.

THE PLANNING AND CONTROL CYCLE

The **planning and control cycle** has seven steps.

- *Step 1*. Identify **objectives**
- *Step 2.* Identify potential **strategies**
- *Step 3.* Evaluate strategies
- *Step 4.* Choose alternative courses of action
- *Step 5.* Implement the long-term plan
- *Step 6.* Measure actual results and compare with the plan
- *Step 7.* Respond to divergences from the plan

The diagram below represents the planning and control cycle. The first five steps cover the planning process. **Planning** involves making choices between alternatives and is primarily a decision-making activity. The last two steps cover the **control** process, which involves measuring and correcting actual performance to ensure that the alternatives that are chosen and the plans for implementing them are carried out.



Step 1 **Identify objectives**

Objectives establish the direction in which the management of the organisation wishes it to be heading. They answer the question: 'where do we want to be?'

Step 2 **Identify potential strategies**

Once an organisation has decided 'where it wants to be', the next step is to identify a range of possible courses of action or **strategies** that might enable the organisation to get there. The organisation must therefore carry out an **information-gathering exercise** to ensure that it has a full **understanding of where it is now.** This is known as a **'position audit**' or **'strategic analysis**' and involves looking both inwards and outwards.

a) The organisation must **gather information from all of its internal parts** to find out what resources it possesses: what its manufacturing capacity and capability are, what is the state of its technical know-how, how well it is able to market itself, how much cash it has in the bank and so on.

b) It must also **gather information externally** so that it can assess its position in the environment. Just as it has assessed its **own strengths and weaknesses**, it must do likewise for its competitors (**threats**). Current and potential markets must be analysed to identify possible new **opportunities**. The 'state of the world' must be considered. Is it in recession or is it booming? What is likely to happen in the future? This part of the analysis is known as SWOT analysis – Strengths, Weaknesses, Opportunities and Threats.

Having carried out a strategic analysis, alternative strategies can be identified. An organisation might decide to be the lowest cost producer in the industry, perhaps by withdrawing from some markets or developing new products for sale in existing markets. This may involve internal development or a joint venture.

Step 3 **Evaluate strategies**

The strategies must then be evaluated **in terms of suitability, feasibility and acceptability**. Management should select those strategies that have the greatest potential for achieving the organisation's objectives.

Step 4 **Choose alternative courses of action**

The next step in the process is to collect the **chosen strategies** together and **co-ordinate them into a long-term financial plan.** Typically this would show the following.

- Projected cash flows
- Capital expenditure plans
- Projected long-term profits
- Balance sheet forecasts
- A description of the long-term objectives and strategies in words

Step 5 **Implement the long-term plan**

The **long-term plan** should then be **broken down into smaller parts**. It is unlikely that the different parts will fall conveniently into successive time periods. Strategy A may take two and a half years, while Strategy B may take five months, but not start until year three of the plan. It is usual, however, to break down the plan as a whole into equal time periods (usually one year). The resulting **short-term plan** is called a **budget**.

Step 6 **Measure actual results and compare with plan**

Actual results are recorded and analysed and information about actual results is fed back to the management concerned, often in the form of accounting reports. This reported information is **feedback** (see section named 'Feedback' below).

Step 7 **Respond to divergences from plan**

By comparing actual and planned results, management can then do one of three things, depending on how they see the situation.

a) They can take control action. By identifying what has gone wrong, and then finding out why, corrective measures can be taken.

b) They can decide to do nothing. This could be the decision when actual results are going better than planned, or when poor results were caused by something which is unlikely to happen again in the future.

c) They can alter the plan or target if actual results are different from the plan or target, and there is nothing that management can do (or nothing,

Level	Detail
Corporate plans	• Focused on overall performance • Environmental influence • Set plans and targets for units and departments • Sometimes qualitative (e.g. a programme to change the culture of the organisation) • Aggregate
Operational plans	• Based on objectives about 'what' to achieve • Specific (e.g. acceptable number of 'rings' before a phone is answered) • Little immediate environmental influence • Likely to be quantitative • Detailed specifications • Based on 'how' something is achieved • Short time horizons

perhaps, that they want to do) to correct the situation.

Control

Consider how the activities of **planning** and **control** are **inter-related**.

a) **Plans** set the targets.

b) **Control** involves two main processes.

(i) **Measure** actual results against the plan.

(ii) **Take action** to adjust actual performance to achieve the plan or to change the plan altogether.

Control is therefore **impossible without planning.**

The essence of control is the **measurement of results** and **comparing** them with the original **plan**. Any deviation from plan indicates that **control action** is required to make the results conform more closely with plan.

Feedback

Feedback occurs when the results (outputs) of a system are used to control it, by adjusting the input or behaviour of the system.

A business organisation uses feedback for control.

a) **Negative feedback** indicates that results or activities must be brought back on course, as they are deviating from the plan.

b) **Positive feedback** results in control action continuing the current course. You would normally assume that positive feedback means that results are going according to plan and that no corrective action is necessary: but it is best to be sure that the control system itself is not picking up the wrong information.

c) **Feedforward control** is control based on **forecast** results: in other words if the forecast is bad, control action is taken well in advance of actual results.

There are two types of feedback.

a) **Single loop feedback** is control, like a thermostat, which regulates the output of a system. For example, if sales targets are not reached, control action will be taken to ensure that targets will be reached soon. The plan or target itself is not changed, even though the resources needed to achieve it might have to be reviewed.

b) **Double loop feedback** is of a different order. It is information used to **change the plan itself**. For example, if sales targets are not reached, the company may need to change the plan.

Control at different levels

Budgetary control occurs at the **lower** levels of the performance hierarchy.

Control at **the lower-levels** of the performance hierarchy, such as standard costing, and budgetary control has the following features.

- Exercised externally by management or, in the case of empowered teams, by the staff themselves
- Immediate or rapid feedback
- Single loop feedback (i.e. little authority to change plans or targets)

Control does also occur at the **higher-levels of the hierarchy**, however, and has the following characteristics.

- Exercised by external stakeholders (e.g. shareholders)
- Exercised by the market
- Double loop feedback (i.e. relatively free to change targets)
- Often feed forward elements

OBJECTIVES OF BUDGETARY SYSTEMS

Here are the objectives of a budgetary planning and control system.

- Ensure the achievement of the organisation's objectives
- Compel planning
- Communicate ideas and plans
- Coordinate activities
- Provide a framework for responsibility accounting
- Establish a system of control
- Motivate employees to improve their performance

A budgetary planning and control system is essentially a system for ensuring **communication**, **coordination** and **control** within an organisation. Communication, coordination and control are general objectives: more information is provided by an inspection of the specific objectives of a budgetary planning and control system.

Objective	Comment
Ensure the achievement of the organisation's objectives	Objectives are set for the organisation as a whole and for individual departments and operations within the organisation. Quantified expressions of these objectives are then drawn up as targets to be achieved within the timescale of the budget plan.
Compel planning	This is probably the most important feature of a budgetary planning and control system. Planning forces management to **look ahead**, to set out **detailed plans** for achieving the targets for each department, operation and (ideally) each manager and to anticipate problems. It thus prevents management from relying on ad hoc or uncoordinated planning which may be detrimental to the performance of the organisation.
Communicate ideas and plans	A formal system is necessary to ensure that each person affected by the plans is aware of what he or she is **supposed to be doing**. Communication might be one-way, with managers giving **orders to subordinates**, or there might be a two-way dialogue and exchange of ideas.
Coordinate activities	The activities of different departments or sub-units of the organisation need to be coordinated to ensure **maximum integration** of effort towards common goals. This concept of

Objective	Comment
	coordination implies, for example, that the purchasing department should base its budget on production requirements and that the production budget should in turn be based on sales expectations. Although straightforward in concept, coordination is remarkably difficult to achieve, and there is often **'sub-optimality'** and conflict between departmental plans in the budget so that the efforts of each department are not fully integrated into a combined plan to achieve the company's best targets.
Provide a framework for responsibility accounting	Budgetary planning and control systems require that managers of **budget centres** are made responsible for the achievement of budget targets for the operations under their personal control.
Establish a system of control	A budget is a **yardstick** against which actual performance is measured and assessed. Control over actual performance is provided by the comparisons of actual results against the budget plan. Departures from budget can then be investigated and the reasons for the departures can be divided into **controllable** and **uncontrollable** factors.
Motivate employees to improve their performance	The interest and commitment of employees can be retained via a system of **feedback of actual results**, which lets them know how well or badly they are performing. The identification of controllable reasons for departures from budget with managers responsible provides an incentive for improving future performance. Some argue that motivation can only come from within one’s self; encouragement and discouragement are the external stimuli

Exam Focus Point

An exam question could well ask you to explain a number of these objectives in the context of a particular scenario such as a not-for-profit organisation.

BEHAVIOURAL IMPLICATIONS OF BUDGETING

Used correctly, a budgetary control system can **motivate** but it can also produce undesirable **negative reactions**.

The purpose of a budgetary control system is to assist management in planning and controlling the resources of their organisation by providing appropriate control information. The information will only be valuable, however, if it is interpreted correctly and used purposefully by managers *and* employees.

The correct use of control information therefore depends not only on the content of the information itself, but also on the behaviour of its recipients. This is because control in business is exercised by people. Their attitude to control information will colour their views on what they should do with it and a number of behavioural problems can arise.

a) The **managers who set the budget** or standards are **often not the managers** who are then made **responsible for achieving budget targets.**

b) The **goals of the organisation as a whole**, as expressed in a budget, **may not coincide with the personal aspirations of individual managers**.

c) **Control is applied at different stages by different people**. A supervisor might get weekly control reports, and act on them; his superior might get monthly control reports, and decide to take different control action. Different managers can get in each others' way, and resent the interference from others.

Motivation

Motivation is what makes people behave in the way that they do. It comes from individual attitudes, or group attitudes. Individuals will be motivated by personal desires and interests. These may be in line with the objectives of the organisation, and some people 'live for their jobs'. Other individuals see their job as a chore, and their motivations will be unrelated to the objectives of the organisation they work for.

It is therefore vital that the goals of management and the employees harmonise with the goals of the organisation as a whole. This is known as goal congruence. Although obtaining goal congruence is essentially a behavioural problem, **it is possible to design and run a**

budgetary control system which will go some way towards ensuring that goal congruence is achieved. Managers and employees must therefore be favourably disposed towards the budgetary control system so that it can operate efficiently.

The management accountant should therefore try to ensure that employees have positive attitudes towards **setting budgets, implementing budgets** (that is, putting the organisation's plans into practice) and feedback of results (**control information**).

Poor attitudes when setting budgets

Poor attitudes or hostile behaviour towards the budgetary control system can begin at the **planning stage. If managers are involved in preparing a budget** the following may happen.

a) Managers may **complain that they are too busy** to spend much time on budgeting.

b) They may **build 'slack' into their expenditure estimates**.

c) They may argue that **formalising a budget plan on paper is too restricting** and that managers should be allowed flexibility in the decisions they take.

d) They may set budgets for their budget centre and **not coordinate** their own plans with those of other budget centres.

e) They may **base future plans on past results**, instead of using the opportunity for formalised planning to look at alternative options and new ideas.

On the other hand, **managers may not be involved in the budgeting process**. Organisational goals may not be communicated to them and they might have their budget decided for them by senior management or administrative decision. It is **hard for people to be motivated to achieve targets set by someone else.**

Poor attitudes when putting plans into action

Poor attitudes can also arise **when a budget is implemented**.

a) Managers might **put in only just enough effort** to achieve budget targets, without trying to beat targets.

b) A formal budget might **encourage rigidity and discourage flexibility**.

c) **Short-term planning** in a budget **can draw attention away from the longer-term consequences** of decisions.

d) There might be **minimal cooperation and communication** between managers.

e) Managers will often try to make sure that they **spend up to their full budget allowance, and do not overspend**, so that they will not be accused of having asked for too much spending allowance in the first place.

Poor attitudes and the use of control information

The **attitude of managers towards the accounting control information** they receive **might reduce the information's effectiveness**.

a) Management accounting control reports could well be seen as having a relatively **low priority** in the list of management tasks. Managers might take the view that they have more pressing jobs on hand than looking at routine control reports.

b) Managers might **resent control information**; they may see it as **part of a system of trying to find fault with their work**. This resentment is likely to be particularly strong when budgets or standards are imposed on managers without allowing them to participate in the budget-setting process.

c) If budgets are seen as **pressure devices** to push managers into doing better, control reports will be resented.

d) Managers **may not understand the information** in the control reports, because they are unfamiliar with accounting terminology or principles.

e) Managers might have a **false sense of what their objectives should be**. A production manager might consider it more important to maintain quality standards regardless of cost. He would then dismiss adverse expenditure variances as inevitable and unavoidable.

f) **If there are flaws in the system of recording actual costs**, managers will dismiss control information as unreliable.

g) **Control information** might be **received weeks after the end of the** period to which it relates, in which case managers might regard it as out-of-date and no longer useful.

h) Managers might be **held responsible for variances outside their control**.

It is therefore obvious that accountants and senior management should try to implement systems that are acceptable to budget holders and which produce positive effects.

Pay as a motivator

Many researchers agree that **pay can be an important motivator**, when there is a formal link between higher pay (or other rewards, such as promotion) and achieving budget targets. Individuals are likely to work harder to achieve budget if they know that they will be rewarded for their successful efforts. There are, however, problems with using pay as an incentive.

a) A serious problem that can arise is that **formal reward and performance evaluation systems can encourage dysfunctional behaviour**. Many investigations have noted the tendency of managers to pad their budgets either in anticipation of cuts by superiors or to make the subsequent variances more favourable. And there are numerous examples of managers making decisions in response to performance indices, even though the decisions are contrary to the wider purposes of the organisation.

b) The targets must be challenging but fair, otherwise individuals will become dissatisfied. **Pay can be a de-motivator as well as a motivator**!

SETTING THE DIFFICULTY LEVEL OF A BUDGET

‘Aspirations’ budgets can be used as **targets** to motivate higher levels of performance but a budget for **planning and decision making** should be based on **reasonable expectations.**

Budgets can motivate managers to achieve a high level of performance. But **how difficult** should targets be? And how might people react to targets of differing degrees of difficulty in achievement?

a) There is likely to be a **de-motivating** effect where an **ideal standard** of performance is set, because adverse efficiency variances will always be reported.

b) A **low standard** of efficiency is also **de-motivating**, because there is no sense of achievement in attaining the required standards. If the budgeted level of attainment is too 'loose', targets will be achieved easily, and there will be no impetus for employees to try harder to do better than this.

c) A budgeted level of attainment could be the **same** as the level that has been achieved in the past. Arguably, this level will be too low. It might encourage **budgetary slack**.

Academics have argued that each individual has a **personal 'aspiration level'.** This is a level of performance in a task with which the individual is familiar, which the individual undertakes for himself to reach.

Individual aspirations might be much higher or much lower than the organisation's aspirations, however. The solution might therefore be to have **two budgets**.

a) A budget for **planning and decision making** based on **reasonable expectations**

b) A budget for **motivational purposes**, with more **difficult targets of performance**

These two budgets might be called an '**expectations budget**' and an '**aspirations budget**' respectively.

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PARTICIPATION IN BUDGETING

A budget can be set from the **top down** (**imposed** budget) or from the **bottom up** (**participatory** budget). Many writers refer to a third style, the negotiated budget.

Participation

It has been argued that **participation** in the budgeting process **will improve motivation** and so will improve the quality of budget decisions and the efforts of individuals to achieve their budget targets (although obviously this will depend on the personality of the individual, the nature of the task (narrowly defined or flexible) and the organisational culture).

There are basically two ways in which a budget can be set: from the **top down** (imposed budget) or from the **bottom up** (participatory budget).

Imposed style of budgeting (top-down budgeting)

In this approach to budgeting, **top management prepare a budget with little or no input from operating personnel** which is then imposed upon the employees who have to work to the budgeted figures.

The times when imposed budgets are effective are as follows.

- In newly-formed organisations
- In very small businesses
- During periods of economic hardship
- When operational managers lack budgeting skills
- When the organisation's different units require precise coordination

There are, of course, advantages and disadvantages to this style of setting budgets.

Advantages

- **Strategic plans** are likely to be incorporated into planned activities
- They **enhance** the **coordination** between the plans and objectives of divisions
- They use **senior management's awareness** of total resource availability
- They **decrease the input from inexperienced or uninformed lower-level employees**
- They **decrease the period of time taken** to draw up the budgets

Disadvantages

- **Dissatisfaction**, **defensiveness** and **low morale** amongst employees
- The **feeling of team spirit** may disappear
- The **acceptance of organisational goals** and **objectives** could be limited
- The feeling of the budget as a **punitive device** could arise
- **Unachievable budgets** for overseas divisions could result if consideration is not given to local operating and political environments
- **Lower-level management initiative** may be **stifled**

Participative style of budgeting (bottom-up budgeting)

In this approach to budgeting, **budgets are developed by lower-level managers who then submit the budgets to their superiors**. The budgets are based on the lower-level managers' perceptions of what is achievable and the associated necessary resources.

Participative budgets are effective in the following circumstances.

- In **well-established organisations**
- In **very large businesses**
- During periods of **economic affluence**
- When operational managers have **strong budgeting skills**
- When the organisation's different units act **autonomously**

The **advantages** of participative budgets are as follows.

- They are based on **information from employees** most familiar with their unit of operation
- **Knowledge spread** among several levels of management is pulled **together**
- **Morale** and **motivation** are improved
- They **increase operational managers' commitment** to organisational objectives
- In general they are **more realistic**
- **Co-ordination** between units is **improved**
- **Specific resource requirements** are **included**
- **Senior managers' overview** is mixed with operational level details

There are, on the other hand, a number of **disadvantages** of participative budgets.

- They often **consume more time**
- **Changes implemented** by senior management may **cause dissatisfaction**
- Budgets may be **unachievable** if managers' are not qualified to participate
- They may cause managers to introduce **budgetary slack**
- They can support **'empire building'** by subordinates
- An **earlier start** to the budgeting process could be required

Negotiated style of budgeting

At the two extremes, budgets can be dictated from above or simply emerge from below but, in practice, different levels of management often agree budgets by a process of negotiation. In the imposed budget approach, operational managers will try to negotiate with senior managers the budget targets which they consider to be unreasonable or unrealistic. Likewise senior management usually review and revise budgets presented to them under a participative approach through a process of negotiation with lower level managers. **Final budgets are therefore most likely to lie between what top management would really like and what junior managers believe is feasible.** The budgeting process is hence a **bargaining process** and it is this bargaining which is of vital importance, **determining whether the budget is an effective management tool or simply a clerical device**.

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MUTUALLY EXCLUSIVE PROJECTS WITH UNEQUAL LIVES

All of the discounted cash flow examples that we have seen so far have involved a choice between projects with equal lives. However, if manager are **deciding between projects with different time spans a direct comparison of the NPV generated by each project would not be valid.**

For example if an organisation decides to invest in a project with a shorter life it may then have the opportunity to invest in a new project in the future sooner than if a longer term project is accepted. This should be taken into account in the analysis in order to be able to make direct comparisons between projects with unequal lives.

Annualised equivalents are used to enable a comparison made between the net present values of projects with different durations. **However, this method cannot be used when inflation is a factor.** Another method, the **lowest common multiple method, is used** instead.

Example: annualised equivalents

An organisation has the opportunity to invest in either Project G or Project H. The forecast from the cash flows from the projects are as follows:

		Project G	*Project H*
		RWF m	RWF m
Capital cost		(200)	(143)
Cash inflows:	Year 1	90	100
	Year 2	120	80
	Year 3	50	-

The company's cost of capital is 12%. Which project should be accepted?

Solution

Project G

Year	*Cash flow*	*PV factor*	*PV of cash flow*
	RWF '000	12%	RWF '000
0	(200,000)	1.000	(200,000)
1	90,000	0.893	80,370
2	120,000	0.797	95,640
3	50,000	0.712	<u>35,600</u>
			NPV = <u>11,610</u>

Project H

Year	*Cash flow*	*PV factor*	*PV of cash flow*
	RWF '000	12%	RWF '000
0	(143,000)	1.000	(143,000)
1	100,000	0.893	89,300
2	80,000	0.797	<u>63,790</u>
			NPV = <u>10,060</u>

These NPV's **cannot be compared** directly because they each relate to a different number of years. In order to make a comparison we must convert each NPV to an **annualised equivalent cos**t. In other words, we convert the project's NPV into an equivalent annual annuity over its expected life. We do this by using **cumulative discount factors**.

	Project G	*Project H*
NPV at 12%	RWF 11,610,000	RWF10,060,000
Cumulative 12% discount factor	÷ 2.402	÷ 1.69
Annualised equivalent	RWF4,833,470	RWF5,952,665

Project H is offering an equivalent annual annuity of RWF5,952,665 which is higher than that offered by project G, therefore project H is preferable.

Exam Focus Point

When inflation is a factor, LCM must be used rather than annualised equivalents.

Example: Lowest Common Multiple (LCM)

Where asset replacement includes inflation you would not be able to use annualised equivalent costs. The correct method, lowest common multiple, is the one to use. The key points when using the lowest common multiple method are:

a) Calculate cash flows including inflated values for both alternatives

b) Use the lowest common multiple to establish a common time period and base asset lives on that

Fred is considering the replacement of a caravan he lets out for hire. He is planning to retire in six years time and is therefore only concerned with that period of time, but cannot decide whether it is better to replace the caravan every two years or every three years.

The following data have been estimated (all values at today's price levels):

Purchase cost and trade-in values

		RWF '000
Cost of a new caravan		20,000
Trade-in value of caravan:	after two years	10,000
	after three years	5,000

Annual costs and revenues

	Per year
	RWF '000
Caravan running costs	10,000
Lettings charged to customers, that is revenue for Fred	20,000

Caravan servicing and repair costs

Caravan servicing and repairs costs depend on the age of the caravan. In the following table, year 1 represents the cost in the first year of the caravan ownership; year 2 represents the cost in the second year of ownership, and so on:

	RWF '000
Year 1	500
Year 2	2,500
Year 3	4,000

Inflation

New caravan costs and trade in values are expected to increase by 5% per year. Caravan running costs and lettings are expected to increase by 7% per year. Caravan servicing and repair costs are expected to increase by 10% per year.

Required

Advise Fred on the optimum replacement cycle for his caravan and state the net present value of the opportunity cost of making the wrong decision. Use a discount rate of 12% per year. All workings and assumptions should be shown. Ignore taxation.

Solution

In this example you need to consider a six-year time horizon, six being the lowest common multiple of two and three.

Projected cash flows – 2 year trade in

	Year 0	*Year 1*	*Year 2*	*Year 3*	*Year 4*	*Year 5*	*Year 6*
	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000	RWF ‘000
Caravan cost							
(+5% pa)	(20,000)		(22,050)		(24,310)		
Trade in value (+5% pa)			11,025		12,155		13,401
Annual costs and revenues (net of costs) (+7%pa)		10,700	11,449	12,250	13,108	14,026	15,007
Servicing and repair (+10% pa)	______	(550)	(3,025)	(666)	(3,660)	(805)	(4,429)
Net cash flow	(20,000)	10,150	(2,601)	11,584	(2,707)	13,221	23,979
Discount at 12%	x 1.000	x 0.893	x 0.797	x 0.712	x 0.636	x 0.567	x 0.507
PV of cash flow	(20,000)	9,064	(2,073)	8,248	(1,722)	7,496	12,157

NPV of cash flow = RWFk 13,170

Projected cash flows – 2 year trade in

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000
Caravan cost (+5% pa)	(20,000)			(23,153)			
Trade in value (+5% pa)				5,788			6,700
Annual costs and revenues (net of costs) (+7%pa)		10,700	11,449	12,250	13,108	14,026	15,007
Servicing and repair (+10% pa)		(550)	(3,025)	(5,324)	(732)	(4,026)	(7,088)
Net cash flow	(20,000)	10,150	8,424	(10,439)	12,376	10,000	14,621
Discount at 12%	x 1.000	x 0.893	x 0.797	x 0.712	x 0.636	x 0.567	x 0.507
PV of cash flow	(20,000)	9,064	6,714	(7,433)	7,871	5,670	7,413

NPV of cash flow = RWF k 9,299

Assumptions: inflation applies from year 0 to all costs and revenues, which are stated at their values in year 0 in the question.

Based on NPVs of the two alternative replacement cycles, that with the higher positive NPV is the two-year replacement cycle and so this should be chosen as the optimum replacement cycle.

Not all mutually exclusive investments need to be considered over the same level of time. It very much depends on what the organisation intends to do once the shorter-life **project ends**. If the organisation has to **invest in similar assets** again at that point, the **projects should be compared over equal time periods**. Investment in manufacturing equipment for a product that will be made for more years than the life of an asset is an example.

If the organisation does **not have to invest in similar assets when the asset's life ends**, however, the approach we have described is not needed. If the investments are alternative advertising campaigns for a short-life product such as a commemorative item, the investments will be one-offs and so can be **compared over different lives**.

CHAPTER ROUNDUP

- **Corporate objectives** concern the firm as a whole. **Unit objectives** are specific to individual units , divisions or functions of an organisation.

- **Primary corporate objectives** are supported by **secondary objectives**, for example for product development or market share. In practice there may be a trade off between different objectives.

- The **planning and control cycle** has seven steps.

  - *Step 1*. Identify **objectives**
  - *Step 2.* Identify potential **strategies**
  - *Step 3.* Evaluate strategies – *SWOT analysis*
  - *Step 4.* Choose alternative courses of action
  - *Step 5.* Implement the long-term plan
  - *Step 6.* Measure actual results and compare with the plan
  - *Step 7.* Respond to divergences from the plan

- **Planning** and **control** occurs at all levels of the **performance hierarchy** to different degrees.

- **Budgetary control** occurs at the **lower** levels of the performance hierarchy.

- Here are the objectives of a budgetary planning and control system.

  - Ensure the achievement of the organisation's objectives
  - Compel planning
  - Communicate ideas and plans
  - Coordinate activities
  - Provide a framework for responsibility accounting
  - Establish a system of control
  - Motivate employees to improve their performance

- Used correctly, a budgetary control system can **motivate** but it can also produce undesirable **negative reactions**.

- **'Aspirations'** budgets can be used as **targets** to motivate higher levels of performance but a budget for **planning and decision making** should be based on **reasonable expectations.**

- A budget can be set from the **top down** (**imposed** budget) or from the **bottom up** (**participatory** budget). Many writers refer to a third style, the negotiated budget.

STUDY UNIT 13

Budgetary Systems

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EXAM GUIDE

The examiner expects you to be aware of the problems of traditional budgetary systems and why organisations may be reluctant to change to more appropriate systems.

TRADITIONAL BUDGETARY SYSTEMS

A budget is a **quantified plan of action** for a forthcoming accounting period.

A budget can be set from the **top down** (**imposed** budget) or from the **bottom up** (**participatory** budget).

Budget preparation

You will have covered budget preparation in your earlier studies and will not be required to prepare sales, production, materials etc budgets in this exam.

The following are the key points of budget preparation to remind you.

Point	Detail
Long-term plan	The **starting point**, this will show **what the budget has to achieve** (the introduction of new production, the required return, and so on) and outline **how it is to be done**. It will also contain **general guidelines** on allowable price increases such as wage rates. The **long-term policy** needs to be **communicated** to all managers responsible for preparing budgets so that they are aware of the context within which they are budgeting and how their area of responsibility is expected to contribute.
Limiting factor	The factor that **limits the scale of operations**, this is usually sales demand, but it may be production capacity where demand is high. Budgeting cannot proceed until the budget for the limiting factor has been prepared, since this affects all the other budgets.
Budget manual	Prepared to **assist functional managers**, this will show how figures and forecasts are to be arrived at and give any other information that is to apply across the organisation. It is likely to include **proformas** showing how the information is to be presented. If budgeting is done with spreadsheets, layouts and computations may be pre-programmed, requiring only the entry of the figures. It may include a **flow diagram** showing how individual budgets are interlinked and specify deadlines by which first drafts must be prepared.
Sales budget	This contains **information on the expected volume of sales** (based on estimates or market research), the **sales mix, and selling prices.** The total revenues indicated will be used to compile the cash budget,

	although this information needs to be adjusted to allow for the expected timing of receipts. The volume of sales indicates the level of production required and the extent of spending on distribution and administration.
Production capacity	The level of sales anticipated is matched against opening inventory and desired closing inventory to establish the level of production. From this can be calculated the need for materials (again allowing for opening and closing inventory), labour and machine hours. In other words production budgeting is **done in terms of physical resources initially and costed afterwards**. At this stage, too, it is likely that needs for new capital expenditure will be identified. This information will be used in preparing the capital budget.
Functional budgets	Budgets **for other areas of the organisation** like distribution and administration take the anticipated sales level as their point of reference. Vehicle costs, carriage/distribution costs, stationery, IT and communication costs, and above all staff costs feature in these budgets.
Discretionary costs	**Training and R&D** are known as 'discretionary costs' and have special features.
Consolidation and coordination	This can begin once all parts of the organisation have submitted their individual budgets. It is most **unlikely** that **all of the budgets will be in line with each other** at the first attempt. Areas of **incompatibility** must be identified and the **budgets modified** in consultation with individual managers. **Spreadsheets** are invaluable at this stage, both for the consolidation itself and to allow changes to be made quickly and accurately.
Cash budget	This can only be prepared at this stage because it **needs to take account of all of the plans of the organisation** and translate them into expected cash flows. Cash must be available when it is needed to enable the plans to be carried out. Overdraft facilities may need to be negotiated in advance, or some activities may need to be deferred until cash has been collected.
Master budget	The final stage, once all of the necessary modifications have been made, is to prepare a **summary** of all of the budgets in the form of a master budget, which generally comprises a **budgeted income statement, a budgeted balance sheet and a budgeted cash flow statement.**

Incremental budgeting

The traditional approach to budgeting, known as **incremental budgeting**, bases the budget on the current year's results plus an extra amount for estimated growth or inflation next year. It encourages slack and wasteful spending to creep into budgets.

Incremental budgeting is so called because it is concerned mainly with the increments in costs and revenues which will occur in the coming period.

Incremental budgeting is a reasonable procedure if current operations are as effective, efficient and economical as they can be. It is also appropriate for budgeting for costs such as staff salaries, which may be estimated on the basis of current salaries plus an increment for inflation and are hence administratively fairly easy to prepare.

In general, however, it is an **inefficient form of budgeting** as it **encourages slack** and **wasteful spending** to creep into budgets. Past inefficiencies are perpetuated because cost levels are rarely subjected to close scrutiny.

Question

Can incremental budgeting be used to budget for rent? What about for advertising expenditure?

Answer

Incremental budgeting is appropriate for budgeting for rent, which may be estimated on the basis of current rent plus an increment for the annual rent increase. Advertising expenditure, on the other hand, is not so easily quantifiable and is more discretionary in nature. Using incremental budgeting for advertising expenditure could allow slack and wasteful spending to creep into the budget.

Incremental budgeting in the public sector

The traditional approach to budgeting in the public sector has been incremental and this has resulted in existing patterns of public expenditure being locked in. For instance, the public spending round in the UK established an annual cycle of year-on-year incremental bids by departments rather than an analysis of outputs and efficiency. How is the annual government budgeting process carried out in Rwanda?

We will look at public sector objectives and performance measurement in more detail in Study Unit 20.

FIXED AND FLEXIBLE BUDGETS

Fixed budgets remain unchanged regardless of the level of activity; **flexible budgets** are designed to flex with the level of activity.

Fixed budgets

A **fixed budget** is a budget which is designed to remain unchanged regardless of the volume of output or sales achieved.

The master budget prepared before the beginning of the budget period is known as the **fixed budget**. The term 'fixed' means the following.

a) The budget is **prepared on the basis of an estimated volume of production** and an **estimated volume of sales**, but no plans are made for the event that actual volumes of production and sales may differ from budgeted volumes.

b) When actual volumes of production and sales during a control period (month or four weeks or quarter) are achieved, a fixed budget is **not adjusted (in retrospect) to the new levels of activity.**

The major purpose of a fixed budget is at the planning stage, when it seeks to define the broad objectives of the organisation.

Flexible budgets

A **flexible budget** is a budget which, by recognising different cost behaviour patterns, is designed to change as volumes of output change.

Flexible budgets may be used in one of two ways.

a) **At the planning stage**. For example, suppose that a company expects to sell 10,000 units of output during the next year. A master budget (the fixed budget) would be prepared on the basis of these expected volumes. However, if the company thinks that output and sales might be as low as 8,000 units or as high as 12,000 units, it may prepare **contingency flexible budgets**, at volumes of, say 8,000, 9,000, 11,000 and 12,000 units and then assess the possible outcomes.

b) **Retrospectively**. At the end of each month (control period) or year, the results that should have been achieved given the actual circumstances (the flexible budget) can be compared with the actual results. As we shall see, flexible budgets are an essential factor in **budgetary control**.

The preparation and use of flexible budgets were looked at in more detail in Chapters 9 & 10 Linear Programming.

ZERO BASED BUDGETARY SYSTEMS

The principle behind **zero based budgeting (ZBB)** is that the budget for each cost centre should be made from 'scratch' or zero. Every item of expenditure must be justified in its entirety in order to be included in the next year's budget.

ZBB, in theory, rejects the assumption inherent in **incremental budgeting;** that this year's activities will continue at the same level or volume next year, and that next year's budget can be based on this year's costs plus an extra amount, perhaps for expansion and inflation.

Zero based budgeting involves preparing a budget for each cost centre from a zero base. Every item of expenditure has then to be justified in its entirety in order to be included in the next year's budget.

In reality, however, managers do not have to budget from zero, but can **start from their current level of expenditure and work downwards**, asking what would happen if any particular aspect of current expenditure and current operations were removed from the budget. In this way, every aspect of the budget is examined in terms of its cost and the benefits it provides and the selection of better alternatives is encouraged.

Implementing zero based budgeting

There is a three-step approach to ZBB.

- Define decision units
- Evaluate and rank packages
- Allocate resources

The implementation of ZBB involves a number of steps but of greater importance is the **development of a questioning attitude** by all those involved in the budgetary process. Existing practices and expenditures must be challenged and searching questions asked.

- Does the activity need to be carried out?
- What would be the consequences if the activity was not carried out?

- Is the current level of provision current?
- Are there alternative ways of providing the function?
- How much should the activity cost?
- Is the expenditure worth the benefits achieved?

The basic approach of ZBB has three steps.

Step 1 **Define decision packages**, comprehensive descriptions of specific organisational activities which management can use to evaluate the activities and **rank** them in order of priority against other activities. There are two types.

a) **Mutually exclusive packages** contain alternative methods of getting the same job done. The best option among the packages must be selected by comparing costs and benefits and the other packages are then discarded.

b) **Incremental packages** divide one aspect of an activity into different levels of effort. The 'base' package will describe the minimum amount of work that must be done to carry out the activity and the other packages describe what additional work could be done, at what cost and for what benefits.

Suppose that a cost centre manager is preparing a budget for maintenance costs. He might first consider two mutually exclusive packages.

- Package A might be to keep a maintenance team of two men per shift for two shifts each day at a cost of Rwf6,000,000 per annum
- Package B might be to obtain a maintenance service from an outside contractor at a cost of Rwf5,000,000

A **cost-benefit analysis** will be conducted because the quicker repairs obtainable from an in-house maintenance service might justify its extra cost. If we now suppose that package A is preferred, the budget analysis must be completed by describing the incremental variations in this chosen alternative.

a) The 'base' package would describe the minimum requirement for the maintenance work. This might be to pay for one man per shift for two shifts each day at a cost of RWF3,000,000.

b) Incremental package 1 might be to pay for two men on the early shift and one man on the late shift, at a cost of RWF4,500,000. The extra cost of RWF1,500,000 would need to be justified, for example by savings in lost production time, or by more efficient machinery.

c) Incremental package 2 might be the original preference, for two men on each shift at a cost of RWF6,000,000. The cost-benefit analysis would compare its advantages, if any, over incremental package 1; and so on.

Step 2 **Evaluate and rank each activity (decision package)** on the basis of its benefit to the organisation. This can be a lengthy process. Minimum work requirements (those that are essential to get a job done) will be given high priority and so too will work which meets legal obligations. In the accounting department these would be minimum requirements to operate the payroll, purchase ledger and sales ledger systems, and to maintain and publish a set of accounts.

Step 3 **Allocate resources** in the budget according to the funds available and the evaluation and ranking of the competing packages.

Question

What might the base and incremental packages for a personnel department cover?

Answer

The base package might cover the recruitment and dismissal of staff. Incremental packages might cover training, pension administration, trade union liaison, staff welfare and so on.

The advantages and limitations of implementing ZBB

The **advantages** of zero based budgeting are as follows.

- It is possible to identify and **remove inefficient or obsolete operations.**
- It forces employees to **avoid wasteful expenditure**.
- It can **increase motivation**.
- It **responds to changes** in the business environment.
- **ZBB documentation provides** an in-depth **appraisal of an organisation's operations.**
- It **challenges the status quo**.
- In summary, ZBB should result in a **more efficient allocation of resources**.

The major **disadvantage** of zero based budgeting is the **volume of extra paperwork** created. The assumptions about costs and benefits in each package must be continually updated and new packages developed as soon as new activities emerge.

The following problems might also occur.

a) **Short-term benefits** might be **emphasised** to the detriment of long-term benefits.

b) It might give the impression **that all decisions have to be made in the budget**. Management must be able to meet unforeseen opportunities and threats at all times, however, and must not feel restricted from carrying out new ideas simply because they were not approved by a decision package, cost benefit analysis and the ranking process.

c) It may **call for management skills** both in constructing decision packages and in the ranking process **which the organisation does not possess**. Managers may have to be trained in ZBB techniques.

d) The organisation's **information systems may not be capable of providing suitable information**.

e) T**he ranking process can be difficult**. Managers face three common problems.

   (i) A large number of packages may have to be ranked.

   (ii) It can be difficult to rank packages which appear to be equally vital, for legal or operational reasons.

   (iii) It is difficult to rank activities which have qualitative rather than quantitative benefits – such as spending on staff welfare and working conditions.

In summary, perhaps the **most serious drawback to ZBB is that it requires a lot of management time and paperwork**. One way of obtaining the benefits of ZBB but of overcoming the drawbacks is to apply it selectively on a rolling basis throughout the organisation. This year finance, next year marketing, the year after personnel and so on. In this way all activities will be thoroughly scrutinised over a period of time.

Using zero based budgeting

ZBB is particularly useful for budgeting for discretionary costs and for rationalisation purposes.

ZBB is not particularly suitable for direct manufacturing costs, which are usually budgeted using standard costing, work study and other management planning and control techniques. It is best applied to **support expenses**, that is expenditure incurred in departments which exist to support the essential production function. These support areas include marketing, finance, quality control, HR/personnel, IT/data processing, sales and distribution. In many organisations, these expenses make up a large proportion of the total expenditure. These activities are less easily quantifiable by conventional methods and are more **discretionary** in nature.

ZBB can also be successfully applied to **service industries** and **non-profit-making organisations** such as local and central government departments, educational establishments, hospitals and so on, and in any organisation where alternative levels of provision for each activity are possible and where the costs and benefits are separately identifiable.

ZBB can also be used to make **rationalisation decisions**. 'Rationalisation' is often a euphemism for cutting back on production and activity levels and cutting costs. The need for service departments to operate above a minimum service level, or the need for having a particular department at all, can be questioned and ZBB can be used to make rationalisation decisions when an organisation is forced to make spending cuts.

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ACTIVITY BASED BUDGETING

At its simplest, **activity based budgeting (ABB)** is merely the use of costs determined using ABC as a basis for preparing budgets.

Activity based budgeting involves defining the activities that underlie the financial figures in each function and using the level of activity to decide how much resource should be allocated, how well it is being managed and to explain variances from budget.

Implementing ABC (see Chapter 1) leads to the realisation that the **business as a whole** needs to be managed with far more reference to the **behaviour of activities and cost drivers** identified. For example, traditional budgeting may make managers 'responsible' for activities which are driven by factors beyond their control: the personnel department cost of setting up new employee records is driven by the number of new employees required by managers other than the personnel manager.

Principles of ABB

ABB involves defining the activities that underlie the financial figures in each function and using the **level of activity** to decide how much resource should be **allocated**, how well it is being **managed** and to **explain variances** from budget.

ABB is therefore based on the following **principles**.

a) It is **activities which drive costs** and the aim is to **control the causes** (drivers) of costs rather than the costs themselves, with the result that in the long term, costs will be better managed and better understood.

b) **Not all activities add value** and so activities must be examined and split up according to their ability to add value.

c) Most departmental activities are driven by demands and decisions **beyond the immediate control** of the manager responsible for the department's budget.

d) Traditional financial measures of performance are unable to fulfil the objective of **continuous improvement**. Additional measures which focus on drivers of costs, the quality of activities undertaken, the responsiveness to change and so on are needed.

Example: ABB

A stores department has two main activities, receiving deliveries of raw materials from suppliers into stores and issuing raw materials to production departments. Two major cost drivers, the number of deliveries of raw materials and the number of production runs, have been identified. Although the majority of the costs of the department can be attributed to these activities, there is a small balance, termed 'department running costs', which includes general administration costs, part of the department manager's salary and so on.

Based on activity levels expected in the next control period, the following cost driver volumes have been budgeted.

250 deliveries of raw materials

120 production runs

On the basis of budgeted departmental costs and the cost analysis, the following budget has been drawn up for the next control period.

	Total	*Costs attributable to receiving deliveries*	*Costs attributable to issuing materials*	*Dept running costs*
Cost	RWF m	RWF m	RWFm	RWF m
Salaries – management	25	8	12	5
Salaries – store workers	27	13	12	2
Salaries – administration	15	4	5	6
Consumables	11	3	5	3
Information technology costs	14	5	8	1
Other costs	19	10	6	3
	111	43	48	20
Activity volumes		250	120	
Cost per unit of cost driver		RWF k 172	RWF k 400	RWFk

20,000

Points to note

a) The apportionment of cost will be subjective to a certain extent. The objective of the exercise is that the resource has to be justified as supporting one or more of the activities. Costs cannot be hidden.

b) The cost driver rates of RWF172,000 and RWF400,000 can be used to calculate product costs using ABC.

c) Identifying activities and their costs helps to focus attention on those activities which add value and those that do not.

d) The budget has highlighted the cost of the two activities.

e) In larger more complex organisations, the apportionment % or fractions will be given by senior management; viz HR or IT departmental costs – bearing in mind that each of these uses the other's services.

Benefits of ABB

Some writers treat ABB as a complete philosophy in itself and attribute to it all the good features of strategic management accounting, zero base budgeting, total quality management and other ideas. For example, the following claims have been made.

a) Different **activity levels** will provide a foundation for the 'base' package and incremental packages of **ZBB**.

b) It will ensure that the organisation's overall **strategy** and any actual or likely changes in that strategy will be taken into account, because it attempts to manage the business as the **sum of its interrelated parts**.

c) **Critical success factors** will be identified and performance measures devised to monitor progress towards them. (A critical success factor is an activity in which a business **must** perform well if it is to succeed).

d) Because concentration is focused on the **whole of an activity**, not just its separate parts, there is more likelihood of **getting it right first time**. For example what is the use of being able to **produce** goods in time for their despatch date if the budget provides insufficient resources for the distribution manager who has to **deliver** them?

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ROLLING BUDGETS

Rolling budgets (**continuous budgets**) are budgets which are continuously being updated by adding a further period (say a month or a quarter) and dropping the earliest period.

Dynamic conditions

Actual conditions may differ from those anticipated when the budget was drawn up for a number of reasons.

a) **Organisational changes** may occur.

   (i) A change in structure, from a functional basis, say, to a process-based one

   (ii) New agreements with the workforce about flexible working or safety procedures

   (iii) The reallocation of responsibilities following, say, the removal of tiers of middle management and the 'empowerment' of workers further down the line

b) Action may be needed to **combat an initiative by a competitor.**

c) **New technology** may be introduced to improve productivity, reduce labour requirements or enhance quality.

d) **Environmental conditions** may change: there may be a general boom or a recession, an event affecting supply or demand, or a change in government or government policy.

e) The level of **inflation** may be higher or lower than that anticipated.

f) The **level of activities** may be different from the levels planned.

Any of these changes **may make the original budget quite inappropriate**, either in terms of the numbers expected, or the way in which responsibility for achieving them is divided, or both.

If management needs the chance to revise their plans, they may decide to introduce a system of **rolling budgets**.

A **rolling budget** is a budget which is continuously updated by adding a further accounting period (a month or quarter) when the earlier accounting period has expired.

Rolling budgets are an attempt to prepare targets and plans which are **more realistic and certain**, particularly with a regard to price levels, by **shortening the period between preparing budgets.**

Instead of preparing a **periodic budget** annually for the full budget period, there would be **budgets every one, two, three or four months** (three to six, or even twelve budgets each year). **Each of these budgets would plan for the next twelve months** so that the current budget is extended by an extra period as the current period ends: hence the name rolling budgets.

Suppose, for example, that a rolling budget is prepared every three months. The first three months of the budget period would be planned in great detail, and the remaining nine months in lesser detail, because of the greater uncertainty about the longer-term future. If a first continuous budget is prepared for January to March in detail and April to December in less detail, a new budget will be prepared towards the end of March, planning April to June in detail and July to March in less detail. Four rolling budgets would be prepared every 12 months on this 3 and 9 month basis, requiring, inevitably, greater administrative effort.

The advantages and disadvantages of rolling budgets

The **advantages** are as follows.

a) They **reduce the element of uncertainty** in budgeting because they concentrate detailed planning and control on short-term prospects where the degree of uncertainty is much smaller.

b) They force managers to reassess the budget regularly, and to produce budgets which are **up to date** in the light of current events and expectations.

c) **Planning and control will be based on a recent plan** which is likely to be far more realistic than a fixed annual budget made many months ago.

d) Realistic budgets are likely to have a **better motivational influence** on managers.

e) There is **always a budget which extends for several months ahead**. For example, if rolling budgets are prepared quarterly there will always be a budget extending for the next 9 to 12 months. This is not the case when fixed annual budgets are used.

The **disadvantages** of rolling budgets can be a deterrent to using them.

a) They involve **more time, effort and money** in budget preparation.

b) Frequent budgeting might have an **off-putting effect on managers** who doubt the value of preparing one budget after another at regular intervals.

c) Revisions to the budget might involve revisions to standard costs too, which in turn would involve revisions to stock valuations. This could replace a large **administrative effort** from the accounts department every time a rolling budget is prepared.

Continuous budgets or updated annual budgets

If the expected changes are not likely to be continuous there is a strong argument that routine updating of the budget is unnecessary. **Instead the annual budget could be updated whenever changes become foreseeable,** so that a budget might be updated once or twice, and perhaps more often, during the course of the year.

When a fixed budget is updated, a 'rolling' budget would probably not be prepared. If a budget is updated in month 8 of the year, the updated budget would relate to months 8 – 12. It would not be extended to month 7 of the following year.

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BEYOND BUDGETING

Beyond Budgeting is a model that proposes that traditional budgeting should be abandoned. **Adaptive management processes** should be used rather than fixed annual budgets.

Criticisms of budgeting

In our discussion of the budgetary planning process we have come across many difficulties with budgets and criticisms of how they are used in organisations.

The Beyond Budgeting Round Table (BBRT), an independent research collaborative, proposes that budgeting, as most organisations practise it, should be abandoned. Their website at www.bbrt.org lists the following ten criticisms of budgeting as put forward by Hope and Fraser *Beyond Budgeting*, 1st edition, Harvard Business School Press, 2003.

a) **Budgets are time consuming and expensive**. Even with the support of computer models it is estimated that the budgeting process uses up to 20 to 30 per cent of senior executives' and financial managers' time.

b) **Budgets provide poor value to users**. Although surveys have shown that some managers feel that budgets give them control, a large majority of financial directors wish to reform the budgetary process because they feel that finance staff spend too much time on 'lower value added activities'.

c) **Budgets fail to focus on shareholder value**. Most budgets are set on an incremental basis as an acceptable target agreed between the manager and the manager's superior. Managers may be rewarded for achieving their short term budgets and will not look to the longer term or take risks, for fear of affecting their own short term results.

d) **Budgets are too rigid and prevent fast response**. Although most organisations do update and revise their budgets at regular intervals as the budget period proceeds the process is often too slow compared with the pace at which the external environment is changing.

e) **Budgets protect rather than reduce costs**. Once a manager has an authorised budget he can spend that amount of resource without further authorisation. A 'use it or lose it' mentality often develops so that managers will incur cost unnecessarily. This happens especially towards the end of the budget period in the expectation that managers will not be permitted to carry forward any unused resource into the budget for next period.

f) **Budgets stifle product and strategy innovation**. The focus on achieving the budget discourages managers from taking risks in case this has adverse effects on their short term performance. Managers do not have the freedom to respond to changing customer needs in a fast changing market because the activity they would need to undertake is not authorised in their budget.

g) **Budgets focus on sales targets rather than customer satisfaction**. The achievement of short term sales forecasts becomes the focus of most organisations. However this does not necessarily result in customer satisfaction. The customer may be sold something **inappropriate to their needs**, as in recent years in the UK financial services industry. Alternatively if a manager has already met the sales target for a particular period they might try to **delay sales to the next period**, in order to give themselves a 'head start' towards achieving the target for the next period. Furthermore, there is an incentive towards the end of a period, if a manager feels that the sales target is not going to be achieved for the period, to **delay sales until the next period**, and thus again have a head start towards achieving the target for the next period. All of these actions, focusing on sales targets rather than customer satisfaction, can have a detrimental effect on the organisation in the longer term.

h) **Budgets are divorced from strategy**. Most organisations monitor the monthly results against the short term budget for the month. What is needed, instead, is a system of monitoring the longer term progress against the organisation's strategy.

i) **Budgets reinforce a dependency culture**. The process of planning and budgeting within a framework devolved from senior management perpetuates a culture of dependency. Traditional budgeting systems, operated on a centralised basis, do not encourage a culture of **personal responsibility**.

j) **Budgets lead to unethical behaviour**. For example building **slack** into the budget in order to create an easier target for achievement.

Beyond Budgeting concepts

Two fundamental concepts underlie the Beyond Budgeting approach.

a) **Use adaptive management processes rather than the more rigid annual budget**. Traditional annual plans tie managers to predetermined actions which are not responsive to current situations. Managers should instead be planning on a **more adaptive**, rolling basis but with the focus on cash forecasting rather than purely on cost control. Performance is monitored against world-class benchmarks, competitors and previous periods.

b) **Move towards devolved networks rather than centralised hierarchies**. The emphasis is on encouraging a culture of personal responsibility by delegating decision making and performance accountability to line managers.

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INFORMATION USED IN BUDGET SYSTEMS

Information used in budget systems will come from a wide variety of sources.

Past data may be used as a starting point for the preparation of budgets but other information from a wide variety of sources will also be used. Each **function** of the organisation will be required to estimate revenue and expenditure for the budget period. For example, marketing, personnel and research and development.

Sales budget information

As we have seen, for many organisations, the principal budget factor is sales volume. The sales budget is therefore often the primary budget from which the majority of the other budgets are derived. Before the sales budget can be prepared a **sales forecast** has to be made. Sales forecasting is complex and difficult and involves the use of information from a variety of sources.

- Past sales patterns
- The economic environment
- Results of market research
- Anticipated advertising
- Competition
- Changing consumer taste
- New legislation
- Distribution
- Pricing policies and discounts offered
- Legislation
- Environmental factors

Production budget information

Sources of information for the production budget will include:

a) **Labour costs** including idle time, overtime and standard output rates per hour.

b) **Raw material costs** including allowances for losses during production.

c) **Machine hours** including expected idle time and expected output rates per machine hour.

d) **Production required** by the sales department to meet their sales targets/budgets

Apart from (d), this information will come from the production department and a large part of the traditional work of **cost accounting** involves ascribing costs to the physical information produced.

CHANGING BUDGETARY SYSTEMS

An organisation which decides to **change** its budgetary practices will face a number of difficulties.

The business environment has become increasingly complex, uncertain and dynamic and organisations need to be able to adapt quickly to changing conditions. It has been argued that traditional budgets are too rigid and prevent fast response to changing conditions.

However, an organisation which decides to **change** its type of budget used, or budgetary system, will face a number of **difficulties**.

a) **Resistance by employees.** Employees will be familiar with the current system and may have built in slack so will not easily accept new targets. New control systems that threaten to alter existing power relationships may be thwarted by those affected.

b) **Loss of control.** Senior management may take time to adapt to the new system and understand the implications of results.

c) **Training.** In order for the new budget to operate effectively, everyone within the organisation will need to be fully trained. This is time-consuming and expensive.

d) **Costs of implementation.** Any new system or process requires careful implementation which will have cost implications.

e) **Lack of accounting information**. The organisation may not have the **systems** in place to obtain and analyse the necessary information.

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BUDGET SYSTEMS AND UNCERTAINTY

Uncertainty can be allowed for in budgeting by means of **flexible budgeting, rolling budgets, probabilistic budgeting** and **sensitivity analysis**.

Causes of uncertainty in the budgeting process include:

a) **Customers.** They may decide to buy less than forecast, or they may buy more.

b) **Products/services**. In the modern business environment, organisations need to respond to customers' rapidly changing requirements.

c) **Inflation** and movements in **interest and exchange rates.**

d) **Volatility** in the **cost of materials.**

e) **Competitors.** They may steal some of an organisation's expected customers, or some competitors' customers may change their buying allegiance.

f) **Employees.** They may not work as hard as was hoped, or they may work harder.

g) **Machines.** They may break down unexpectedly.

h) There may be **political unrest** (terrorist activity), **social unrest** (public transport strikes) or minor or major **natural disasters** (storms, floods).

Rolling budgets are a way of trying to **reduce the element of uncertainty** in the plan. There are **other planning methods** which try to **analyse the uncertainty** such as **probabilistic budgeting** (where probabilities are assigned to different conditions – see Chapter 14) and **sensitivity analysis**. These methods are suitable when the **degree of uncertainty is quantifiable** from the start of the budget period and actual results are not expected to go outside the range of these expectations.

CHAPTER ROUNDUP

- A budget is a **quantified plan of action** for a forthcoming accounting period.
- A budget can be set from the **top down** (**imposed** budget) or from the **bottom up** (**participatory** budget).
- The traditional approach to budgeting, known as **incremental budgeting**, bases the budget on the current year's results plus an extra amount for estimated growth or inflation next year. It encourages slack and wasteful spending to creep into budgets.
- **Fixed budgets** remain unchanged regardless of the level of activity; **flexible budgets** are designed to flex with the level of activity
- The principle behind **zero based budgeting (ZBB)** is that the budget for each cost centre should be made from 'scratch' or zero. Every item of expenditure must be justified in its entirety in order to be included in the next year's budget.
- There is a three-step approach to ZBB.

  – Define decision units
  – Evaluate and rank packages
  – Allocate resources

- ZBB is particularly useful for budgeting for discretionary costs and for rationalisation purposes.
- At its simplest, **activity based budgeting (ABB)** is merely the use of costs determined using ABC as a basis for preparing budgets.
- **Rolling budgets (continuous budgets)** are budgets which are continuously updated by adding a further period (say a month or a quarter) and deducting the earliest period.
- **Information** used in budget systems will come from a wide variety of sources.
- An organisation which decides to **change** its budgetary practices will face a number of difficulties.
- Uncertainty can be allowed for in budgeting by means of **flexible budgeting, rolling budgets, probabilistic budgeting** and **sensitivity analysis**.

STUDY UNIT 14

Quantitative Analysis In Budgeting

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EXAM GUIDE

The quantitative techniques covered in this chapter are likely to form the calculation part of a budgeting question.

ANALYSING FIXED AND VARIABLE COSTS

Two important quantitative methods the management accountant can use to analyse fixed and variable cost elements from total cost data are the **high-low** and **regression methods.**

The high-low method

You will have encountered the high-low method in your earlier studies. It is used to identify the fixed and variable elements of costs that are **semi-variable**. Read through the knowledge brought forward and do the question below to jog your memory.

Knowledge brought forward from earlier studies

Follow the steps below.

Step 1 Review records of costs in previous periods.

- Select the period with the **highest** activity level
- Select the period with the **lowest** activity level

Step 2 If inflation makes it difficult to compare costs, adjust by indexing up or down.

Step 3 Determine the following.

- Total cost at high activity level
- Total costs at low activity level
- Total units at high activity level
- Total units at low activity level

Step 4 Calculate the following.

$$\frac{\text{Total cost at high activity level} - \text{total cost at low activity level}}{\text{Total units at high activity level} - \text{total units at low activity level}}$$

= variable cost per unit (v)

Step 5 The fixed costs can be determined as follows. (Total cost at high activity level) – (total units at high activity level × variable cost per unit)

Example

A department in a large organisation wishes to develop a method of predicting its total costs in a period. The following data have been recorded.

Month	*Activity level (X)*	*Cost*
	units	RWF ‘000
January	1,600	28,200
February	2,300	29,600
March	1,900	28,800
April	1,800	28,600
May	1,500	28,000
June	1,700	28,400

The total cost model for a period could be represented by what equation?

Answer

The highest activity level is in February and the lowest in May.

Total cost at highest activity level	=	RWF29,600,000
Total cost at lowest activity level	=	RWF28,000,000
Total units at highest activity level	=	2,300
Total units at lowest activity level	=	1,500

$$\text{Variable cost per unit} = \frac{29{,}600{,}000 - 28{,}000{,}000}{2{,}300 - 1{,}500} = \frac{1{,}600{,}000}{800} = \text{RWF}2{,}000$$

Fixed costs = 29,600,000 – (2,300 × 2,000) = RWF25,000,000

Total costs = 25,000,000 + 2x

The usefulness of the high-low method

The high-low method is a simple and easy to use method of estimating fixed and variable costs. However there are a number of problems with it.

a) The method **ignores** all cost information apart from at the highest and lowest volumes of activity and these may not be **representative** of costs at all levels of activity.

b) **Inaccurate** cost estimates may be produced as a result of the assumption of a constant relationship between costs and volume of activity.

c) Estimates are based on **historical** information and conditions may have changed.

Linear regression analysis

Knowledge brought forward from earlier studies

Linear relationships

- A **linear relationship** can be expressed in the form of an equation which has the general form y = a + bx

where y is the **dependent** variable, depending for its value on the value of x

x is the **independent** variable, whose value helps to determine the value of y

a is a **constant**, a fixed amount

b is a constant, being the **coefficient of x** (that is, the number by which the value of x should be multiplied to derive the value of y)

- If there is a linear relationship between total costs and level of activity, y = total costs, x = level of activity, a = fixed cost (the cost when there is no activity level) and b = variable cost per unit.
- The graph of a linear equation is a **straight line** and is determined by two things, the **gradient** (or slope) of the straight line and the point at which the straight line crosses the y axis (the **intercept**).

  – Gradient = b in the equation y = a + bx = $(y_2 - y_1)/(x_2 - x_1)$ where (x_1, y_1), (x_2, y_2) are two points on the straight line

  – Intercept = a in the equation y = a + bx

- **Linear regression analysis**, also known as the **'least squares technique'**, is a **statistical method** of estimating costs using historical data from a number of previous accounting periods.

$$\text{If } y = a + bx,\ b = \frac{n\Sigma xy - \Sigma x\Sigma y}{n\Sigma x^2 - (\Sigma x)^2} \text{ and } a = \frac{\Sigma y}{n} - \frac{b\Sigma x}{n}$$

where n is the number of pair of data for x and y.

Exam Focus Point

Note that you don't need to learn these formulae, as they are provided in the exam, but it would be very easy to make a mistake when copying them down so always double check back to the exam paper. Make sure you are confident using these formulae quickly and accurately.

Example: linear regression analysis

The transport department of NCC Ltd operates a large fleet of vehicles. These vehicles are used by the various departments of the NCC Ltd. Each month a statement is prepared for the transport department comparing actual results with budget. One of the items in the transport department's monthly statement is the cost of vehicle maintenance. This maintenance is carried out by the employees of the department. To facilitate control, the transport manager has asked that future statements should show vehicle maintenance costs analysed into fixed and variable costs.

Data from the six months from January to June inclusive are given below.

	Vehicle maintenance cost	*Vehicle running hours*
	RWF '000	
January	13,600	2,100
February	15,800	2,800
March	14,500	2,200
April	16,200	3,000
May	14,900	2,600
June	15,000	2,500

Required

Analyse the vehicle maintenance costs into fixed and variable costs, based on the data given, utilising the least squares method.

Solution

If y = a + bx, where y represents costs and x represents running hours (since costs depend on running hours) then b= (nΣxy – ΣxΣy)/ (nΣx^2 – (Σx)^2), when n is the number of pairs of data, which is 6 in this problem.

x	*y*	*xy*	x^2
'000 hrs	Rwf m		
2.1	13.6	28.56	4.41
2.8	15.8	44.24	7.84
2.2	14.5	31.90	4.84
3.0	16.2	48.60	9.00
2.6	14.9	38.74	6.76
2.5	15.0	37.50	6.25
15.2	90.0	229.54	39.10

Variable cost per hour, b $= \dfrac{(6x229.54) - (15.2x90.0)}{(6x39.10) - 15.2^2}$

= (1,377.24 – 1,368)/(234.6 – 231.04) = 9.24/3.56 = RWF2.60

Fixed costs (in RWF m), a = (Σy/n) – (bΣx/n) = (90/6) – (2.6(15.2)/6) = 8.41 approx, say Rwf8,400,000

The conditions suited to the use of linear regression analysis

The conditions which should apply if linear regression analysis is to be used to estimate costs are as follows.

a) A **linear cost function should be assumed**. This assumption can be tested by measures of reliability, such as the correlation coefficient and the coefficient of determination (which ought to be reasonably close to 1).

b) When calculating a line of best fit, there will be a range of values for x. In Question 1, the line $y = 28 + 2.6x$ was predicted from data with output values ranging from $x = 16$ to $x = 24$. Depending on the degree of correlation between x and y, we might safely use the estimated line of best fit to forecast values for y, provided that the value of x remains within the range 16 to 24. We would be on less safe ground if we used the equation to predict a value for y when $x = 10$, or 30, or any other value outside the range 16 to 24, because we would **have to assume that costs behave in the same way outside the range of x values used to establish the line in the first place.**

Interpolation means using a line of best fit to predict a value within the two extreme points of the observed range.

Extrapolation means using a line of best fit to predict a value outside the two extreme points.

c) The **historical data** for cost and output should be **adjusted to a common price level** (to overcome cost differences caused by inflation) and the historical data should also be **representative of current technology, current efficiency levels and current operations** (products made).

d) As far as possible, **historical data should be accurately recorded** so that variable costs are properly matched against the items produced or sold, and fixed costs are properly matched against the time period to which they relate. For example, if a factory rental is RWF120,000 per annum, and if data is gathered monthly, these costs should be charged RWF10,000 to each month instead of RWF120,000 in full to a single month.

e) Management should either be **confident that conditions** which have existed in the past **will continue into the future or amend the estimates** of cost produced by the linear regression analysis to **allow for expected changes** in the future.

f) As with any forecasting process, the **amount of data available is very important**. Even if correlation is high, if we have fewer than about ten pairs of data, we must regard any forecast as being somewhat unreliable.

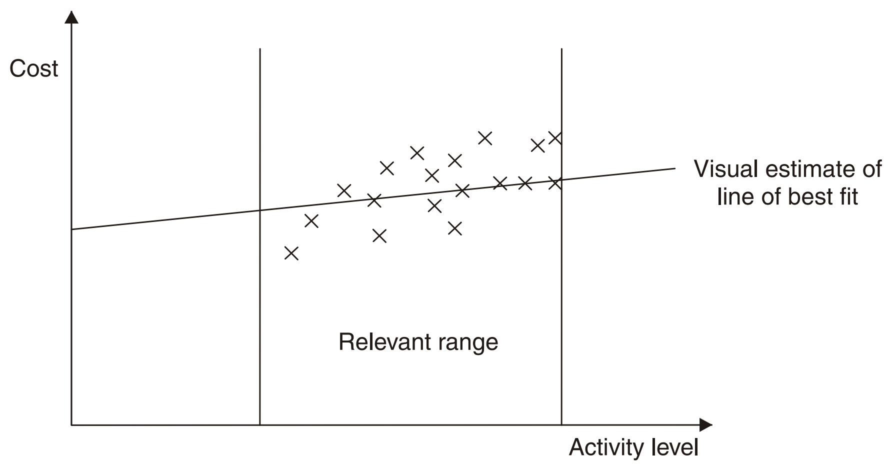
g) It must be assumed that the **value of one variable, y, can be predicted or estimated from the value of one other variable, x.**

Scatter diagrams

Scatter diagrams can be used to estimate the fixed and variable components of costs.

By this method of cost estimation, cost and activity data are plotted on a graph. A **'line of best fit'** is then drawn. This line should be drawn through the middle of the plotted points as closely as possible so that the distance of points above the line are equal to distances below the line. Where necessary costs should be adjusted to the same indexed price level to allow for inflation.

Scatter diagram method of estimating costs



The fixed cost is the intercept of the line of best fit on the vertical axis. Suppose the fixed cost is RWF500 and that one of the plotted points (which is very close to the line or actually on it) represents output of 100 units and total cost of RWF550. The variable cost of 100 units is therefore calculated as RWF(550 – 500) = RWF50 and so the variable cost per unit is Rwf0.50. The equation of the line of best fit is therefore *approximately*

$y = 500 + 0.5x$.

If the company to which thede data relate wanted to forecast total costs when output is 90 units, a forecast based on the equation would be $500 + (0.5 \times 90)$ = RWF545. Alternatively the **forecast could be read directly from the graph using the line of best fit.**

The disadvantage of the scatter diagram method is that the cost line is drawn by visual judgement and so is a **subjective approximation**.

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FORECASTING TECHNIQUES

Forecasting techniques include estimates based on **judgement and experience,** simple **average growth models** and **time series.**

Numerous techniques have been developed for using past data as the basis for forecasting future values. These techniques range from simple arithmetic and visual methods to advanced computer-based statistical systems. With all techniques, however, there is the **presumption that the past will provide guidance to the future**. Before using any extrapolation techniques, the **past data** must therefore be critically examined to **assess their appropriateness for the intended purpose**. The following checks should be made.

a) The **time period** should be long enough to include any periodically paid costs but short enough to ensure that averaging of variations in the level of activity has not occurred.

b) The **data** should be examined to ensure that any non-activity level factors affecting costs were roughly the same in the past as those forecast for the future. Such factors might include changes in technology, changes in efficiency, changes in production methods, changes in resource costs, strikes, weather conditions and so on. Changes to the past data are frequently necessary.

c) The **methods of data collection** and the accounting policies used should not introduce bias. Examples might include depreciation policies and the treatment of by-products.

d) Appropriate choices of **dependent** and **independent variables** must be made.

The sales budget is frequently the first budget prepared since '**Sales' is usually the principal budget factor**, but before the sales budget can be prepared a sales forecast has to be made. Sales forecasting is complex *and* difficult and involves the consideration of a number of factors.

Management can use a number of forecasting methods, often combining them to reduce the level of uncertainty.

a) **Sales personnel** can be asked to provide estimates. Such estimates are based on **judgement and experience.**

b) **Market research** can be used (especially for new products or services).

c) **Simple average growth models** can be used.

d) **Time series** can be used to produce forecasts.

e) **Mathematical** models can be set up so that repetitive computer simulations can be run which permit managers to review the results that would be obtained in various circumstances.

Simple average growth models

A **growth rate** can be estimated from an analysis of the growth in, for example sales, over the past few years.

Year	*Sales revenue*
	RWF '000
20X1	150,000
20X2	192,000
20X3	206,000
20X4	245,000
20X5	262,350

Sales have risen from RWF150m in 20X1 to RWF262.35m in 20X5. The increase represents four years growth. (Check that you can see that there are four years growth, and not five years growth, in the table.) The average growth rate, g, may be calculated as follows.

Sales in 20X1 × $(1 + g)^4$ = Sales in 20X5

$$(1+g)^4 = \frac{\text{Sales in 20X}}{\text{Sales in 20X}}$$

$$= \frac{\text{RWF262.350m}}{\text{Rwf150m}}$$

$$= 1.749$$

$$1 + g = \sqrt[4]{1.749} = 1.15$$

$$g = 0.15\text{, ie }15\%$$

TIME SERIES

A **time series** is a series of figures or values recorded over time.

The following are examples of time series.

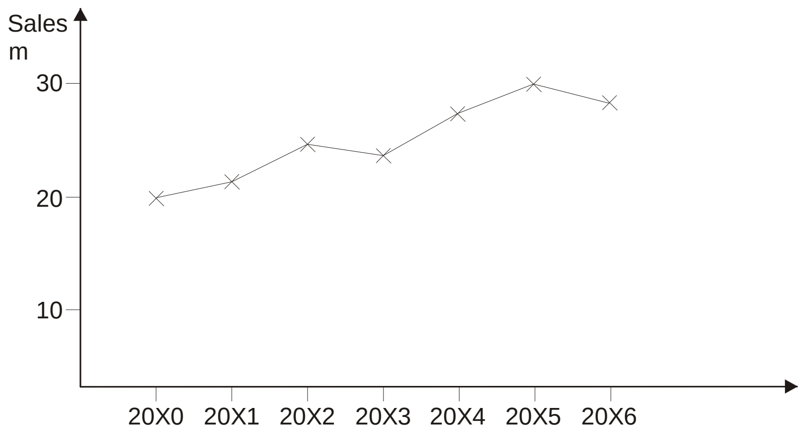
- Output at a factory each day for the last month
- Monthly sales over the last two years
- The Retail Prices Index each month for the last ten years

A graph of a time series is called a **historigram**.

(Note the letters 'ri'; this is not the same as a histogram.) For example, consider the following time series.

Year	*20X0*	*20X1*	*20X2*	*20X3*	*20X4*	*20X5*	*20X6*
*Sales (*RWF m)	20	21	24	23	27	30	28

The historigram is as follows.



The horizontal axis is always chosen to represent time, and the vertical axis represents the values of the data recorded.

Regression and forecasting

Regression can be used to find a **trend line**, such as the trend in sales over a number of periods.

The same regression techniques as those considered earlier in the chapter can be used to **calculate a regression line (a trend line) for a time series**. A time series is simply a series of figures or values recorded over time (such as total annual costs for the last ten years). The determination of a trend line is particularly useful in forecasting.

The **years (or days or months) become the x variables in the regression formulae** by **numbering them from 0 upwards.**

Example: Regression and forecasting

Sales of product B over the seven year period from 20X1 to 20X7 were as follows.

Year	*20X1*	*20X2*	*20X3*	*20X4*	*20X5*	*20X6*	*20X7*
*Sales of B ('*000 units)	22	25	24	26	29	28	30

There is high correlation between time and the volume of sales.

Required

Calculate the trend line of sales, and forecast sales in 20X8 and 20X9.

Solution

Workings

Year	*x*	*y*	*xy*	*x^2*
20X1	0	22	0	0
20X2	1	25	25	1
20X3	2	24	48	4
20X4	3	26	78	9
20X5	4	29	116	16
20X6	5	28	140	25
20X7	6	30	180	36
	$\Sigma x = 21$	$\Sigma y = 184$	$\Sigma xy = 587$	$\Sigma x^2 = 91$

n = 7

Where y = a + bx

b = ((7 × 587) – (21 × 184))/((7 × 91) – (21 × 21)) = 245/196 = 1.25

a = (184/7) – ((1.25 × 21)/7) = 22.5357, say 22.5

y = 22.5 + 1.25x where x = 0 in 20X1, x = 1 in 20X2 and so on.

Using this trend line, predicted sales in 20X8 (year 7) would be 22.5 + (1.25 × 7) = 31.25 = 31,250 units.

Similarly, for 20X9 (year 8) predicted sales would be 22.5 + (1.25 × 8) = 32.50 = 32,500 units.

The components of time series

A time series has four components: a **trend**, **seasonal variations**, **cyclical variations** and **random variations**.

There are several **components of a time series** which it may be necessary to identify.

a) A **trend**

b) **Seasonal variations** or fluctuations

c) Cycles, or **cyclical variations**

d) Non-recurring, **random variations**. These may be caused by unforeseen circumstances such as a change in government, a war, technological change or a fire.

The trend

The **trend** is the underlying long-term movement over time in values of data recorded.

In the following examples of time series, there are three types of trend.

	Output per labour hour	*Cost per unit*	*Number of employees*
	Units	RWF	
20X4	30	1.00	100
20X5	24	1.08	103
20X6	26	1.20	96
20X7	22	1.15	102
20X8	21	1.18	103
20X9	17	1.25	98
	(A)	(B)	(C)

a) In time series **(A)** there is a **downward trend** in the output per labour hour. Output per labour hour did not fall every year, because it went up between 20X5 and 20X6, but the long-term movement is clearly a downward one.

b) In time series **(B)** there is an **upward trend** in the cost per unit. Although unit costs went down in 20X7 from a higher level in 20X6, the basic movement over time is one of rising costs.

c) In time series **(C)** there is **no clear movement** up or down, and the number of employees remained fairly constant. The trend is therefore a static, or level one.

Seasonal variations

Seasonal variations are short-term fluctuations in recorded values, due to different circumstances which affect results at different times of the year, on different days of the week, at different times of day, or whatever.

Here are two examples of seasonal variations.

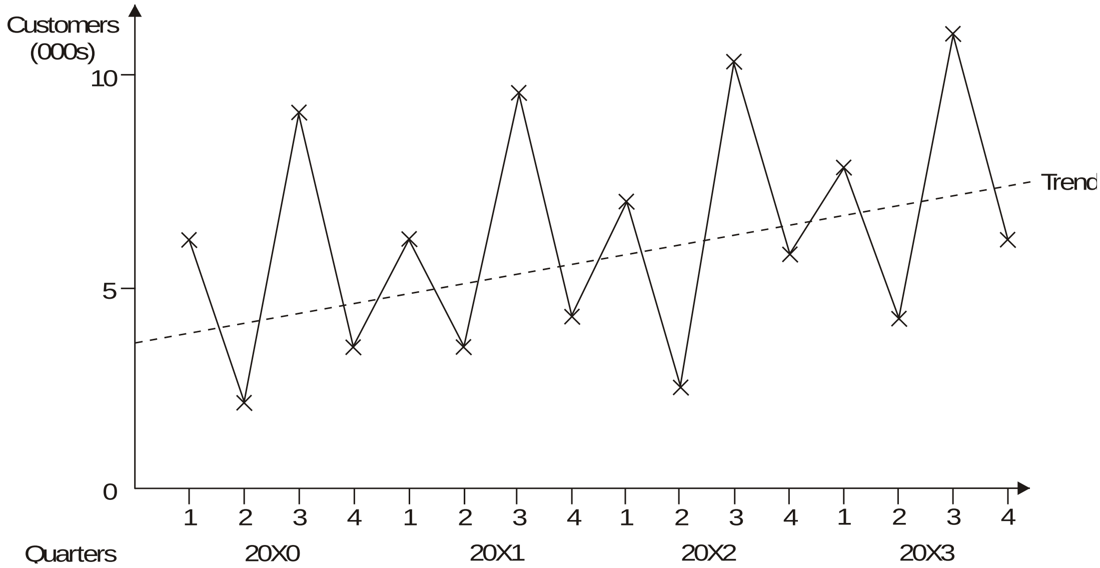
a) Sales of ice cream will be higher in summer than in winter.

b) The telephone network may be heavily used at certain times of the day (such as mid-morning and mid-afternoon) and much less used at other times (such as in the middle of the night).

'Seasonal' is a term which may appear to refer to the seasons of the year, but its meaning in time series analysis is somewhat broader, as the examples given above show.

Example: A trend and seasonal variations

The number of customers served by a company of travel agents over a four year period is shown in the following historigram.



In this example, there would appear to be large seasonal fluctuations in demand, but there is also a basic upward trend.

Cyclical variations

Cyclical variations are **medium-term changes in results caused by circumstances which repeat in cycles**. In business, cyclical variations are commonly associated with economic cycles, successive booms and slumps in the economy. Economic cycles may last a few years. Cyclical variations are longer term than seasonal variations.

Summarising the components

In practice a time series could incorporate all of the four features we have been looking at and, to make reasonably accurate forecasts, the four features often have to be isolated. We can begin the process of isolating each feature by summarising the components of a time series as follows.

The **actual time series, Y= T + S + C + R**

where	**Y = the actual time series**	**C = the cyclical component**
	T = the trend series	**R = the random component**
	S = the seasonal component	

Though you should be aware of the cyclical component, it is unlikely that you will be expected to carry out any calculation connected with isolating it. The mathematical models which we will use therefore exclude any reference to C.

We will begin by looking at how to find the trend in a time series.

Moving averages

Trend values can be determined by a process of **moving averages**.

Look at these monthly sales figures.

	August	*September*	*October*	*November*	*December*
*Sales (*RWFm)	0.02	0.04	0.04	3.20	14.60

It looks as though the business is expanding rapidly – and so it is, in a way. But when you know that the business is a Christmas card manufacturer, then you see immediately that the January sales will no doubt slump right back down again.

It is obvious that the business will do better in the Christmas season than at any other time – that is the seasonal variation. Using the monthly figures, how can we tell whether or not the business is doing well overall – whether there is a rising sales trend over time other than the short-term rise over Christmas?

One possibility is to compare figures with the equivalent figures of a year ago. However, many things can happen over a year to make such a comparison misleading – new products might now be manufactured and prices will probably have changed.

In fact, there are a number of ways of overcoming this problem of distinguishing trend from seasonal variations. One such method is called **moving averages**. This method attempts to **remove seasonal (or cyclical) variations from a time series by a process of averaging so as to leave a set of figures representing the trend**.

A moving average is an average of the results of a fixed number of periods. Since it is an average of several time periods, it is **related to the mid-point of the overall period**.

Exam Focus Point

You will not be required to carry out a time series analysis from raw data but you do need to be able to explain the approach and discuss its use.

Example: Moving averages

Year	*Sales*
	Units
20X0	390
20X1	380
20X2	460
20X3	450
20X4	470
20X5	440
20X6	500

Required

Take a moving average of the annual sales over a period of three years.

Solution

a) Average sales in the three year period

20X0 – 20X2 were (390 + 380 + 460)/3 = 1,230/3 = 410.

This average relates to the middle year of the period, 20X1.

b) Similarly, average sales in the three year period

20X1 – 20X3 were (380 + 460 + 450)/3 = 1,290/3 = 430.

This average relates to the middle year of the period, 20X2.

c) The average sales can also be found for the periods 20X2 – 20X4, 20X3 – 20X5 and

		Moving total of	*Moving average of*
Year	*Sales*	*3 years sales*	*3 years sales (÷ 3)*
20X0	390		
20X1	380	1,230	410
20X2	460	1,290	430
20X3	450	1,380	460
20X4	470	1,360	453
20X5	440	1,410	470
20X6	500		

20X4 – 20X6, to give the following.

Note the following points.

(i) The moving average series has five figures relating to the years 20X1 to 20X5. The original series had seven figures for the years from 20X0 to 20X6.

(ii) There is an upward trend in sales, which is more noticeable from the series of moving averages than from the original series of actual sales each year.

Moving averages of an even number of results

In the previous example, moving averages were taken of the results in an **odd** number of time periods, and the average then related to the **mid-point** of the overall period.

If a moving average of results was taken in an **even** number of time periods, the basic technique would be the same, but the mid-point of the overall period would not relate to a single period. For example, suppose an average were taken of the following four results.

Spring	120	
Summer	90	
Autumn	180	Average = 115
Winter	70	

The average would relate to the mid-point of the period, between summer and autumn.

The trend line average figures need to relate to a particular time period; otherwise, seasonal variations cannot be calculated. To overcome this difficulty, we take a **moving average of the moving average**. An example will illustrate this technique.

Example: Moving averages over an even number of periods

Calculate a moving average trend line of the following results.

Year	*Quarter*	*Volume of sales*
		'000 units
20X5	1	600
	2	840
	3	420
	4	720
20X6	1	640
	2	860
	3	420
	4	740

Solution

A moving average of **four** will be used, since the volume of sales would appear to depend on the season of the year, and each year has four **quarterly** results. The moving average of four does not relate to any specific period of time; therefore a second moving average of two will be calculated on the first moving averages.

Year	Quarter	*Actual volume of sales* '000 units (Y)	*Moving total of 4 quarters' sales* '000 units (B)	*Moving average of 4 quarters' sales* '000 units (B ÷ 4)	*Mid-point of 2 moving averages Trend line* '000 units (T)
20X5	1	600			
	2	840			
	3	420	2,580	645.0	650.00
	4	720	2,620	655.0	657.50
20X6	1	640	2,640	660.0	660.00
	2	860	2,640	660.0	662.50
	3	420	2,660	665.0	
	4	740			

By taking a mid-point (a moving average of two) of the original moving averages, we can relate the results to specific quarters (from the third quarter of 20X5 to the second quarter of 20X6).

Finding the seasonal variations

Seasonal variations can be estimated using the **additive** model or the **proportional** (**multiplicative**) model.

Once a trend has been established we can find the seasonal variations.

The additive model

The **additive model** for time series analysis is Y = T + S + R.

We can therefore write Y – T = S + R. In other words, if we deduct the trend series from the actual series, we will be left with the seasonal and residual components of the time series. If we assume that the random component is relatively small, and hence negligible, the **seasonal component can be found as S = Y – T,** the **de-trended series.**

The actual and trend sales for the example above are set out below. The **difference** between the **actual** results for any one quarter (Y) and the **trend** figure for that quarter (T) will be the **seasonal variation** for that quarter.

Year	*Quarter*	*Actual*	*Trend*	*Seasonal variation*
20X5	1	600		
	2	840		
	3	420	650.00	–230.00
	4	720	657.50	62.50
20X6	1	640	660.00	–20.00
	2	860	662.50	197.50
	3	420		
	4	740		

Suppose that seasonal variations for the third and fourth quarters of 20X6 and the first and second quarters of 20X7 are –248.75, 62.50, –13.75 and 212.50 respectively. The variation between the actual result for a particular quarter and the trend line average is not the same from year to year, but an **average of these variations can be taken**.

	Q1	*Q2*	*Q3*	*Q4*
20X5			–230.00	62.50
20X6	–20.00	197.50	–248.75	62.50
20X7	–13.75	212.50		
Total	–33.75	410.00	–478.75	125.00
Average (÷ 2)	–16.875	205.00	–239.375	62.50

Variations around the basic trend line should cancel each other out, and add up to zero. At the moment, they do not. We therefore **spread** the total of the variations (11.25) across the four quarters (11.25 ÷ 4) so that the final total of the variations **sum to zero.**

	Q1	*Q2*	*Q3*	*Q4*	*Total*
Estimated quarterly variations	– 16.8750	205.0000	–239.3750	62.5000	11.250
Adjustment to reduce variations to 0	–2.8125	–2.8125	–2.8125	–2.8125	–11.250
Final estimates of quarterly variations	–19.6875	202.1875	–242.1875	59.6875	0
These might be rounded as follows	Ql: –20	Q2: 202	Q3:-242	Q4: 60	Total: 0

The proportional model

The method of estimating the seasonal variations in the above example was to use the differences between the trend and actual data. This model **assumes that the components of the series are independent** of each other, so that an increasing trend does not affect the seasonal variations and make them increase as well, for example.

The alternative is to use the **proportional model** whereby each actual figure is expressed as a proportion of the trend. Sometimes this method is called the **multiplicative model.**

The **proportional (multiplicative) model** summarises a time series as $Y = T \times S \times R$.

The **trend component** will be the **same whichever model is used** but the values of the **seasonal and random components** will **vary** according to the model being applied.

The example above can be reworked on this alternative basis. The trend is calculated in exactly the same way as before but we need a different approach for the seasonal variations. The proportional model is $Y = T \times S \times R$ and, just as we calculated $S = Y - T$ for the additive model above, we can calculate $\mathbf{S = Y/T}$ for the proportional model.

Year	*Quarter*	*Actual* (Y)	*Trend* (T)	*Seasonal ratio* (Y/T)
20X5	1	600		
	2	840		
	3	420	650.00	0.646
	4	720	657.50	1.095
20X6	1	640	660.00	0.970
	2	860	662.50	1.298
	3	420		
	4	740		

Suppose that seasonal variations for the next four quarters are 0.628, 1.092, 0.980 and 1.309 respectively. The summary of the seasonal variations expressed in proportional terms is therefore as follows.

	Q1	*Q2*	*Q3*	*Q4*
	Ratio	Ratio	Ratio	Ratio
20X5			0.646	1.095
20X6	0.970	1.298	0.628	1.092
20X7	0.980	1.309		
Total	1.950	2.607	1.274	2.187
Average	0.975	1.3035	0.637	1.0935

Instead of summing to zero, as with the additive approach, the **averages should sum** (in this case) **to 4.0, 1.0 for each of the four quarters.** They actually sum to 4.009 so 0.00225 has to be deducted from each one.

	Q1	*Q2*	*Q3*	*Q4*
Average	0.97500	1.30350	0.63700	1.09350
Adjustment	–0.00225	–0.00225	–0.00225	–0.00225
Final estimate	0.97275	1.30125	0.63475	1.09125
Rounded	0.97	1.30	0.64	1.09

Note that the **proportional model is better than the additive model when the trend is increasing or decreasing over time**. In such circumstances, seasonal variations are likely to be increasing or decreasing too. The additive model simply adds absolute and unchanging seasonal variations to the trend figures whereas the proportional model, by multiplying increasing or decreasing trend values by a constant seasonal variation factor, takes account of changing seasonal variations.

Time series analysis and forecasting

Forecasts can be made by calculating a **trend line** (using moving averages or linear regression), using the trend line to forecast future trend line values, and adjusting these values by the **average seasonal variation** applicable to the future period.

By extrapolating a trend and then adjusting for seasonal variations, forecasts of future values can be made.

Forecasts of future values should be made as follows.

a) Find a trend line using moving averages or using linear regression analysis

b) Use the trend line to forecast future trend line values.

c) Adjust these values by the average seasonal variation applicable to the future period, to determine the forecast for that period. With the additive model, **add** (or subtract for negative variations) the variation. With the multiplicative model, **multiply** the trend value by the variation proportion.

Extending a trend line outside the range of known data, in this case forecasting the future from a trend line based on historical data, is known as **extrapolation**.

Example: Forecasting

The sales (in Rwf m) of swimwear by a large store for each period of three months and trend values found using moving averages are as follows.

Quarter	*20X4*		*20X5*		*20X6*		*20X7*	
	Actual	*Trend*	*Actual*	*Trend*	*Actual*	*Trend*	*Actual*	*Trend*
	RWF m	RWF m	RWF m	RWF m	RWF m	RWF m	RWF m	RWF m
First			8		20	40	40	57
Second			30	30	50	45	62	
Third			60	31	80	50	92	
Fourth	24		20	35	40	54		

Using the additive model, seasonal variations have been determined as follows.

Quarter 1	*Quarter 2*	*Quarter 3*	*Quarter 4*
–RWF k18,250	+RWF k2,750	+RWF k29,750	–RWF k14,250

Required

Predict sales for the last quarter of 20X7 and the first quarter of 20X8, stating any assumptions.

Solution

We might guess that the trend line is rising steadily, by (57 – 40)/4 = 4.25 per quarter in the period 1st quarter 20X6 to 1st quarter 20X7 (57 being the prediction in 1st quarter 20X7 and 40 the prediction in 1st quarter 20X6). Since the trend may be levelling off a little, a quarterly increase of +4 in the trend will be assumed.

		Trend	*Seasonal variation*	*Forecast*
1st quarter	20X7	57		
4th quarter	20X7 (+ (3 × 4))	69	–14.25	54.75
1st quarter	20X8 (+ (4 × 4))	73	–18.25	54.75

Rounding to the nearest million francs, the forecast sales are Rwf m55 for each of the two quarters.

Note that you could actually plot the trend line figures on a graph, extrapolate the trend line into the future and read off forecasts from the graph using the extrapolated trend line.

If we had been using the proportional model, with an average variation for (for example) quarter 4 of 0.8, our prediction for the fourth quarter of 20X7 would have been 69 × 0.8 = 55.2, say RWF55,000,000

Forecasting problems

Errors can be expected in forecasting due to unforeseen changes. This is more likely to happen the further into the future the forecast is for, and the smaller the quantity of data on which the forecast is based.

All forecasts are subject to error, but the likely errors vary from case to case.

- The **further into the future** the forecast is for, the **more unreliable** it is likely to be

- The **less data** available on which to base the forecast, the **less reliable** the forecast
- The historic **pattern** of trend and seasonal variations **may not continue** into the future
- **Random variations** may upset the pattern of trend and seasonal variation
- **Extrapolation** of the **trend line** is done by judgment and can introduce errors

There are a number of changes that also may make it difficult to forecast future events.

Type of change	Examples
Political and economic changes	Changes in interest rates, exchange rates or inflation can mean that future sales and costs are difficult to forecast.
Environmental changes	The opening of new roads or the railway might have a considerable impact on some companies' markets.
Technological changes	These may mean that the past is not a reliable indication of likely future events. For example new faster machinery may make it difficult to use current output levels as the basis for forecasting future production output.
Technological advances	Advanced manufacturing technology is changing the cost structure of many firms. Improved education and the increase in the standards of living are impacting on the skills of the labour force. This causes forecasting difficulties because of the resulting changes in cost behaviour patterns, breakeven points and so on.
Social changes	Alterations in taste, fashion and the social acceptability of products can cause forecasting difficulties.

Management should have reasonable **confidence** in their estimates and forecasts. The assumptions on which the forecasts/estimates are based should be properly understood and the methods used to make a forecast or estimate should be in keeping with the nature, quantity and reliability of the data on which the forecast or estimate will be based. There is no point in using a 'sophisticated' technique with unreliable data; on the other hand, if there are a lot of accurate data about historical costs, it would be a waste of the data to use the scatter diagram method for cost estimating.

LEARNING CURVES

Learning curve theory may be useful for forecasting production time and labour costs in certain circumstances, although the method has many limitations.

Whenever an individual starts a job which is **fairly repetitive** in nature, and provided that his speed of working is not dictated to him by the speed of machinery (as it would be on a production line), he is likely to become **more confident and knowledgeable** about the work as he gains experience, to become **more efficient**, and to do the work **more quickly**.

Eventually, however, when he has acquired enough experience, there will be nothing more for him to learn and so **the learning process will stop**.

Learning curve theory applies to situations where the work force as a whole improves in efficiency with experience. The **learning effect** or **learning curve effect** describes the speeding up of a job with repeated performance.

Where does learning curve theory apply?

Labour time should be expected to get shorter, with experience, in the production of items which exhibit any or all of the following features.

- Made largely **by labour effort** (rather than by a **highly mechanised** process)
- Brand **new** or relatively **short-lived** (learning process does not continue indefinitely)
- **Complex** and made in **small quantities** for **special orders**

The learning rate: cumulative average time

In learning theory the **cumulative average time per unit** produced is assumed to **decrease** by a **constant percentage** every time **total output** of the product **doubles**.

For instance, where an 80% learning effect occurs, the cumulative average time required per unit of output is reduced to 80% of the previous cumulative average time when output is doubled.

a) By **cumulative average time**, we mean the average time per unit for all units produced so far, back to and including the first unit made.

b) The **doubling** of output is an important feature of the learning curve measurement.

Don't worry if this sounds quite hard to grasp in words, because it is hard to grasp (until you've learned it!). It is best explained by a numerical example.

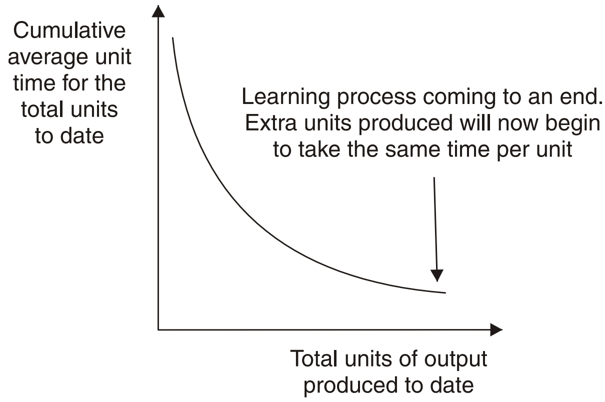
Example: an 80% learning curve

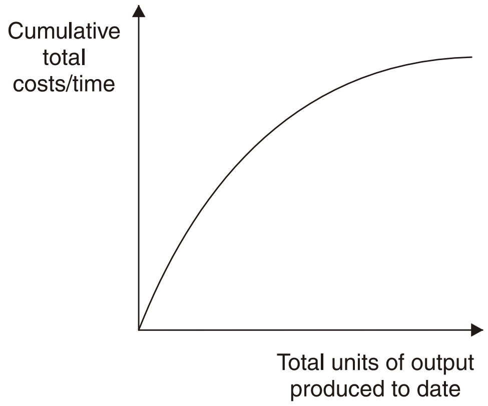
The first unit of output of a new product requires 100 hours. An 80% learning curve applies. The production times would be as follows.

Number of units produced	*Cumulative avg time required per unit*		*Total time required*		*Incremental time for additional units*	
1		100.0	(× 1)	100.0		
2*	(80%)	80.0	(× 2)	160.0	60.0	(for 1 extra unit)
4*	(80%)	64.0	(× 4)	256.0	96.0	(for 2 extra units)
8*	(80%)	51.2	(× 8)	409.6	153.6	(for 4 extra units)

* Output is being **doubled** each time.

This effect can be shown on a **graph**, as a learning curve either for **unit times** or **cumulative total times or costs**.





Example: the learning curve

Kivu Sailcraft Ltd has designed a new type of sailing boat, for which the cost of the first boat to be produced has been estimated as follows:

Materials	5,000
Labour (800 hrs × RWF5,000 per hr)	4,000
Overhead (150% of labour cost)	6,000
	15,000
Profit mark-up (20%)	3,000
Sales price	18,000

It is planned to sell all the yachts at full cost plus 20%. An 80% learning curve is expected to apply to the production work. The management accountant has been asked to provide cost information so that decisions can be made on what price to charge.

a) What is the separate cost of a second yacht?

b) What would be the cost per unit for a third and a fourth yacht, if they are ordered separately later on?

c) If they were all ordered now, could Kivu Sailcraft Ltd quote a single unit price for four yachts and eight yachts.

Solution

Number of yachts		*Cumulative average time per yacht*		*Total time for all yachts to date*		*Incremental time for additional yachts*
		Hours		Hours		Hours
1				1000.0		1000
2	(× 80%)	800.0	(× 2)	1600	(1600 – 1000)	600
4	(× 80%)	640.0	(× 4)	2560	(2560-1600)	960
8	(× 80%)	512.0	(× 8)	4096	(4096-2560)	1536

a) **Separate cost of a second yacht**

	RWF '000
Materials	4,000
Labour (4600 hrs × RWF250)	150
Overhead (150% of labour cost)	225
Total cost	4,375

b) **Cost of the third and fourth yachts**

	RWF '000
Materials cost for two yachts	8,000
Labour (960 hours × RWF250)	240
Overhead (150% of labour cost)	360
Total cost	8,600
Cost per yacht (÷2)	4,300

c) **A price for the first four yachts together and for the first eight yachts together**

		First four yachts		*First eight yachts*
		RWF '000		RWF '000
Materials		16,000		32,000
Labour	(2,560 hrs)	640	(4,096hrs)	1,024
Overhead (150% of labour cost)		960		1,536
Total cost		17,600		34,560
Profit (20%)		93,520		6,912
Total sales price		21,120		41,472
Price per yacht	(÷4)	5,280	(÷8)	5,184

This assumes that Kivu Sailcraft is happy to pass on the efficiency savings to the customer in the form of a lower price.

A formula for the learning curve

The formula for the learning curve is $\mathbf{y = ax^b}$, where b, the learning coefficient or learning index, is defined as (log of the learning rate/log of 2).

The formula for the learning curve is $\mathbf{y = ax^b}$

where **y** is the average cost per batch

x is the total number of batches produced

a is the cost of the first batch

b is the learning factor (logLR/log2)

LR is the learning rate as a decimal

Logarithms and the value of b

When $y = ax^b$ in learning curve theory, the value of **b = log of the learning rate/log of 2**. The learning rate is expressed as a proportion, so that for an 80% learning curve, the learning rate is 0.8, and for a 90% learning curve it is 0.9, and so on.

For an 80% learning curve, b = log 0.8/log 2.

Using the button on your calculator marked 'log' or the Log function in a spread-sheet such as MS Excel or IBM Lotus 1-2-3

b = $\dfrac{-0.0969}{0.3010}$ -0.3219	b = $\dfrac{\text{=LOG(0.8,10)}}{\text{=LOG(2,10)}}$ =+K3/K4

Example: using the formula

Suppose, for example, that an 80% learning curve applies to production of item ABC. To date (the end of June) 230 units of ABC have been produced. Budgeted production for July is 55 units.

The cost of the very first unit of ABC, in January, was RWF120.

Note: Values are RWF '000

Required

Calculate the budgeted total labour cost for July.

Solution

To solve this problem, we need to calculate three things.

a) The cumulative total labour cost so far to produce 230 units of ABC.

b) The cumulative total labour cost to produce 285 units of ABC, that is adding on the extra 55 units for July.

c) The extra cost of production of 55 units of ABC in July, as the difference between (b) and (a).

Calculation (a)

$y = ax^b$ and we know that for 230 cumulative units, a = Rwf120 (cost of first unit), x = 230 (cumulative units) and b = –0.322 (80% learning curve) and so $y = 120 \times (230^{-0.322})$ =RWF20.83.

So when x = 230 units, the cumulative average cost per unit is Rwf20.83.

Calculation (b)

Now we do the same sort of calculation for x = 285.

If x = 285, y = 120 × ($285^{-0.322}$) = RWF19.44

So when X = 285 units, the cumulative average cost per unit is RWF19.44.

Calculation (c)

Cumulative units	*Average cost per unit*	*Total cost*
	RWF	RWF
230	20.83	4,790.90
285	19.44	5,540.40
Incremental cost for 55 units		749.50

Average cost per unit, between 230 and 285 units = 749.50/55 = RWF13.63 per unit approx.

Example: Learning curves and standard costs

A company needs to calculate a new standard cost for one of its products. When the product was introduced, the standard variable cost of the first unit was as follows.

		Cost per unit
		RWF'000
Direct material	10 kg @ RWF2400 per kg	24
Direct labour	12 hours @RWF2250 per hour	27
Variable overhead	12 hours @ RWF2500 per hour	30
Total		81

During the following year, a 90% learning curve was observed. The cumulative production at the end of the third quarter was 50 units and the budgeted production for the fourth quarter is 10 units.

Required

a) What is the standard cost per unit for the fourth quarter assuming that the 90% learning curve still applies?

b) What is the standard cost per unit for the fourth quarter assuming the learning curve had reached a **steady state** ie peak efficiency was reached after the 50^{th} unit was produced?

Solution

a) $y = ax^b$ and for 60 cumulative units a = 12 hours (time for first unit), x = 60 (cumulative units) and b = -0.152 (90% learning curve) and so y = 10 x ($60^{-0.152}$) = 5.37 hours.

For 50 cumulative units y = 12 x ($50^{-0.152}$) = 6.62 hours.

Cumulative units	*Average time per unit*	*Total time*
50	6.62	331.0
60	6.44	386.4
Incremental time for 10 units		55.4

The standard time per unit is therefore 55.4/10 = 5.54 hours
The standard cost per unit is:

		Cost per unit
		RWF '000
Direct material	10 kg @ RWF2400 per kg	24.00
Direct labour	5.54 hours @ RWF2250 per hour	12.47
Variable overhead	5.54 hours @ 2500 per hour	13.85
Total		50.32

b) A steady state is reached after the 50th unit so we need the time taken to produce the 50th unit.

For 49 cumulative units a = 12 hours (time for first unit), x = 49 (cumulative units) and b = -0.152 (90% learning curve) and so y = 12 x ($49^{-0.152}$) = 5.535 hours.

Cumulative units	*Average time per unit*	*Total time*
49	6.6415	325.4335
50	6.6211	331.055
Incremental time for 50th unit		5.6215

The standard cost per unit is:

		Cost per unit
		RWF'000
Direct material	10 kg @ RWF2400 per kg	24
Direct labour	5.6215 hours @ 2250 RWF9000 per hour	12.65
Variable overhead	5.6215 hours @ RWF2500 per hour	14.05
Total		50.7

The practical application of learning curve theory

What costs are affected by the learning curve?

a) Direct labour time and costs

b) Variable overhead costs, if they vary with direct labour hours worked.

c) **Materials costs** are usually **unaffected** by learning among the workforce, although it is conceivable that materials handling might improve, and so wastage costs be reduced.

d) **Fixed overhead expenditure** should be **unaffected** by the learning curve (although in an organisation that uses absorption costing, if fewer hours are worked in producing a unit of output, and the factory operates at full capacity, the **fixed overheads recovered or absorbed per unit** in the cost of the output **will decline** as more and more units are made).

The relevance of learning curve effects in management accounting

Learning curve theory can be used to:

a) Calculate the marginal (incremental) cost of making extra units of a product.

b) **Quote selling prices for a contract**, where prices are calculated at cost plus a percentage mark-up for profit. An awareness of the learning curve can make all the difference between winning contracts and losing them, or between making profits and selling at a loss-making price.

c) **Prepare realistic production budgets** and more **efficient production schedules**.

d) **Prepare realistic standard costs** for cost control purposes.

Considerations to bear in mind include:

a) **Sales projections, advertising expenditure and delivery date commitments.** Identifying a learning curve effect should allow an organisation to plan its advertising and delivery schedules to coincide with expected production schedules. Production capacity obviously affects sales capacity and sales projections.

b) **Budgeting with standard costs**. Companies that use standard costing for much of their production output cannot apply standard times to output where a learning effect is taking place. This problem can be overcome in practice by:

   (i) Establishing **standard times** for output, once the learning effect has worn off or become insignificant, and

   (ii) Introducing a **'launch cost'** budget for the product for the duration of the learning period.

c) **Budgetary control**. When learning is still taking place, it would be unreasonable to compare actual times with the standard times that ought eventually to be achieved when the learning effect wears off. **Allowance should be made** accordingly when interpreting labour efficiency variances.

d) **Cash budgets**. Since the learning effect reduces unit variable costs as more units are produced, it should be allowed for in **cash flow projections**.

e) **Work scheduling and overtime decisions**. To take full advantage of the learning effect, **idle production time** should be avoided and work scheduling/overtime decisions should pay regard to the expected learning effect.

f) **Pay**. Where the workforce is paid a **productivity bonus**, the time needed to learn a new production process should be allowed for in calculating the bonus for a period.

g) **Recruiting new labour**. When a company plans to take on new labour to help with increasing production, the learning curve assumption will have to be reviewed.

h) **Market share**. The significance of the learning curve is that by increasing its share of the market, a company can benefit from shop-floor, managerial and technological 'learning' to achieve **economies of scale**.

Limitations of learning curve theory

a) The learning curve phenomenon is **not always present**.

b) It assumes **stable conditions** at work which will **enable learning to take place**. This is not always practicable, for example because of **labour turnover**.

c) It must also assume a certain degree of **motivation** amongst employees.

d) Breaks between repeating the production of an item must not be too long, or workers will **'forget'** and the learning process will have to begin all over again.

e) It might be difficult to **obtain accurate data** to decide what the learning curve is.

f) **Workers might not agree** to a gradual reduction in production times per unit.

g) **Production techniques might change**, or product design alterations might be made, so that it takes a long time for a **'standard'** production method to emerge, to which a learning effect will apply.

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APPLYING EXPECTED VALUES

Expected values can be used in budgeting to determine the best combination of expected profit and risk.

Probabilistic budgeting assigns probabilities to different conditions (most likely, worst possible, best possible) to derive an Expected Value (EV) of profit.

A company, for example might make the following estimates of profitability for a given budget strategy under consideration.

	Profit/(loss)	*Probability*
	RWF m	
Worst possible outcome	(220)	0.3
Most likely outcome	300	0.6
Best possible outcome	770	0.1

The EV of profit would be calculated as follows.

	Probability	*Profit*	*Expected value*
		RWFm	RWF m
Worst possible	0.3	(220)	(66)
Most likely	0.6	300	180
Best possible	0.1	770	77
EV of profits			191

Example: a probabilistic budget

PIB has recently developed a new product, and is planning a marketing strategy for it. A choice must be made between selling the product at a unit price of either RWF15k or RWF17k.

Estimated sales volumes are as follows.

At price of RWF9,000 per unit		*At price of RWF11,000 per unit*	
Sales volume	*Probability*	*Sales volume*	*Probability*
Units		Units	
20,000	0.1	8,000	0.1
30,000	0.6	16,000	0.3
40,000	0.3	20,000	0.3
		24,000	0.3

a) Sales promotion costs would be RWF5,000,000 at a price of RWF9,000 and RWF12,000,000 at a price of RWF11,000.

b) Material costs are RWF6,000 per unit.

c) Labour and variable production overhead costs will be RWF1,250 per unit up to 30,000 units and RWF1,375per unit for additional units.

d) Fixed production costs will be RWF38,000,000.

The management of PIB wish to allow for the risk of each pricing decision before choosing RWF9,000 or RWF11,000 as the selling price.

Required

Determine which sales price would be preferred if the management selected the alternative which did the following.

a) Minimised the worst possible outcome of profit

b) Maximised the best possible outcome of profit

Solution

The unit contribution will be as follows.

	Price per unit	
	RWF9,000	*RWF 11,000*
Up to 30,000 units	RWF1,750	RWF3,750
Above 30,000 units	RWF1,625	N/A

Sales price RWF9,000

Units of sale	*Unit contb'n*	*Total contb'n*	*Fixed costs*	*Profit*	*Probability*	*EV of profit*
'000	RWF '000	RWF m	RWF m	RWFm		RWF m
20	1.75	35.00	43	(8.00)	0.1	(0.8)
30	1.75	52.50	43	9.50	0.6	5.7
40	30 @ RWF 1,750 10 @ RWF1,625	68.75	43	25.75	0.3	7.725

12.625

Sales price RWF11,000

Units of sale	*Unit contb'n*	*Total contb'n*	*Fixed costs*	*Profit*	*Probability*	*EV of profit*
'000	RWF ‘000	RWF m	RWF m	RWFm		RWF m
8	3.75	30	50	(20)	0.1	(2.0)
16	3.75	60	50	10	0.3	3.0
20	3.75	75	50	25	0.3	12.0
24	3.75	90	50	40	0.3	20.5

a) The price which minimises the worst possible outcome is RWF9,000(with a worst-possible loss of RWF8,000,000).

b) The price which maximises the best possible outcome is RWF11,000 (with a best-possible profit RWF46,000,000).

USING SPREADSHEETS IN BUDGETING

Spreadsheet packages can be used to build business **models** to assist the forecasting and planning process. They are particularly useful for 'what if?' analysis.

A spreadsheet is a type of general purpose software package with **many business applications**, not just accounting ones. It **can be used to build a model**, in which data is presented in these **rows and columns**, and it is up to the model builder to determine what data or information should be presented in it, how it should be presented and how the data should be manipulated by the spreadsheet program. The most widely used spreadsheet packages are IBM Lotus 1-2-3 and Microsoft Excel.

The idea behind a spreadsheet is that the model builder should **construct a model as follows**.

a) Identify what data you have and what you want to report.

b) Then decide what data go into each row and column and by **inserting text** (for example, column headings and row identifications).

c) **Specify how the numerical data in the model should be derived**. Numerical data might be derived using one of the following methods.

   - **Insertion into the model via keyboard input**.
   - **Calculation from other data in the model** by means of formulae specified within the model itself. The model builder must insert these formulae into the spreadsheet model when it is first constructed.
   - **Retrieval from data on a disk file** from another computer application program or module.

The advantages of spreadsheets

The uses of spreadsheets are really only limited by your imagination, and by the number of rows and columns in the spreadsheet, but some of the more **common accounting applications** are listed below.

- Balance sheets
- Cash flow analysis/forecasting
- General ledger
- Inventory records
- Job cost estimates
- Market share analysis and planning
- Profit projections
- Profit statements
- Project budgeting and control
- Sales projections and records
- Tax estimation

The great value of spreadsheets derives from their **simple format** of rows, columns and worksheets of data, and the ability of the data **users to have direct access themselves** to their spreadsheet model via their own PC. For example, an accountant can construct a cash flow model with a spreadsheet package on the PC on his desk: he can **create** the model, **input** the data, **manipulate** the data and **read or print the output** direct. He will also have fairly **instant access** to the model whenever it is needed, in just the time it takes to load the model into his PC. Spreadsheets therefore bring computer modelling within the everyday reach of data users.

Also, by linking different models, when one spreadsheet is updated say for Sales, another such as Raw material stocks can be updated as well – automatically.

The disadvantages of spreadsheets

Spreadsheets have disadvantages if they are not properly used.

a) A **minor error in the design** of a model at any point can **affect the validity of data** throughout the spreadsheet. Such errors can be very difficult to trace.

b) Even if it is properly designed in the first place, it is very **easy to corrupt** a model by accidentally changing a cell or inputting data in the wrong place. This can be minimised by "protecting" cells containing formulae or fixed data

c) It is possible to **become over-dependent on them**, so that simple one-off tasks that can be done in seconds with a pen and paper are done on a spreadsheet instead.

d) The possibility for experimentation with data is so great that it is possible to **lose sight of the original intention** of the spreadsheet.

e) Spreadsheets **cannot take account of qualitative factors** since these are invariably difficult to quantify. Decisions should not be made on the basis of quantitative information alone.

In summary, spreadsheets should be seen as a **tool in planning and decision making**. The user must make the decision.

'What if' analysis

Once a model has been constructed the consequences of changes in any of the variables may be tested by asking **'what if' questions, a form of sensitivity analysis**. For example, a spreadsheet may be used to develop a cash flow model, such as that shown below.

	A	*B*	*C*	*D*
1		Month 1	Month 2	Month 3
2	Sales	1,000	1,200	1,440
3	Cost of sales	(650)	(780)	(936)
4	Gross profit	350	420	504
5				
6	Receipts:			
7	Current month	600	720	864
8	Previous month		400	480
9		–	–	–
10		600	1,120	1,344
11	Payments	(650)	(780)	(936)
12		(50)	340	408
13	Balance b/f	–	(50)	290
14	Balance c/f	(50)	290	698

Typical 'what if' questions for sensitivity analysis

a) What if the cost of sales is 68% of sales revenue, not 65%?

b) What if payment from debtors is received as 40% in the month of sale, 50% one month in arrears and 10% two months in arrears, instead of 60% in the month of sale and 40% one month in arrears?

c) What if sales growth is only 15% per month, instead of 20% per month?

Using the spreadsheet model, the answers to such questions can be obtained simply and quickly, using the editing facility in the program. The information obtained should provide management with a **better understanding** of what the cash flow position in the future might be, and what **factors are critical** to ensuring that the cash position remains reasonable. For example, it might be found that the cost of sales must remain less than 67% of sales value to achieve a satisfactory cash position.

CHAPTER ROUNDUP

- Two important quantitative methods the management accountant can use to analyse fixed and variable cost elements from total cost data are the **high-low** and **regression methods.**

- **Scatter diagrams** can be used to estimate the fixed and variable components of costs.

- Forecasting techniques include estimates based on **judgement and experience,** simple **average growth models** and **time series.**

- A **time series** is a series of figures or values recorded over time.

- Regression can be used to find a **trend line**, such as the trend in sales over a number of periods.

- A time series has four components: a **trend**, **seasonal variations**, **cyclical variations** and **random variations**.

- **Trend** values can be determined by a process of **moving averages**.

- **Seasonal variations** can be estimated using the **additive** model or the **proportional** (**multiplicative**) model.

- **Forecasts** can be made by calculating a **trend line** (using moving averages or linear regression), using the trend line to forecast future trend line values, and adjusting these values by the **average seasonal variation** applicable to the future period.

- Errors can be expected in forecasting due to unforeseen changes. This is more likely to happen the further into the future the forecast is for, and the smaller the quantity of data on which the forecast is based.

- **Learning curve theory** may be useful for forecasting production time and labour costs in certain circumstances, although the method has many limitations.

- The formula for the learning curve is $\mathbf{y = ax^b}$, where b, the learning coefficient or learning index, is defined as (log of the learning rate/log of 2).

- **Expected values** can be used in budgeting to determine the best combination of expected profit and risk.

- **Spreadsheet packages** can be used to build business **models** to assist the forecasting and planning process. They are particularly useful for 'what if?' analysis.

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STUDY UNIT 15

Budgeting And Standard Costing

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EXAM GUIDE

The contents of this chapter are likely to be examined in conjunction with variance analysis, covered in the next chapter.

THE USE OF STANDARD COSTS

A **standard cost** is an estimated unit cost built up of standards for each cost element (standard resource price and standard resource usage).

Standard costing is principally used to value inventories and cost production and to act as a control device.

What is a standard cost?

A **standard cost** is an estimated unit cost.

The standard cost of product 12345 is set out below on a **standard cost card.**

STANDARD COST CARD

Product: the Splodget, No 12345

	Cost per	*Unit*	*Requirement*		
Direct materials	RWF		Units	RWF	
A	1,500.00	Kg	6.00	9,000.00	
B	2,250.00	Kg	2.00	4,500.00	
C	3,000.00	Litre	1.00	3,000.00	
Others				2,000.00	
					18,500.00
Direct labour					
Grade I	1,000.00	Hour	3.00	3,000.00	
Grade II	1,620.00	Hour	5.00	8,100.00	
					11,100.00
Variable production overheads	1,000.00	Hour	8.00	8,000.00	
Fixed production overheads	3,000.00	Hour	8.00	24,000.00	
Standard full cost of production					32,000.00
					61,600.00

Notice how it is **built up from standards for each cost element:** standard quantities of materials at standard prices, standard quantities of labour time at standard rates and so on. It is therefore determined by management's estimates of the following.

- The expected prices of materials, labour and expenses
- Efficiency levels in the use of materials and labour
- Budgeted overhead costs and budgeted volumes of activity

We will see how management arrives at these estimates later in the chapter.

But why should management want to prepare standard costs? Obviously to assist with standard costing, but what is the point of standard costing?

The uses of standard costing

Standard costing has two principal **uses**.

- **To value inventories and cost production** for cost accounting purposes. It is an alternative method of valuation to methods such as FIFO and LIFO which you will have covered in your earlier studies.
- **To act as a control device** by establishing standards (expected costs) and comparing actual costs with the expected costs, thus highlighting areas of the organisation which may be out of control.

It can also be used in the following circumstances.

a) To assist in setting **budgets** and **evaluating managerial performance**.

b) To enable the principle of **'management by exception'** to be practised. A standard cost, when established, is an average expected unit cost. Because it is only an average, actual results will vary to some extent above and below the average. Only significant differences between actual and standard should be reported.

c) To provide a prediction of future costs to be used in **decision-making**.

d) To **motivate** staff and management by the provision of challenging targets.

e) To provide guidance on possible ways of **improving efficiency**.

Although the various uses of standard costing should not be overlooked, we will be concentrating on the control aspect.

Standard costing as a control technique

Standard costing involves the establishment of predetermined estimates of the costs or units of products or services, the collection of actual costs and units and the comparison of the actual costs/units with the predetermined estimates. The predetermined costs/units are known as standard costs or units and the difference between standard and actual is known as a **variance**. The process by which the total difference between standard and actual results is analysed in known as **variance analysis**.

Where standard costing should be used

Standard costing is most suited to mass production and repetitive assembly work.

Although standard costing can be used in a variety of costing situations (batch and mass production, process manufacture, jobbing manufacture (where there is standardisation of parts) and service industries (if a realistic cost unit can be established)), the **greatest benefit** from its use can be gained if there is a **degree of repetition** in the production process so that average or expected usage of resources can be determined. It is therefore most suited to **mass production** and **repetitive assembly work** and less suited to organisations which produce to customer demand and requirements.

But even in cases such as production of "one offs", the method of production, or even design, can often be measured "by unit", standard costing can be useful. A unit could be an hour, a sq. metre of steel or metre of cable

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DERIVING STANDARDS

The **responsibility for deriving standard costs** should be shared between **managers able to provide the necessary information** about levels of expected efficiency, prices and overhead costs.

Setting standards for materials costs

Direct materials costs per unit of raw material will be estimated by the purchasing department from their knowledge of the following.

- Purchase contracts already agreed
- Pricing discussions with regular suppliers
- The forecast movement of prices in the market
- The availability of bulk purchase discounts
- The quality of material required by the production departments

The standard cost ought to include an allowance for **bulk purchase discounts**, if these are available on all or some of the purchases, and it may have to be a weighted average price of the differing prices charged for the same product by alternative suppliers.

A decision must also be taken as to how to deal with price **inflation**. Suppose that a material costs RWF10,000 per kilogram at the moment, and during the course of the next 12 months, it is expected to go up in price by 20% to RWF12,000 per kilogram. What standard price should be selected?

a) If the **current price** of RWF10,000 per kilogram **were used in the standard**, the reported price variance would become adverse as soon as prices go up, which might be very early in the year. If prices go up gradually rather than in one big jump, it would be difficult to select an appropriate time for revising the standard.

b) If an **estimated mid-year price** of, say, RWF11,000 per kilogram **were used**, price variances should be favourable in the first half of the year and adverse in the second half, again assuming that prices go up gradually. Management could only really check that in any month, the price variance did not become excessively adverse (or favourable) and that the price variance switched from being favourable to adverse around month six or seven and not sooner.

Standard costing is therefore more **difficult in times of inflation but it is still worthwhile.**

- Usage and efficiency variances will still be meaningful
- Inflation is measurable: there is no reason why its effects cannot be removed
- Standard costs can be revised, so long as this is not done too frequently

Setting standards for labour costs

Direct labour rates per hour will be set by reference to the payroll and to any agreements on pay rises with trade union representatives of the employees. A separate hourly rate or weekly wage will be set for each different labour grade/type of employee and an average hourly rate will be applied for each grade (even though individual rates of pay may vary according to age and experience).

Similar problems to those which arise when setting material standards in times of high inflation can be met when setting labour standards.

Setting standards for material usage and labour efficiency

To estimate the materials required to make each product (material usage) and also the labour hours required (labour efficiency), technical specifications must be prepared for each product by production experts (either in the production department or the work study department).

Setting standards for overheads

When standard costs are fully absorbed costs (standard costs can be used in both marginal and absorption costing systems), the **absorption rate** of fixed production overheads will be

predetermined and **based on budgeted** fixed production **overhead** and planned **production volume**.

Production volume will depend on two factors.

a) **Production capacity** (or '**volume capacity**') measured perhaps in standard hours of output (a standard hour being the amount of work achievable at standard efficiency levels in an hour), which in turn reflects direct production labour hours.

b) **Efficiency of working**, by labour or machines, allowing for rest time and contingency allowances.

Suppose that a department has a work force of ten men, each of whom works a 36 hour week to make standard units, and each unit has a standard time of two hours to make. The expected efficiency of the work-force is 125%.

a) Budgeted capacity, in direct labour hours, would be $10 \times 36 = 360$ production hours per week.

b) Budgeted efficiency is 125% so that the work-force should take only 1 hour of actual production time to produce 1.25 standard hours of output.

c) This means in our example that budgeted output is 360 production hours $\times$ 125% = 450 standard hours of output per week. At 2 standard hours per unit, this represents production activity or volume of 225 units of output per week.

Example

ABC carries out routine office work in a sales order processing department, and all tasks in the department have been given standard times. There are 40 clerks in the department who work on average 140 hours per month each. The efficiency ratio of the department is 110%.

Required

Calculate the budgeted output in the department.

Solution

Capacity = 40 × 140 = 5,600 hours per month

Efficiency = 110%

Budgeted output = 5,600 × 110% = 6,160 standard hours of work per month.

Setting standards for sales price and margin

The **standard selling price** will depend on a number of factors including the following.

- Anticipated market demand
- Manufacturing costs
- Competing products
- Inflation estimates

The **standard sales margin** is the difference between the standard cost and the standard selling price.

The following problems can occur when setting standards.

a) Deciding how to incorporate **inflation** into planned unit costs

b) Agreeing on a **performance standard** (attainable or ideal)

c) Deciding on the **quality** of materials to be used (a better quality of material will cost more, but perhaps reduce material wastage)

d) Estimating materials prices where **seasonal price variations** or **bulk purchase discounts** may be significant

e) Finding sufficient **time** to construct standards as standard setting can be time consuming

f) Incurring the **cost** of setting up and maintaining a system for establishing standards

Types of standard

There are four **types of standard:**

- **ideal,**
- **attainable,**
- **current** and
- **basic**.

These can have an impact on employee motivation.

How demanding should a standard be?

Should the standard represent perfect performance, easily attainable performance or achievable target?

An **ideal standard** is a standard which can be attained under perfect operating conditions: no wastage, no inefficiencies, no idle time, no breakdowns

An **attainable standard** is a standard which can be attained if production is carried out efficiently, machines are properly operated and/or materials are properly used. Some allowance is made for wastage and inefficiencies

A **current standard** is standard based on current working conditions (current wastage, current inefficiencies)

A **basic standard** is a long-term standard which remains unchanged over the years and is used to show trends

The **different types of standard have a number of advantages and disadvantages.**

a) **Ideal standards** can be seen as **long-term targets** but are not very useful for day-to-day control purposes.

b) **Ideal standards cannot be achieved**. If such standards are used for budgeting, an allowance will have to be included to make the budget realistic and attainable.

c) **Attainable standards** can be used for **product costing**, cost control, stock (raw materials,WIP & finished goods) valuation, estimating and as a basis for budgeting.

d) **Current standards** or attainable standards provide the **best basis for budgeting**, because they represent an achievable level of productivity.

e) Current standards **do not attempt to improve** on current levels of efficiency.

f) **Current standards** are useful during **periods when inflation is high**. They can be set on a month by month basis.

g) **Basic standards** are used to show **changes in efficiency or performance** over a long period of time. They are perhaps the least useful and least common type of standard in use.

The impact on employee behaviour of the type of standard set

The type of standard set can have an impact on the behaviour of the employees trying to achieve those standards.

Type of standard	Impact
Ideal	Some say that they provide employees with an **incentive to be more efficient** even though it is highly unlikely that the standard will be achieved. Others argue that they are likely to have an unfavourable effect on employee motivation because the differences between standards and actual results will always be adverse. The **employees may feel that the goals are unattainable** and so **they will not work so hard**.
Attainable	Might be an **incentive to work harder** as they provide a **realistic but challenging target of efficiency**.
Current	**Will not motivate employees to do anything more than they are currently doing**.
Basic	May have an **unfavourable impact** on the motivation of employees. Over time they will discover that they are easily able to achieve the standards. They may become bored and lose interest in what they are doing if they have nothing to aim for.

BUDGETS AND STANDARDS COMPARED

Budgets and standards are very similar and interrelated, but there are important differences between them.

You will recall from previous chapters that a **budget** is a **quantified monetary plan** for a future period, which managers will try to achieve. Its major function lies in **communicating plans** and **coordinating activities** within an organisation.

On the other hand, a **standard** is a **carefully predetermined quantity target** which can be **achieved under certain conditions**.

Budgets and standards are **similar** in the following ways.

a) They both involve looking to the future and **forecasting** what is likely to happen given a certain set of circumstances.

b) They are both **used for control purposes**. A budget aids control by setting financial targets or limits for a forthcoming period. Actual achievements or expenditures are then compared with the budgets and action is taken to correct any variances where necessary. A standard also achieves control by comparison of actual results against a predetermined target.

As well as being similar, **budgets and standards are interrelated**. For example, a standard unit production cost can act as the basis for a production cost budget. The unit cost is multiplied by the budgeted activity level to arrive at the budgeted expenditure on production costs.

There are, however, **important differences between budgets and standards**.

Budgets	Standards
Gives planned total aggregate costs for a function or cost centre	Shows the unit resource usage for a single task, for example the standard labour hours for a single unit of production
Can be prepared for all functions, even where output cannot be measured	Limited to situations where repetitive actions are performed and output can be measured in more than monetary terms
Expressed in money terms	Need not be expressed in money terms. For example a standard rate of output does not need a financial value put on it

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ALLOWING FOR WASTE AND IDLE TIME

In the exam you may be asked to deal with a situation in which not all resources are actually used to make saleable products.

Wastage

The amount of raw material used to meet the budgeted production level might be **less** than the amount of raw material contained in the finished products for a number of reasons.

- Evaporation
- Spillage
- Natural wastage (such as the skin of fruit used to make fruit juice)

This wastage can be built into an **attainable materials standard** and adjustments can be made to **materials budgets**.

If the wastage occurs **before** production commences, the **materials purchases budget** must be adjusted. If the wastage occurs **during** production, the **materials usage budget** must be adjusted.

Example: wastage in budgets

The production quantities required for each of the first four periods of the year are as follows.

Production budget – units

Period 1	*Period 2*	*Period 3*	*Period 4*
10,204	13,010	14,796	12,755

From the standard cost card it is determined that each unit of production requires 2 kg of raw material X. However we also know that the production process has a normal loss of 20% of the materials input into the process.

This means that although each unit of product requires 2 kg of material X, this represents only 80% of the actual amount required. 25% (100/80) more than 2 kg per unit must be input into the process. The amount of material X required for each unit is therefore:

$$2 \text{ kg} \times 100/80 = 2.5 \text{ kg}$$

The amount of normal loss can be calculated separately as:

$$2 \text{ kg} \times 20/80 = 0.5 \text{ kg}$$

The materials usage budget can now be prepared.

Materials usage budget

	Period 1	*Period 2*	*Period 3*	*Period 4*
Quantity of production	10,204	13,010	14,796	12,755
Materials usage (quantity × 2.5 kg)	25,510 kg	32,525 kg	36,990 kg	31,888 kg

Example

A business requires 15,400 units of production in a period and each unit uses 5 kg of raw materials. The production process has a normal loss of 10% during the production process. What is the total amount of the raw material required for the period?

Solution		Kg
Kg required for production	5 × 15,400	77,000
Additional for normal loss	77,000 × 10/90	8,556
Required usage	15,400 × 5 × 100/90)	85,556

Idle time

A workforce that is expected to work at a particular level of efficiency may not always be able to achieve this. **Idle time** may be caused by machine breakdowns or not having enough work to give to employees, perhaps because of bottlenecks in production or a shortage of orders for customers.

Idle time can again be built into an **attainable labour hours standard** and adjustments can be made to the **labour budget.**

Example: idle time and standards

A machine has running costs of RWF60,000 per hour and typically incurs 5% non-productive time. To get 60 minutes of output (a standard hour) would take 60 ÷ (100 – 5)% = 63.16 minutes. The **standard cost of production** or **cost of idle time** is therefore RWF63,160 per hour.

Example: idle time and the labour usage budget

The standard cost card for the Stephenson shows that the standard time for production of one unit is 1 grade A labour hour. However due to necessary break times only 80% of the time paid is productive, that is there is 20% idle time.

To calculate the number of hours of labour required, again the starting point will be the production budget showing the number of units to be produced in each period. However the number of hours that must be paid in total in order to produce one unit is:

1 hour × 100/80 = 1.25 hours

The idle time per product can be calculated as 1 hour × $\frac{20}{80}$ = 0.25 hours.

Production budget

	Period 1	*Period 2*	*Period 3*	*Period 4*
Quantity of production	10,204	13,010	14,796	12,755

Labour usage budget – hours

	Period 1	*Period 2*	*Period 3*	*Period 4*
Labour hours	12,755 hrs	16,263 hrs	18,495 hrs	15,944 hrs

Example

A product requires 10 labour hours for each unit. However 10% of working hours are idle time. For how long must an employee be paid in order to produce 20 units?

Solution

Standard time	20 units × 10 hours	200
Additional time	200 × 10/90	22
Total time required	*20 × 10 × 100/90*	222

FLEXIBLE BUDGETS

Comparison of a fixed budget with the actual results for a different level of activity is of little use for control purposes. **Flexible budgets** should be used to show what cost and revenues should have been for the actual level of activity.

A **flexible budget** is a budget which, by recognising different cost behaviour patterns, is designed to change as volume of activity changes.

If you previously studied F2, you will be familiar with this material.

Preparing a flexible budget

Step 1 The first step in the preparation of a flexible budget is the **determination of cost behaviour patterns**, which means **deciding whether costs are fixed, variable or semi-variable**.

Step 2 The second step in the preparation of a flexible budget is to calculate the **budget cost allowance** for each cost item.

Budget cost allowance = budgeted fixed cost* + (number of units × variable cost per unit)**

* nil for variable cost

** nil for fixed cost

Semi-variable costs therefore need splitting into their fixed and variable components so that the budget cost allowance can be calculated. One method for splitting semi-variable costs is the high-low method, which we covered in Study Unit 14.

Example: preparing a flexible budget

a) Prepare a budget for 20X6 for the direct labour costs and overhead expenses of a production department flexed at the activity levels of 80%, 90% and 100%, using the information listed below.

(i) The direct labour hourly rate is expected to be RWF 375.

(ii) 100% activity represents 60,000 direct labour hours.

(iii) *Variable costs*

Indirect labour	RWF75 per direct labour hour
Consumable supplies	RWF37.5 per direct labour hour
Canteen and other welfare services	6% of direct and indirect labour costs

(iv) Semi-variable costs are expected to relate to the direct labour hours in the same manner as for the last five years.

Year	*Direct labour hours*	*Semi-variable costs*
		RWF '000
20X1	64,000	2,080
20X2	59,000	1,980
20X3	53,000	1,860
20X4	49,000	1,780
20X5	40,000 (estimate)	1,600 (estimate)

(v) *Fixed costs*

	RWF '000
Depreciation	1,800
Maintenance	1,000
Insurance	400
Rates	1,500
Management salaries	2,500

(vi) Inflation is to be ignored.

b) Calculate the budget cost allowance (ie expected expenditure) for 20X6 assuming that 57,000 direct labour hours are worked.

Solution

a)

	80% level	*90% level*	*100% level*
	48,000 hrs	*54,000 hrs*	*60,000 hrs*
	RWF '000	RWF '000	RWF '000
Direct labour	18,000		22,500
Other variable costs			
Indirect labour	3,600	4,050	4,500
Consumable supplies	1,800	2,025	2,250
Canteen etc	1,296	1,458	1,620
Total variable costs (Rwf515 per hour)	24,696	24,696	24,696
Semi-variable costs (W)	1,760	1,880	2,000
Fixed costs			
Depreciation	1,800	1,800	1,800
Maintenance	1,000	1,000	1,000
Insurance	400	400	400
Rates	1,500	1,500	1,500
Management salaries	2,500	2,500	2,500
Budgeted costs	33,656	36,863	40,070

Working

Using the high/low method:

	RWF '000
Total cost of 64,000 hours	2,080
Total cost of 40,000 hours	1,600
Variable cost of 24,000 hours	480
Variable cost per hour (RWF480,000/24,000)	0.02

	RWF'000
Total cost of 64,000 hours	2,080
Variable cost of 64,000 hours (× RWF0.020)	1,2800
Fixed costs	800

Semi-variable costs are calculated as follows.

			RWF '000
60,000 hours	(60,000 × RWF20) + RWF800,000	=	2,000
54,000 hours	(54,000 RWF20) + RWF800,000	=	1,880
48,000 hours	(48,000 × RWF20) + RWF800,000	=	1,760

b) The budget cost allowance for 57,000 direct labour hours of work would be as follows.

		RWF '000
Variable costs	(57,000 × RWF k5.145)	29,326.5
Semi-variable costs	(RWFk800+ (57,000 × RWF k0.020))	1,940.0
Fixed costs		7,200
		384,66.5

Flexible budgets and performance management

Budgetary control involves drawing up budgets for the areas of responsibility for individual managers (for example production managers, purchasing managers and so on) and of regularly **comparing** actual results against expected results. The differences between actual results and expected results are called **variances** and these are used to provide a guideline for control action by individual managers.

Note that individual managers are held responsible for investigating differences between budgeted and actual results, and are then expected to take corrective action or amend the plan in the light of actual events.

The wrong approach to budgetary control is to compare actual results against a fixed budget. Suppose that a company manufactures a single product, Z. Budgeted results and actual results for June 20X2 are shown below.

	Budget	Actual results	Variance
Production and sales of the cloud (units)	2,000	3,000	
	RWF '000	RWF '000	RWF '000
Sales revenue (a)	20,000	30,000	10,000 (F)
Direct materials	6,000	8,500	2,500 (A)
Direct labour	4,000	4,500	500 (A)
Maintenance	1,000	1,400	400 (A)
Depreciation	2,000	2,200	200 (A)
Rent and rates	1,500	1,600	100 (A)
Other costs	3,600	5,000	1,400 (A)
Total costs (b)	18,100	23,200	5,100
Profit (a) – (b)	1,900	6,800	4,900 (F)

a) Here the variances are **meaningless** for control purposes. Costs were higher than budget because the output volume was also higher; variable costs would be expected to increase above the costs budgeted in the fixed budget. There is no information to show whether control action is needed for any aspect of costs or revenue.

b) For control purposes, it is necessary to know the following.

(i) Were actual costs higher than they should have been to produce and sell 3,000 Zs?

(ii) Was actual revenue satisfactory from the sale of 3,000 Zs?

The **correct approach to budgetary control** is as follows.

a) **Identify fixed and variable costs**

b) **Produce a flexible budget using marginal costing techniques**

Let's suppose that we have the following estimates of cost behaviour for the company.

a) Direct materials, direct labour and maintenance costs are variable.

b) Rent and rates and depreciation are fixed costs.

c) Other costs consist of fixed costs of RWF1,600,000 plus a variable cost of RWF1,000 per unit made and sold.

Now that the cost behaviour patterns are known, a budget cost allowance can be calculated for each item of expenditure. This allowance is shown in a **flexible budget** as the expected expenditure on each item for the relevant level of activity. The budget cost allowances are calculated as follows - *RWF values in thousands*.

a) Variable cost allowances = original budgets × (3,000 units/2,000 units)

eg material cost allowance = RWF6,000 × $^3/2$ = RWF9,000

b) Fixed cost allowances = as original budget

c) Semi-fixed cost allowances = original budgeted fixed costs

+ (3,000 units × variable cost per unit)

eg other cost allowances = RWF1,600 + (3,000 × RWF1) = RWF4,600

The budgetary control analysis should be as follows.

	Fixed budget	*Flexible budget*	*Actual results*	*Budget variance*
	(a)	(b)	(c)	(b) – (c)
Production and sales (units)	2,000	3,000	3,000	
	RWF '000	RWF '000	RWF '000	RWF '000
Sales revenue	20,000	30,000	30,000	0
Variable costs				
Direct materials	6,000	9,000	8,500	500 (F)
Direct labour	4,000	6,000	4,500	1,500 (F)
Maintenance	1,000	1,500	1,400	100 (F)
Semi-variable costs				
Other costs	3,600	4,600	5,000	400 (A)
Fixed costs				
Depreciation	2,000	2,000	2,200	200 (A)
Rent and rates	1,500	1,500	1,600	100 (A)
Total costs	18,100	24,600	23,200	1,400 (F)
Profit	1,900	5,400	6,800	1,400 (F)

Note. **(F) denotes a favourable variance** and **(A) an adverse or unfavourable variance.**

We can **analyse** the above as follows *again RWF in thousands*.

a) In selling 3,000 units the expected profit should have been, not the fixed budget profit of RWF1,900, but the flexible budget profit of RWF5,400. Instead, actual profit was RWF6,800 ie RWF1,400 more than we should have expected. One of the reasons for the improvement is that, **given output and sales** of 3,000 units, **costs were lower than expected** (and sales revenue exactly as expected).

	Rwf '000
Direct materials cost variance	500 (F)
Direct labour cost variance	1,500 (F)
Maintenance cost variance	100 (F)
Other costs variance	400 (A)
Fixed cost variances	
Depreciation	200 (A)
Rent and rates	100 (A)
	1,400 (F)

b) Another reason for the improvement in profit above the fixed budget profit is the **sales volume** (3,000 Zs were sold instead of 2,000).

	RWF '000	RWF '000
Sales revenue increased by		10,000
Variable costs increased by:		
Direct materials	3,000	
Direct labour	2,000	
Maintenance	500	
Variable element of other costs	1,000	
Fixed costs are unchanged		6,500
Profit increased by		3,500

Profit was therefore increased by RWF 3,500,000 because sales volumes increased.

c) A full variance analysis statement would be as follows.

	RWF '000	RWF '000
Fixed budget profit		1,900
Variances		
Sales volume	3,500 (F)	
Direct materials cost	500 (F)	
Direct labour cost	1,500 (F)	
Maintenance cost	100 (F)	
Other costs	400 (A)	
Depreciation	200 (A)	
Rent and rates	100 (A)	
		4,900 (F)
Actual profit		6,800

If management believes that any of these variances are large enough to justify it, they will investigate the reasons for them to see whether any corrective action is necessary or whether the plan needs amending in the light of actual events.

Factors to consider when preparing flexible budgets

The mechanics of flexible budgeting are, in theory, fairly straightforward but in practice there are a number of points to consider before figures are simply flexed.

a) Splitting mixed costs is not always straightforward.

b) Fixed costs may behave in a step-line fashion as activity levels increase/decrease.

c) Account must be taken of the assumptions upon which the original fixed budget was based. Such assumptions might include the constraint posed by limiting factors, the rate of inflation, judgements about future uncertainty, the demand for the organisation's products and so on.

d) 'Flexing … can incorporate changes for any factor which differs from that which applied when the budget was prepared, for example different states of the economy. In this way, flexing is saying "If I knew then what I know now, what budget would I set?" It is a useful concept but can lead to some concern, if taken to extremes, because managers can be confused and frustrated if faced throughout the year with a possibly moving target.'

(Mike Tayles, *ACCA Students Newsletter*, December 1998)

The need for flexible budgets

We have seen that flexible budgets may be prepared in order to plan for variations in the level of activity above or below the level set in the fixed budget. It has been suggested, however, that since many cost items in modern industry are fixed costs, the **value** of flexible budgets in planning is dwindling.

a) In manufacturing industries, especially in Europe or North America,, plant costs (depreciation, rent and so on) are a very large proportion of total costs, and these tend to be fixed costs.

b) Wage costs also tend to be fixed, because employees are generally guaranteed a basic wage for a working week of an agreed number of hours.

c) With the growth of service industries, labour (wages or fixed salaries) and overheads will account for most of the costs of a business, and direct materials will be a relatively small proportion of total costs.

Flexible budgets are nevertheless necessary, and even if they are not used at the planning stage, they must be used for budgetary control variance analysis.

THE PRINCIPLE OF CONTROLLABILITY

The **principle of controllability** is that managers of responsibility centres should only be held accountable for costs over which they have some influence.

Budget centres

Budgetary control is based around a system of **budget centres**. Each budget centre will have its own budget and a manager will be responsible for managing the budget centre and ensuring that the budget is met.

The selection of budget centres in an organisation is therefore a key first step in setting up a control system. What should the budget centres be? What income, expenditure and/or capital employment plans should each budget centre prepare? And how will measures of performance for each budget centre be made?

A well-organised system of control should have the following features.

Feature	Explanation
A hierarchy of budget centres	If the organisation is quite large a hierarchy is needed. Subsidiary companies, departments and work sections might be budget centres. Budgets of each section would then be consolidated into a departmental budget, departmental budgets in turn would be consolidated into the subsidiary's budget, and the budgets of each subsidiary would be **combined into a master budget** for the group as a whole.
Clearly identified responsibilities for achieving budget targets	Individual managers should be made responsible for achieving the budget targets of a particular budget centre.
Responsibilities for revenues, costs and capital employed	Budget centres should be organised so that all the revenues earned by an organisation, all the costs it incurs, and all the capital it employs are made the responsibility of someone within the organisation, at an appropriate level of authority in the management hierarchy.

Budgetary control and budget centres are therefore part of the overall system of **responsibility accounting** within an organisation.

Responsibility accounting is a system of accounting that segregates revenue and costs into areas of personal responsibility in order to monitor and assess the performance of each part of an organisation.

Controllable costs

Controllable costs are items of expenditure which can be directly influenced by a given manager within a given time span.

Care must be taken to distinguish between controllable costs and uncontrollable costs in variance reporting. The **controllability principle** is that managers of responsibility centres should only be held accountable for costs over which they have some influence. From a **motivation** point of view this is important because it can be very demoralising for managers who feel that their performance is being judged on the basis of something over which they have no influence. It is also important from a **control** point of view in that control reports should ensure that information on costs is reported to the manager who is able to take action to control them.

Responsibility accounting attempts to associate costs, revenues, assets and liabilities with the managers most capable of controlling them. As a system of accounting, it therefore distinguishes between controllable and uncontrollable costs.

Most **variable costs** within a department are thought to be **controllable in the short term** because managers can influence the efficiency with which resources are used, even if they cannot do anything to raise or lower price levels.

A cost which is not controllable by a junior manager might be controllable by a senior manager. For example, there may be high direct labour costs in a department caused by excessive overtime working. The junior manager may feel obliged to continue with the overtime to meet production schedules, but his senior may be able to reduce costs by hiring extra full-time staff, thereby reducing the requirements for overtime.

A cost which is not controllable by a manager in one department may be controllable by a manager in another department. For example, an increase in material costs may be caused by buying at prices higher than expected (controllable by the purchasing department) or by excessive wastage (controllable by the production department) or by a faulty machine producing rejects (controllable by the maintenance department).

Some costs are **non-controllable**, such as increases in expenditure items due to inflation. Other costs are **controllable, but in the long term rather than the short term**. For example, production costs might be reduced by the introduction of new machinery and technology, but in the short term, management must attempt to do the best they can with the resources and machinery at their disposal.

The controllability of fixed costs

It is often assumed that all fixed costs are non-controllable in the short run. This is not so.

a) **Committed fixed costs** are those costs arising from the possession of plant, equipment, buildings and an administration department to **support the long-term needs of the business**. These costs (depreciation, rent, administration salaries) are largely **non-controllable in the short term** because they have been committed by longer-term decisions affecting longer-term needs. When a company decides to cut production drastically, the long-term committed fixed costs will be reduced, but only after redundancy terms have been settled and assets sold.

b) **Discretionary fixed costs**, such as advertising and research and development costs, are incurred as a result of a top management decision, but could be **raised or lowered at fairly short notice** (irrespective of the actual volume of production and sales).

Controllability and apportioned costs

Managers should only be held accountable for costs over which they have some influence. This may seem quite straightforward in theory, but it is not always so easy in practice to distinguish controllable from uncontrollable costs. **Apportioned overhead costs provide a good example**.

Suppose that a manager of a production department in a manufacturing company is made responsible for the costs of his department. These costs include **directly attributable overhead items** such as the costs of indirect labour employed and indirect materials consumed in the department. The department's overhead costs also include an apportionment of costs from other cost centres, such as rent and rates for the building it shares with other departments and a share of the costs of the maintenance department.

Should the production manager be held accountable for any of these apportioned costs?

a) Managers should not be held accountable for costs over which they have no control. In this example, apportioned rent and rates costs would not be controllable by the production department manager.

b) Managers should be held accountable for costs over which they have some influence. In this example, it is the responsibility of the maintenance department manager to keep maintenance costs within budget. But their costs will be partly variable and partly fixed, and the variable cost element will depend on the volume of demand for their services. If the production department's staff treat their equipment badly we might expect higher repair costs, and the production department manager should therefore be made accountable for the repair costs that his department makes the maintenance department incur on its behalf.

c) Charging the production department with some of the costs of the maintenance department prevents the production department from viewing the maintenance services as 'free services'. Over-use would be discouraged and the production manager is more likely to question the activities of the maintenance department possibly resulting in a reduction in maintenance costs or the provision of more efficient maintenance services.

Controllability and dual responsibility

Quite often a particular cost might be the **responsibility of two or more managers**. For example, raw materials costs might be the responsibility of the purchasing manager (prices) and the production manager (usage). A **reporting system must allocate responsibility appropriately**. The purchasing manager must be responsible for any increase in raw materials prices whereas the production manager should be responsible for any increase in raw materials usage.

This where Standard Cost analysis can be useful. It can show price and usage variances separately.

You can see that there are **no clear cut rules** as to which costs are controllable and which are not. Each situation and cost must be reviewed separately and a decision taken according to the control value of the information and its behavioural impact.

CHAPTER ROUNDUP

- A **standard cost** is an estimated unit cost built up of standards for each cost element (standard resource price and standard resource usage)
- **Standard costing** is principally used to value inventories and cost production and to act as a control device.
- Standard costing is most suited to mass production and repetitive assembly work.
- The **responsibility for deriving standard costs** should be shared between **managers able to provide the necessary information** about levels of expected efficiency, prices and overhead costs.
- There are four **types of standard: ideal, attainable, current** and **basic**. These can have an impact on employee motivation.
- Budgets and standards are very similar and interrelated, but there are important differences between them.
- Comparison of a fixed budget with the actual results for a different level of activity is of little use for control purposes. **Flexible budgets** should be used to show what cost and revenues should have been for the actual level of activity.
- The **principle of controllability** is that managers of responsibility centres should only be held accountable for costs over which they have some influence.
- **Controllable costs** are items of expenditure which can be directly influenced by a given manager within a given time span.

STUDY UNIT 16

Variance Analysis

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EXAM GUIDE

The variance calculations set in this paper are likely to be the more complicated variances and you will be required to **explain** them and **evaluate** performance.

BASIC VARIANCES

Knowledge brought forward from earlier studies

- A **variance** is the difference between an actual result and an expected result.
- **Variance analysis** is the process by which the *total* difference between standard and actual results is analysed.
- When actual results are better than expected results, we have a **favourable variance (F).** If actual results are worse than expected results, we have an **adverse variance (A).**
- The **selling price variance** measures the effect on expected profit of a selling price different from the standard selling price. It is calculated as the difference between what the sales revenue should have been for the actual quantity sold, and what it was.
- The **sales volume variance** measures the increase or decrease in expected profit as a result of the sales volume being higher or lower than budgeted. It is calculated as the difference between the budgeted sales volume and the actual sales volume multiplied by the standard profit per unit.
- The material **total variance** is the difference between what the output actually cost and what it should have cost, in terms of material(s). It can be divided into the following two sub-variances.
- The **material price variance** is the difference between what the material did cost and what it should have cost.
- The **material usage variance** is the difference between the standard cost of the material that should have been used and the standard cost of the material that was used.
- The **labour total variance** is the difference between what the output should have cost and what it did cost, in terms of labour. It can be divided into two sub-variances.
- The **labour rate variance** is the difference between what the labour did cost and what it should have cost.
- The **labour efficiency variance** is the difference between the standard cost of the hours that should have been worked and the standard cost of the hours that were worked.

- **The variable production overhead total variance** is the difference between what the output should have cost and what it did cost, in terms of variable production overhead. It can be divided into two sub-variances.

- The **variable production overhead expenditure variance** is the difference between the amount of variable production overhead that should have been incurred in the actual hours actively worked, and the actual amount of variable production overhead incurred.

- The **variable production overhead efficiency variance** is the difference between the standard cost of the hours that should have been worked for the number of units actually produced, and the standard cost of the actual number of hours worked.

- **Fixed production overhead total variance** is the difference between fixed production overhead incurred and fixed production overhead absorbed. In other words, it is the under– or over-absorbed fixed production overhead.

- **Fixed production overhead expenditure variance** is the difference between the budgeted fixed production overhead expenditure and actual fixed production overhead expenditure.

- **Fixed production overhead volume variance** is the difference between actual and budgeted production/volume multiplied by the standard absorption rate per *unit*.

- **Fixed production overhead volume efficiency variance** is the difference between the number of hours that actual production should have taken, and the number of hours actually taken (that is, worked) multiplied by the standard absorption rate per *hour*.

- **Fixed production overhead volume capacity variance** is the difference between budgeted hours of work and the actual hours worked, multiplied by the standard absorption rate per *hour*.

Example

A company produces and sells one product only, the Thing, the standard cost for one unit being as follows.

	RWF
Direct material A – 10 kilograms at RWF20 per kg	200
Direct material B – 5 litres at RWF6 per litre	30

Direct wages – 5 hours at RWF6per hour	30
Fixed production overhead	50
Total standard cost	310

The fixed overhead included in the standard cost is based on an expected monthly output of 900 units. Fixed production overhead is absorbed on the basis of direct labour hours.

During April the actual results were as follows.

Production	800 units
Material A	7,800 kg used, costing RWF159,900
Material B	4,300 litres used, costing RWF23,650
Direct wages	4,200 hours worked for RWF24,150
Fixed production overhead	RWF47,000

Required

a) Calculate price and usage variances for each material.

b) Calculate labour rate and efficiency variances.

c) Calculate fixed production overhead expenditure and volume variances and then subdivide the volume variance.

Solution

a) **Price variance – A**

	RWF	
7,800 kgs should have cost (× RWF20)	156,000	
but did cost	159,900	
Price variance	3,900	(A)

Usage variance – A

800 units should have used (× 10 kgs)	8,000	kgs
but did use	7,800	kgs
Usage variance in kgs	200	kgs (F)
× standard cost per kilogram	× RWF20	
Usage variance	RWF4,000	(F)

Price variance – B

	RWF	
4,300 litres should have cost (× RWF6)	25,800	
but did cost	23,650	
Price variance	2,150	(F)

Usage variance – B

	RWF	
800 units should have used (× 5 l)	4,000	l
but did use	4,300	l
Usage variance in litres	300	(A)
× standard cost per litre	× RWF6	
Usage variance	RWF1,800	(A)

b) **Labour rate variance**

	RWF	
4,200 hours should have cost (× Rwf6)	25,200	
but did cost	24,150	
Rate variance	1,050	(F)

Labour efficiency variance

800 units should have taken (× 5 hrs)	4,000 hrs
but did take	4,200 hrs
Efficiency variance in hours	200 hrs (A)
× standard rate per hour	× RWF6
Efficiency variance	RWF1,200 (A)

c) **Fixed overhead expenditure variance**

	RWF
Budgeted expenditure (RWF50 × 900)	45,000
Actual expenditure	47,000
Expenditure variance	2,000 (A)

Fixed overhead volume variance

	RWF
Budgeted production at standard rate (900 × RWF50)	45,000
Actual production at standard rate (800 × RWF50)	40,000
Volume variance	5,000 (A)

Fixed overhead volume efficiency variance

800 units should have taken (× 5 hrs)	4,000 hrs
but did take	4,200 hrs
Volume efficiency variance in hours	200 hrs
× standard absorption rate per hour	× RWF10
Volume efficiency variance	RWF2,000 (A)

Fixed overhead volume capacity variance

Budgeted hours	4,500 hrs
Actual hours	4,200 hrs
Volume capacity variance in hours	300 hrs (A)
× standard absorption rate per hour (RWF50 ÷ 5)	× RWF10
	RWF3,000 (A)

Exam Focus Point

You have to be very happy with basic variance calculations so it is **essential** to do more practice if you struggled with this question.

THE REASONS FOR VARIANCES

Knowledge brought forward from Formation 2 Management Accounting

In an examination question you should review the information given and use your imagination and common sense to suggest possible reasons for variances.

Variance	Favourable	Adverse
Material price	Unforeseen discounts received Greater care taken in purchasing Change in material standard	Price increase Careless purchasing Change in material standard
Material usage	Material used of higher quality than standard More effective use made of material Errors in allocating material to jobs	Defective material Excessive waste Theft Stricter quality control Errors in allocating material to jobs
Labour rate	Use of workers at a rate of pay lower than standard	Wage rate increase
Idle time	Possible if idle time has been built into the budget	Machine breakdown Non-availability of material Illness or injury to worker
Labour efficiency	Output produced more quickly than expected, because of work motivation, better quality of equipment or materials, better learning rate Errors in allocating time to jobs	Lost time in excess of standard allowed Output lower than standard set because of lack of training, sub-standard material etc Errors in allocating time to jobs
Overhead expenditure	Savings in costs incurred More economical use of services	Increase in cost of services Excessive use of services Change in type of services used
Overhead volume	Production or level of activity greater than budgeted.	Production or level of activity less than budgeted
Fixed overhead capacity	Production or level of activity greater than budgeted	Production or level of activity less than budgeted
Selling price	Unplanned price increase	Unplanned price reduction
Sales volume	Additional demand	Unexpected fall in demand Production difficulties

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LABOUR VARIANCES AND THE LEARNING CURVE

Care must be taken when interpreting labour variances where the **learning curve** has been used in the budget process.

In Chapter 14 we looked at how the **learning curve** can be used for forecasting production time and labour costs in certain circumstances where the workforce as a whole improves in efficiency with experience.

Companies that use standard costing for much of their production output cannot apply standard times to output where a learning effect is taking place. This problem can be overcome in practice by:

a) Establishing **standard times** for output, once the learning effect has worn off or become insignificant; and

b) Introducing a **'launch cost'** budget for the product for the duration of the learning period.

When learning is still taking place, it would be unreasonable to compare actual times with the standard times that ought eventually to be achieved so **allowances must be made** when interpreting labour efficiency variances. Standard costs should reflect the point that has been reached on the learning curve. When learning has become **insignificant**, standards set on the basis of this **'steady state'** will be different to when learning was taking place. If the learning rate has been wrongly calculated, this must be allowed for in the variance calculations.

Example: labour variances and the learning curve

A new product has been introduced for which an 80% learning curve is expected to apply. The standard labour information has been based on estimates of the time needed to produce the first unit which is 200 hours at RWF5 per hour.

The first four units took 700 hours to produce at a cost of RWF37,500.

Required

a) The original labour rate and efficiency variances.

b) The labour rate and efficiency variances which take into account the learning effect.

Solution

a) **Labour rate variance**

	RWF	
700 hours should have cost (× RWF5)	35,000	
but did cost	37,500	
Labour rate variance	2,500	(A)

Labour efficiency variance

Four units should have taken (× 200 hrs)	800	hours
but did take	700	hours
Efficiency variance in hours	100	hours (F)
× standard rate per hour	× RWF5	
Efficiency variance	RWF500	(F)

b) **Incorporating the learning curve effect**

Average standard time per unit for 4 units

$= 200 \times 0.8 \times 0.8$

= 128 hours

Total expected time for 4 units

$= 128 \times 4$

= 512 hours

Labour efficiency variance

Four units should have taken	512	hours
but did take	700	hours
	188	hours (A)
× standard rate per hour	× RWF5	
	RWF940	(A)

The labour rate variance does not change but a favourable labour efficiency variance is now adverse once the learning effect has been incorporated.

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IDLE TIME AND WASTE

In the previous chapter we looked at the meaning of **waste** and **idle time** and how they can be allowed for in standards and budgets. We now need to calculate their effect on variances.

Idle time variance

Idle time may be caused by machine breakdowns or not having work to give to employees, perhaps because of bottlenecks in production or a shortage of orders from customers. When it occurs, the labour force is still paid wages for time at work, but no actual work is done. Such time is unproductive and therefore inefficient. In variance analysis, idle time is an **adverse efficiency variance**.

The **idle time variance** is the number of hours that labour were idle valued at the standard rate per hour.

The idle time variance is shown as a separate part of the total labour efficiency variance. The remaining efficiency variance will then relate only to the productivity of the labour force during the hours spent actively working**.**

In Chapter 15 we discussed how budgets can be prepared which **incorporate** expected idle time. An adverse variance will only result from idle time in **excess** of what was expected.

Example: Labour variances with idle time

During period 5, 1,500 units of product X were made and the cost of grade Z labour was RWF17,500 for 3,080 hours. A unit of product X is expected to use 2 hours of grade Z labour at a standard cost of RWF5 per labour hour. During the period, however, there was a shortage of customer orders and 100 hours were recorded as idle time.

Required

Calculate the following variances.

a) The labour total variance

b) The labour rate variance

c) The idle time variance

d) The labour efficiency variance

Solution

a) **The labour total variance**

	RWF
1,500 units of product X should have cost (×RWF10)	15,000
but did cost	17,500
Labour total variance	2,500 (A)

Actual cost is greater than standard cost. The variance is therefore adverse.

b) **The labour rate variance.** This is a comparison of what the hours paid should have cost and what they did cost.

	RWF
3,080 hours of grade Z labour should have cost (× RWF5)	15,400
but did cost	17,500
Labour rate variance	2,100 (A)

Actual cost is greater than standard cost. The variance is therefore adverse.

c) **The idle time variance**. This is the hours of idle time, valued at the standard rate per hour.

Idle time variance = 100 hours (A) × RWF5 = RWF500 (A)

d) **The labour efficiency variance.** This considers the hours actively worked (the difference between hours paid for and idle time hours) and is calculated by taking the amount of output produced and comparing the time it should have taken to make them, with the actual time spent *actively* making them (3,080 – 100 = 2,980 hours). The variance in hours is valued at the standard rate per labour hour.

1,500 units of product X should take (× 2 hrs)	3,000 hrs
but did take (3,080 – 100)	2,980 hrs
Labour efficiency variance in hours	20 hrs (F)
× standard rate per hour	×RWF5
Labour efficiency variance	RWF100 (F)

e) **Summary**

	RWF
Labour rate variance	2,100 (A)
Idle time variance	500 (A)
Labour efficiency variance	100 (F)
Labour total variance	2,500 (A)

Remember that, if idle time is recorded, the actual hours used in the efficiency variance calculation are the **hours worked** and not the hours paid for.

Example: Idle time in the budget

Bruno's budget for April includes total budgeted machine time of 5,000 hours, and budgeted output of 18,525 units. Due to inevitable delays for set-ups, idle time of 5% is allowed. Total budgeted costs for the month are RWF44,460. In practice in April, actual machine hours were 6,000, of which 800 were idle hours.

Required

a) Calculate the idle time variance.

b) Suggest why this variance has arisen and what could be done to control excess idle time.

Solution

a)

		Hours
Actual idle time		800
Standard idle time	5% of 6,000	300
Excess idle time		500

Cost of labour per hour (44,460/5,000)*100/95	RWF9.36
Variance 500 × RWF9.36 =	RWF4,680

b) There is an adverse variance due to excess idle time. Idle time of 5% is expected for machine set-up delays and this has presumably taken longer than usually expected. This could be due to faulty machinery or problems with staff trained to do the set-ups. Management needs to investigate why the idle time was excessive and take action to prevent re-occurrence.

Wastage and material variances

In the same way as idle time, a certain amount of expected wastage may be built into the material usage standard. A variance therefore needs to be calculated comparing the actual results with a standard that has been adjusted for expected wastage.

Example

a) Capella has prepared standard material specifications for each of products A and B as follows.

   (i) Each finished unit of product A and product B contains 2 units and 6 units of component X respectively.

   (ii) The standard input requirements for both products must also allow for losses during processing of 10% of the units of component X.

   (iii) The standard purchase price for component X is RWF8 per unit.

Customer demand for period 2 for products A and B is budgeted at 2,280 units and 2,925 units respectively. It is budgeted that returns from customers of products A and B requiring free replacement will be 5% and 2.5% respectively of goods delivered to customers. No stocks of raw material, work-in-progress or finished goods are planned.

Required

(i) Calculate the material purchase budget for period 2 (units and RWF) for component X.

(ii) Comment on the usefulness of standard specifications in the compilation of the material budget for Capella rather than using the following actual information for period 1.

	Product A	*Product B*
Sales to customers (units)	2,500	2,750
Purchases of component X (units)	6,250	19,250

Solution

a) (i) **Losses and returns**

The figure of two units of X required for product A represents (1 – 0.1) = 0.9 (or 90%) of the requirement, because of losses. Likewise the demand figure of 2,280 represents 95% of the production needs, because of returns.

Material purchases budget for period 2

	A	*B*
Demand (units)	2,280	2,925
Returns (as decimal)	0.05	0.025
Demand allowing for returns (eg 2,925 × 1/(1 – 0.025)) (units)	2,400	3,000
Free replacements (units)	120	75

	A	*B*
Standard input of X (units)	2	6
Losses (as decimal)	0.1	0.1
Standard input allowing for losses (eg 2 × 1/(1 – 0.1)) (units)	2.2222	6.6667

	A	*B*
	Units	*Units*
Standard units of component X required (eg 3,000 × 6)	4,800	18,000
Losses in process (balance)	533	2,000

Actual units of component X required (eg 2,400 × 2.2222)	5,333	20,000

	RWF
Cost for product A (5,333 × Rwf8)	42,664
Cost for product B (20,000 × Rwf8)	160,000
Total cost	202,664

(ii) **Usefulness of standard specifications**

With sales of 2,500 units of product A the **standard input** figure suggests that only **5,000 units of component X need be purchased**. In fact **6,250 units were required**. Likewise for product B: the standard suggests that 16,500 units of X would have been needed but actual needs were 19,250 units.

It could be argued that the **current standard** is **misleading**, and could lead to **under-purchasing** of component X, and **inability to meet demand** or **additional emergency purchasing,** at above average cost, later in the period. It might be better to **revise** the standard to reflect the actual figures 6,250/2,500 = **2.5 units** for product A and 19,250/2,750 = **7 units** for product B.

On the other hand it could be **argued** that such a **revision sends the wrong signals** to management. The **losses** in process and **returns** are undesirable, and it may be possible to **reduce** them or **eliminate** them entirely. From this point of view the **current standards** have been set at a level that will **give rise to variances**: this will continually **draw management attention** to inefficiencies, and give management a **target** to aim at.

The **period 2 budget** prepared for part (a)(i) illustrates this: effectively it sets management a period 2 **target** of reducing requirements for component X from 2.5 units to 2.2 units (product A), and from 7 units to 6.6 units (product B).

The standard specifications are thus quite in keeping with the principles of **Total Quality Management**.

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OPERATING STATEMENTS

Knowledge brought forward from earlier studies

- An **operating statement** is a regular report for management which compares actual costs and revenues with budgeted figures and shows variances.
- There are several ways in which an operating statement may be presented. Perhaps the most common format is one which **reconciles budgeted profit to actual profit**. Sales variances are reported first, and the total of the budgeted profit and the two sales variances results in a figure for 'actual sales minus the standard cost of sales'. The cost variances are then reported, and an actual profit calculated.

Example

A company manufactures one product, and the entire product is sold as soon as it is produced. There are no opening or closing inventories and work in progress is negligible. The company operates a standard costing system and analysis of variances is made every month. The standard cost card for the product, a widget, is as follows.

STANDARD COST CARD – WIDGET

All RWFvalues in thousands		RWF
Direct materials	0.5 kilos at RWF4 per kilo	2.00
Direct wages	2 hours at RWF2.00 per hour	4.00
Variable overheads	2 hours at RWF0.30 per hour	0.60
Fixed overhead	2 hours at RWF3.70 per hour	7.40
Standard cost		14.00
Standard profit		6.00
Standing selling price		20.00

Budgeted output for January was 5,100 units. Actual results for January were as follows.

Production of 4,850 units was sold for RWF95,600

Materials consumed in production amounted to 2,300 kilos at a total cost of RWF9,800

Labour hours paid for amounted to 8,500 hours at a cost of RWF16,800

Actual operating hours amounted to 8,000 hours

Variable overheads amounted to RWF2,600

Fixed overheads amounted to RWF42,300

Required

Calculate all variances and prepare an operating statement for January.

Answer

AGAIN RWF values in thousands	RWF	
a) 2,300 kg of material should cost (× Rwf4)	9,200	
but did cost	9,800	
Material price variance		600 (A)
b) 4,850 Widgets should use (× 0.5 kgs)	2,425 kg	
but did use	2,300 kg	
Material usage variance in kgs	125 kg (F)	
× standard cost per kg	× RWF4	
Material usage variance in RWF	RWF 500 (F)	
c) 8,500 hours of labour should cost (× RWF2)	17,000	
but did cost	16,800	
Labour rate variance	200 (F)	
d) 4,850 Widgets should take (× 2 hrs)	9,700 hrs	
but did take (active hours)	8,000 hrs	
Labour efficiency variance in hours	1,700 hrs (F)	
× standard cost per hour	× RWF2	
Labour efficiency variance	RWF3,400 (F)	

e)	Idle time variance 500 hours (A) × RWF2	RWF1,000 (A)
f)	8,000 hours incurring variable o/hd expenditure should cost (× RWF 0.30)	2,400
	but did cost	2,600
	Variable overhead expenditure variance	200 (A)
g)	Variable overhead efficiency variance is the same as the labour efficiency variance:	
	1,700 hours (F) × RWF0.30 per hour	RWF 510 (F)
h)	Budgeted fixed overhead (5,100 units × 2 hrs × RWF3.70)	37,740
	Actual fixed overhead	42,300
	Fixed overhead expenditure variance	4,560 (A)
i)	Actual production at standard rate (4,850 units × RWF7.40)	35,890
	Budgeted production at standard rate (5,100 units × RWF7.40)	37,740
	Fixed overhead volume variance	1,850 (A)
j)	4,850 Widgets should have sold for (× RWF20)	97,000
	but did sell for	95,600
	Selling price variance	1,400 (A)
k)	Budgeted sales volume	5,100 units

Actual sales volume	4,850 units
Sales volume variance in units	250 units
× standard profit per unit	× RWF6 (A)
Sales volume variance	RWF1,500 (A)

	RWF	RWF
Budgeted profit (5,100 units × RWF6 profit)		30,600
Selling price variance	1,400	(A)
Sales volume variance	1,500	(A)
		2,900 (A)
Actual sales (RWF95,600) less the standard cost of sales (4,850 × RWF14)		27,700

OPERATING STATEMENT FOR JANUARY

	RWF	RWF	RWF
Budgeted profit			30,600
Sales variances: price		1,400 (A)	
volume		1,500 (A)	
			2,900 (A)
Actual sales minus the standard cost of sales			27,700

Cost variances

	(F)	(A)	
	RWF	RWF	RWF
Material price		600	
Material usage	500		
Labour rate	200		
Labour efficiency	3,400		
Labour idle time		1,000	
Variable overhead expenditure		200	
Variable overhead efficiency	510		
Fixed overhead expenditure		4,560	
Fixed overhead volume		1,850	
	4,610	8,210	3,600 (A)
Actual profit for January			24,100

Check

	RWF	RWF
Sales		95,600
Materials	9,800	
Labour	16,800	
Variable overhead	2,600	
Fixed overhead	42,300	
		71,500
Actual profit		24,100

Operating statements in a marginal cost environment

Knowledge brought forward from earlier studies

- There are two main differences between the variances calculated in an absorption costing system and the **variances calculated in a marginal costing system**. In a marginal costing system the only fixed overhead variance is an expenditure variance and the sales volume variance is valued at standard contribution margin, not standard profit margin.

Example

Returning to the question above, now assume that the company operates a marginal costing system.

Required

Recalculate any variances necessary and produce an operating statement.

Solution

a) There is no fixed overhead volume variance.

b) The standard contribution per unit is RWF(20 – 6.60) = RWF13.40, therefore the sales volume variance of 250 units (A) is valued at (× RWF13.40) = RWF3,350 (A).

The other variances are unchanged, therefore an operating statement might appear as follows.

OPERATING STATEMENT FOR JANUARY

	RWF	RWF	RWF
Budgeted profit		30,600	
Budgeted fixed production costs		37,740	
Budgeted contribution		68,340	
Sales variances: volume		3,350 (A)	
price		1,400 (A)	
			4,750 (A)
Actual sales (RWF95,600) minus the standard variable cost of sales (4,850 × RWF6.60)			63,590
	(F)	*(A)*	
Variable cost variances	RWF	RWF	RWF
Material price		600	
Material usage	500		
Labour rate	200		
Labour efficiency	3,400		
Labour idle time		1,000	
Variable overhead expenditure		200	
Variable overhead efficiency	510		
	4,610	1,800	
			2,810 (F)
Actual contribution			66,400
Budgeted fixed production overhead		37,740	
Expenditure variance		4,560 (A)	
Actual fixed production overhead			42,300
Actual profit			24,100

Note. The profit here is the same as the profit calculated by standard absorption costing because there were no changes in stock levels. Absorption costing and marginal costing do not always produce an identical profit figure.

ABC AND VARIANCE ANALYSIS

Within an **ABC system, efficiency variances for longer-term variable overheads** are the difference between the level of activity that should have been needed and the actual activity level, valued at the standard rate per activity.

All overheads within an **ABC system** are **treated as variable costs**, varying either with production levels in the short term or with some other activity. The traditional method of calculating fixed overhead variances is therefore not taken. The calculation of ABC overhead variances is either **the same as the traditional approach for variable overheads** (if the overhead varies with production level) **or extremely similar** (if it varies with some other activity).

Approach for longer-term variable overheads

Expenditure variances are the difference between what expenditure should have been for the actual level of activity and actual expenditure.

Efficiency variances are the difference between the level of activity that should have been needed and the actual activity level, valued at the standard rate per activity.

Example: Simple ABC overhead variance analysis

The following information relates to B's ordering activity during control period 2.

Budget

Output	10,000 units
Activity level	2,000 orders
Total cost of activity	RWF90,000,000

Actual

Output	10,500 units
Activity level	1,800 orders
Total cost of activity	RWF84,000,000

Required

Calculate the overhead expenditure and efficiency variances relating to the ordering activity.

Solution

Expenditure variance

This is the difference between how much 1,800 orders should have cost and how much they did cost.

Each order should cost RWF90,000,000/2,000 = RWF45,000. This is the **cost driver rate**.

	RWF '000
1,800 orders should have cost (× RWF45,000)	81,000
but did cost	84,000
Expenditure variance	3,000 (A)

Efficiency variance

This is the difference between what the level of activity should have been for the output of 10,500 units, and what it was, valued at the standard rate per order (the cost driver rate).

Each unit of output should use 2,000/10,000 = 0.2 of an order

Activity level for 10,500 units should have been (× 0.2)	2,100 orders
but was	1,800 orders
Variance in orders	300 orders (F)

× standard rate per order	× RWF45,000
Efficiency variance	RWF13,500,000 (F)

Usefulness of this analysis

Given the lack of relevant management information provided by traditionally-analysed fixed overhead variances, the **results using ABC** analysis are of **more use**. It is clear in the example above that one reason why the cost of the ordering activity was greater than it should have been given the level of production was because the **cost per order was above budget**. The **main difference** was because it **took more orders than planned** given the actual level of production, however. The analysis has highlighted the efficiency of the ordering process for investigation.

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INVESTIGATING VARIANCES

Materiality, **controllability**, the **type** of standard being used, variance **trend**, **interdependence** and **costs** should be taken into account when deciding on the significance of a variance.

The decision whether or not to investigate

Before management decide whether or not to investigate the reasons for the occurrence of a particular variance, there are a number of factors which should be considered in assessing the significance of the variance.

Materiality

Because a standard cost is really only an *average* expected cost, small variations between actual and standard are bound to occur and are unlikely to be significant. Obtaining an 'explanation' of the reasons why they occurred is likely to be time consuming and irritating for the manager concerned. The explanation will often be 'chance', which is not, in any case, particularly helpful. For such variations **further investigation is not worthwhile** since such variances are not controllable.

Controllability

This must also influence the decision about whether to investigate. If there is a general worldwide increase in the price of a raw material there is nothing that can be done internally to control the effect of this. If a central decision is made to award all employees a 10% increase in salary, staff costs in division A will increase by this amount and the variance is not controllable by division A's manager. **Uncontrollable variances call for a change in the plan, not an investigation into the past.**

The type of standard being used

The efficiency variance reported in any control period, whether for materials or labour, will depend on the **efficiency level set**. If, for example, an ideal standard is used, variances will always be adverse. A similar problem arises if average price levels are used as standards. If

inflation exists, favourable price variances are likely to be reported at the beginning of a period, to be offset by adverse price variances later in the period.

Variance trend

Although small variations in a single period are unlikely to be significant, small variations that occur consistently may need more attention. Variance trend is probably more important that a single set of variances for one accounting period. The trend **provides an indication of whether the variance is fluctuating within acceptable control limits or becoming out of control.**

a) If, say, an efficiency variance is RWF1,000,000 adverse in month 1, the obvious conclusion is that the process is out of control and that corrective action must be taken. This may be correct, but what if the same variance is RWF1,000,000 adverse every month? The *trend* indicates that the process is not out of control and may be the standard has been wrongly set.

b) Suppose, though, that the same variance is consistently RWF1,000,000 adverse for each of the first six months of the year but that production has steadily fallen from 100 units in month 1 to 65 units by month 6. The variance trend in absolute terms is constant, but relative to the number of units produced, efficiency has got steadily worse.

Individual variances should therefore not be looked at in isolation; variances should be scrutinised for a number of successive periods if their full significance is to be appreciated.

Interdependence between variances

Individual variances should not be looked at in isolation. One variance might be inter-related with another, and much of it might have occurred only because the other variance occurred too. **When two variances are interdependent (interrelated) one will usually be adverse and the other one favourable.**

Here are some examples.

Interrelated variances	Explanation
Materials price and usage	If **cheaper materials** are purchased for a job in order to obtain a favourable price variance, materials wastage might be **higher** and an **adverse usage variance** may occur. If the cheaper materials are more difficult to handle, there might be an **adverse labour efficiency variance** too. If more expensive materials are purchased, the **price variance** will be **adverse** but the **usage variance** might be **favourable** if the material is easier to use or of a higher quality.
Labour rate and efficiency	If employees are paid higher rates for experience and skill, using a highly skilled team might lead to an **adverse rate variance** and a **favourable efficiency variance** (experienced staff are less likely to waste material, for example). In contrast, a favourable rate variance might indicate a larger-than-expected proportion of inexperienced workers, which could result in an **adverse labour efficiency variance**, and perhaps **poor materials handling and high rates of rejects** too (and hence an adverse materials usage variance).
Selling price and sales volume	A reduction in the selling price might stimulate bigger sales demand, so that an **adverse selling price variance** might be counterbalanced by a **favourable sales volume variance**. Similarly, a price rise would give a **favourable price variance**, but possibly cause an **adverse sales volume variance**.

Costs of investigation

The costs of an investigation should be weighed against the benefits of correcting the cause of a variance.

Exam Focus Point

When asked to provide a commentary on variances you have calculated, make sure that you *interpret* your calculations rather than simply detail them.

Variance investigation models

The **rule-of-thumb** and **statistical significance** variance investigation models and/or statistical **control charts** can be used to determine whether a variance should be investigated.

Rule-of-thumb model

This involves **deciding a limit** and if the size of a **variance is within the limit**, it should be considered **immaterial**. Only if it exceeds the limit is it considered materially significant, and worthy of investigation.

In practice many managers believe that this approach to deciding which variances to investigate is perfectly adequate. However, it has a number of **drawbacks**.

a) Should variances be investigated if they exceed 10% of standard? Or 5%? Or 15%?

b) Should a **different fixed percentage be applied to favourable and unfavourable variances**?

c) Suppose that the fixed percentage is, say, 10% and an important category of expenditure has in the past been very closely controlled so that adverse variances have never exceeded, say, 2% of standard. Now if adverse variances suddenly shoot up to, say, **8% or 9%** of standard, there might well be **serious excess expenditures incurred that ought to be controlled**, but with the fixed percentage limit at 10%, the variances would not be 'flagged' for investigation.

d) **Unimportant categories** of low-cost expenditures might be loosely controlled, with variances commonly exceeding 10% in both a favourable and adverse direction. These would be regularly – and **unnecessarily – flagged for investigation**.

e) Where actual expenditures have **normal and expected wide fluctuations** from period to period, but the 'standard' is a fixed expenditure amount, variances will be **flagged for investigation unnecessarily often**.

f) There is **no attempt to consider the costs and potential benefits of investigating variances** (except insofar as the pre-set percentage is of 'material significance').

g) The **past history of variances in previous periods is ignored**. For example, if the pre-set percentage limit is set at 10% and an item of expenditure has regularly exceeded the standard by, say, 6% per month for a number of months in a row, in all probability there is a situation that ought to warrant control action. Using the pre-set percentage rule, however, the variance would never be flagged for investigation in spite of the cumulative adverse variances.

Some of the difficulties can be overcome by **varying the pre-set percentage from account to account** (for example 5% for direct labour efficiency, 2% for rent and rates, 10% for salesmen's expenditure, 15% for postage costs, 5% for direct materials price, 3% for direct materials usage and so on). On the other hand, some difficulties, if they are significant, can only be overcome with a different cost-variance investigation model.

Statistical significance model

Historical data are used to **calculate** both a standard as **an expected average** and the **expected standard deviation** around this average when the process is under control. An **in-control process** (process being material usage, fixed overhead expenditure and so on) is one in which any resulting **variance is simply due to random fluctuations** around the expected outcome. An **out-of-control process**, on the other hand, is one in which **corrective action can be taken to remedy any variance**.

By assuming that variances that occur are normally distributed around this average, a **variance will be investigated if it is *more* than a distance from the expected average than the estimated normal distribution suggests is likely if the process is in control**. (Note that such a variance would be deemed significant.)

The statistical significance rule has two principal **advantages** over the rule of thumb approach.

a) **Important costs** that normally vary by only a small amount from standard will be **signalled for investigation if variances increase significantly**.

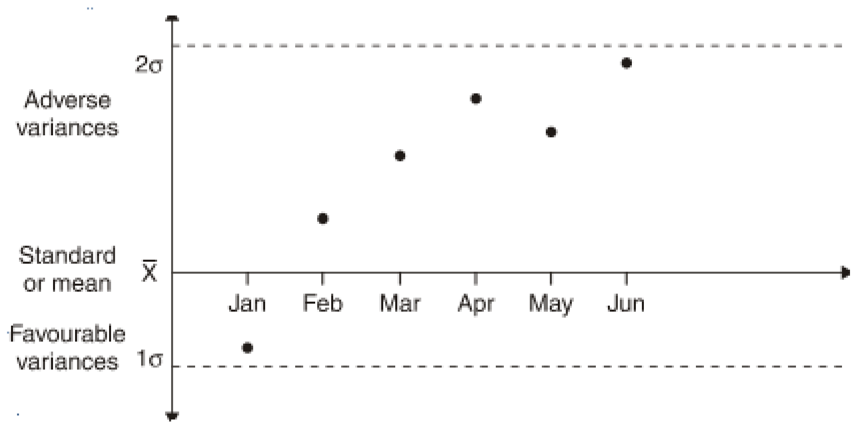
b) Costs that **usually fluctuate by large amounts will not be signalled** for investigation unless variances are extremely large.

The main **disadvantage** of the statistical significance rule is the problem of assessing standard deviations in expenditure.

Statistical control charts

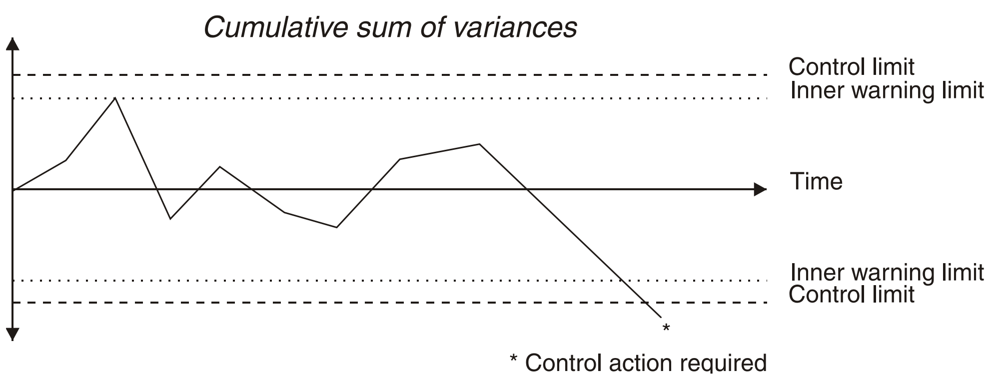
By marking variances and control limits on a control chart, **investigation** is signalled not only when a particular **variance exceeds the control limit** (since it would be non-random and worth investigating) but also when the **trend of variances shows a progressively worsening movement** in actual results (even though the variance in any single control period has not yet overstepped the control limit).

The $\bar{x}$ **control chart** is based on the principle of the statistical significance model. For each cost item, a chart is kept of monthly variances and **tolerance limits are set at 1, 2 or 3 standard deviations**.



In this example, variances do not exceed the tolerance limits in any month, but the chart shows a worsening of variances over time, and so management might decide that an investigation is warranted, perhaps when it exceeds an inner warning limit.

Using a **cusum chart, the cumulative sum of variances** over a long period of time **is plotted**. If the variances are not significant, these 'sums' will simply fluctuate in a random way above and below the average to give a total or cumulative sum of zero. But if significant variances occur, the cumulative sum will start to develop a positive or negative drift, and when it exceeds a set tolerance limit, the situation must be investigated.



The **advantage** of the multiple period approach over the single period approach is that **trends are detectable earlier**, and control action would be introduced sooner than might have been the case if only current-period variances were investigated.

Possible control action

Measurement errors and **out of date standards**, as well as **efficient/inefficient operations** and **random fluctuations**, can cause differences between standard and actual performance.

There are few basic reasons why variances occur and the **control action which may be taken will depend on the reason why the variance occurred**.

Measurement errors

In exam questions there is generally no question of the information that you are given being wrong. In practice on the factory floor, however, it may be extremely difficult to establish that 1,000 units of product A used 32,000 kg of raw material X. Scales may be misread, the pilfering or wastage of materials may go unrecorded, items may be wrongly classified (as material X3, say, when in reality material X8 was used), or employees may make 'cosmetic' adjustments to their records to make their own performance look better than it really was. An investigation may show that **control action is required to improve the accuracy of the recording system** so that measurement errors do not occur.

Out of date standards

Price standards are likely to become out of date quickly when frequent changes to the costs of material, power, labour and so on occur, or in **periods of high inflation**. In such circumstances an **investigation of variances is likely to highlight a general change in market prices** rather than efficiencies or inefficiencies in acquiring resources. Standards may also be out of date where operations are subject to **technological development** or if **learning**

curve effects have not been taken into account. Investigation of this type of variance will provide information about the inaccuracy of the standard and **highlight the need to frequently review and update standards.**

Efficient or inefficient operations

Spoilage and better quality material/more highly skilled labour than standard are all likely to affect the efficiency of operations and hence cause variances. **Investigation** of variances in this category should **highlight the cause of the inefficiency or efficiency and will lead to control action to eliminate the inefficiency being repeated** or action to **compound the benefits of the efficiency**. For example, stricter supervision may be required to reduce wastage levels and the need for overtime working. The purchasing department could be encouraged to continue using suppliers of good quality materials.

Random or chance fluctuations

A standard is an average figure and so **actual results are likely to deviate unpredictably within the predictable range.** As long as the variance falls within this range, it will be classified as a random or chance fluctuation and **control action will not be necessary**.

MATERIALS MIX AND YIELD VARIANCES

The **materials usage variance** can be subdivided into a materials **mix** variance and a materials **yield** variance when more than one material is used in the product.

Manufacturing processes often require that a number of different materials are combined to make a unit of finished product. When a product requires two or more raw materials in its make-up, it is often possible to **sub-analyse the materials usage variance into a materials mix and a materials yield variance**.

Adding a greater proportion of one material (therefore a smaller proportion of a different material) might make the materials mix **cheaper or more expensive**. For example the standard mix of materials for a product might consist of the following.

	RWF
(2/3) 2 kg of material A at RWF1.00 per kg	2.00
(1/3) 1 kg of material B at RWF0.50 per kg	0.50
	2.50

It may be possible to change the mix so that one kilogram of material A is used and two kilograms of material B. The new mix would be cheaper.

	RWF
(1/3) 1 kg of material A	1
(2/3) 2 kg of material B	1
	2

By changing the proportions in the mix, the **efficiency** of the combined material usage may change. In our example, in making the proportions of A and B cheaper, at 1:2, the product may now require more than three kilograms of input for its manufacture, and the new materials requirement per unit of product might be 3.6 kilograms.

	RWF
(^{1}/3) 1.2 kg of material A at RWF1.00 per kg	1.20
(^{2}/3) 2.4 kg of material B at RWF0.50 per kg	1.20
	2.40

In establishing a materials usage standard, management may therefore have to balance the **cost** of a particular mix of materials with the **efficiency** of the yield of the mix.

Once the standard has been established it may be possible for management to exercise control over the materials used in production by calculating and reviewing mix and yield variances.

A **mix variance** occurs when the materials are not mixed or blended in standard proportions and it is a measure of whether the actual mix is cheaper or more expensive than the standard mix.

A **yield variance** arises because there is a difference between what the input should have been for the output achieved and the actual input.

Calculating the variances

The **mix variance** is calculated as the **difference between** the **actual total quantity used** in **the standard mix** and the **actual quantities used in the actual mix**, **valued at standard costs**.

The **yield variance** is calculated as the **difference between the standard input for what was actually output, and the actual total quantity input (in the standard mix), valued at standard costs.**

When to calculate the mix and yield variance

A mix variance and yield variance are only appropriate in the following situations.

a) **Where proportions of materials in a mix are changeable and controllable**

b) Where the **usage variance of individual materials is of limited value because of the variability of the mix**, and a combined yield variance for all the materials together is more helpful for control

It would be totally inappropriate to calculate a mix variance where the materials in the 'mix' are discrete items. A chair, for example, might consist of wood, covering material, stuffing and glue. These materials are separate components, and it would not be possible to think in terms of controlling the proportions of each material in the final product. The usage of each material must be controlled separately.

Example: Materials usage, mix and yield variances

A company manufactures a chemical, Dynamite, using two compounds Flash and Bang. The standard materials usage and cost of one unit of Dynamite are as follows.

		RWF
Flash	5 kg at RWF2 per kg	10
Bang	10 kg at RWF3 per kg	30
		40

In a particular period, 80 units of Dynamite were produced from 500 kg of Flash and 730 kg of Bang.

Required

Calculate the materials usage, mix and yield variances.

Solution

a) **Usage variance**

	Std usage for actual output	*Actual usage*	*Variance*	*Standard cost per kg*	*Variance*
	kgs	kgs	kgs	RWF	RWF
Flash	400	500	100 (A)	2	200 (A)
Bang	800	730	70 (F)	3	210 (F)
	1,200	1,230	30 (A)		10 (F)

The total usage variance of RWF10 (F) can be analysed into a mix variance and a yield variance.

b) **Mix variance**

To calculate the mix variance, it is first necessary to decide how the total quantity of materials used (500 kg + 730 kg) should have been divided between Flash and Bang. In other words, we need to **calculate the standard mix of the actual quantity of materials used.**

	kg
Total quantity used (500 + 730)	1,230

		kg
Standard mix of actual use:	1/3 Flash	410
	2/3 Bang	820
		1,230

The differences between what should have been used in the mix (as calculated above) and what was actually used is the mix variance (in kg) which should be converted into money values at standard cost.

	Actual quantity standard mix	*Actual quantity actual mix*	*Variance*	*Standard cost per kg*	*Variance*
	kgs	kgs	kgs	RWF	RWF
Flash	410	500*	90 (A)	2	180 (A)
Bang	820	730	90 (F)	3	270 (F)
	1,230	1,230	–		90 (F)

* When actual use exceeds standard use the variance is always adverse.

Note that the **total mix variance in quantity is zero**. This must always be the case since the expected mix is based on the total quantity actually used and hence the difference between the total expected and total actual is zero.

The favourable money variance is due to the greater use in the mix of the relatively cheap material, Flash.

c) **Yield variance**

The yield variance can be calculated in total or for each individual material input.

In total

Each unit of output (Dynamite) requires	5 kg	of Flash, costing	RWF10
	10 kg	of Bang, costing	RWF30
	15 kg		RWF40

1,230 kg should have yielded (÷ 15 kg)	82 units of Dynamite
but did yield	80 units of Dynamite
Yield variance in units	2 units (A)
× standard cost per unit of output	× RWF40
Yield variance in RWF	RWF80 (A)

The adverse yield variance is due to the output from the input being less than standard.

For individual materials

This is calculated as the **difference between what the usage should have been for the output actually achieved and the actual usage in the standard mix**, converted into money values at standard cost.

	Standard quantity standard mix	*Actual quantity standard mix*	*Variance*	*Standard cost per kg*	*Variance*
	kgs	kgs	kgs	RWF	RWF
Flash	400	410	10 (A)	2	20 (A)
Bang	800	820	20 (A)	3	60 (A)
	1,200	1,230	30 (A)		80 (A)

Exam Focus Point

With all variance calculations, it is vital that you do not simply learn formulae. You must have a thorough understanding of what your calculations are showing. This is especially true of the variances we will look at in this section and in the next chapter.

Example: Losses, mix and yield

C and S Ltd makes product T42 in a continuous process, for which standard and actual quantities in month 10 were as follows.

		Standard			*Actual*	
	Quantity	*Price per kg*	*Value*	*Quantity*	*Price per kg*	*Std cost of actual usage*
	kg	RWF	RWF	kg	RWF	RWF
Material P	40,000	2.50	100,000	34,000	2.50	85,000
Material Q	20,000	4.00	80,000	22,000	4.00	88,000
	60,000		180,000	56,000		173,000

Losses occur at an even rate during the processing operation and are expected to be 10% of materials input. Actual output during the month was 53,000 kgs.

Required

Calculate total usage, mix and yield variances.

Solution

Usage variance

Output of 53,000 kgs should have used input of 53,000/90% = 58,889 kgs.

$\therefore$ Standard input should have been as follows.

			Kg
P	$^2/3 \times 58,889$	=	39,259
Q	$^1/3 \times 58,889$	=	19,630
			58,889

	P	*Q*
53,000 kg of T42 should need	39,259 kg	19,630 kg
but did need	34,000 kg	22,000 kg
Usage variance in kg	5,259 kg (F)	2,370 kg (A)
× standard price per kg	× RWF2.50	× RWF4
Usage variance in RWF	RWF13,148 (F)	RWF9,480 (A)
Total usage variance	RWF3,668 (F)	

Yield variance

Each kg of T42 requires (1 × 100/90) kg of input costing RWF3.33 (RWF180,000/(60 ,000 × 90%))

56,000 kg should have yielded (÷ 100/90)	50,400 kg
but did yield	53,000 kg
Yield variance in kgs	2,600 kg (F)
× standard cost per kg of T42	× RWF3.33
Yield variance in RWF	RWF8,667 (F)

Mix variance

Total quantity used	56,000.00 kg
Standard mix for actual use: 2/3 P	37,333.33 kg
1/3 Q	18,666.67 kg
	56,000.00 kg

	P	Q
Mix should have been	37,333.33 kg	18,666.67 kg
but was	34,000.00 kg	22,000.00 kg
Mix variance in kg	3,333.33 kg (F)	3,333.33 kg (A)
× standard cost per kg	× RWF2.50	× RWF4.00
Mix variance in RWF	RWF8,333.00 (F)	RWF13,333.00 (A)

Total mix variance	RWF5,000 (A)

(Note that there is a difference between the sum of the mix and yield variances and the usage variance due to rounding.)

The issues involved in changing the mix

The materials mix variance indicates the **cost** of a change in the mix of materials and the yield variance indicates the **productivity** of the manufacturing process. A change in the mix can have wider implications. For example, rising raw material prices may cause pressure to change the mix of materials. Even if the yield is not affected by the change in the mix, the **quality** of the final product may change. This can have an adverse effect on sales if customers do not accept the change in quality. The production manager’s performance may be measured by mix and yield variances but these **performance measures** may fail to indicate problems with falling quality and the impact on other areas of the business. **Quality targets** may also be needed.

Alternative methods of controlling production processes

In a modern manufacturing environment with an emphasis on quality management, using mix and yield variances for control purposes may not be possible or may be inadequate. Other control methods could be more useful.

- Rates of wastage
- Average cost of input calculations
- Percentage of deliveries on time
- Customer satisfaction ratings
- Yield percentage calculations or output to input conversion rates

We will be considering performance measures in more detail in Study Unit 18.

CHAPTER ROUNDUP

- Care must be taken when interpreting labour variances where the **learning curve** has been used in the budget process.
- Within an **ABC system, efficiency variances for longer-term variable overheads** are the difference between the level of activity that should have been needed and the actual activity level, valued at the standard rate per activity.
- **Materiality**, **controllability**, the **type** of standard being used, variance **trend**, **interdependence** and **costs** should be taken into account when deciding on the significance of a variance.
- The **rule-of-thumb** and **statistical significance** variance investigation models and/or statistical **control charts** can be used to determine whether a variance should be investigated.
- **Measurement errors** and **out of date standards**, as well as **efficient/inefficient operations** and **random fluctuations**, can cause differences between standard and actual performance.
- The **materials usage variance** can be subdivided into a materials **mix** variance and a materials **yield** variance when more than one material is used in the product.

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STUDY UNIT 17

Behavioural Aspects Of Standard Costing

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EXAM GUIDE

Planning and operational variances are highly examinable and behavioural aspects of standard costing may form the discussion part of a question.

PLANNING AND OPERATIONAL VARIANCES

A planning and operational approach to variance analysis divides the total variance into those variances which have arisen because of inaccurate planning or faulty standards (**planning variances**) and those variances which have been caused by adverse or favourable operational performance, compared with a standard which has been revised in hindsight (**operational variances**).

So far in this text we have been looking at variances which are calculated using what we will call the conventional approach to variance analysis, whereby an actual cost is compared with an original standard cost. In this section of the chapter we will be examining planning and operational variances. They are not really alternatives to the conventional approach, they merely provide a much more detailed analysis.

Basically, the planning and operational approach attempts to divide a total variance (which has been calculated conventionally) into a group of variances which have arisen because of **inaccurate planning** or **faulty standards** (planning variances) and a group of variances which have been caused by adverse or favourable **operational performance** (operational variances, surprisingly enough!).

Planning and operational variances may seem confusing if you do not have a really good grasp of the conventional approach and so, before you go any further, make sure that you understand everything that we covered so far in this Text. Go back over any areas you are unsure about.

Only when you are happy that you have mastered the basics should you begin on this section.

A **planning variance** (or **revision variance**) compares an original standard with a revised standard that should or would have been used if planners had known in advance what was going to happen.

An **operational variance** (or **operating variance**) compares an actual result with the revised standard.

Planning and operational variances are based on the principle that variances ought to be reported by taking as the **main starting point**, not the original standard, but a **standard** which can be seen, in hindsight, to be the **optimum** that should have been **achievable**.

Exponents of this approach argue that the monetary value of variances ought to be a realistic reflection of what the **causes** of the variances have cost the organisation. In other words they should show the cash (and profit) gained or lost as a consequence of operating results being different to what should have been achieved. Variances can be valued in this way by **comparing actual results with a realistic standard or budget**. Such variances are called **operational variances**.

Planning variances arise because the **original standard and revised more realistic standards are different** and have nothing to do with operational performance. In most cases, it is unlikely that anything could be done about planning variances: they are **not controllable by operational managers but by senior management**.

In other words the **cause of a total variance** might be one or both of:

- Adverse or favourable operational performance (**operational variance**)
- Inaccurate planning, or faulty standards (**planning variance**)

Calculating total planning and operational variances

We will begin by looking at how to split a total cost variance into its planning and operational components.

Example: Total cost planning and operational variances

At the beginning of 20X0, WB set a standard marginal cost for its major product of RWF25 per unit. The standard cost is recalculated once each year. Actual production costs during August 20X0 were RWF304,000, when 8,000 units were made.

With the benefit of hindsight, the management of WB realises that a more realistic standard cost for current conditions would be RWF40 per unit. The planned standard cost of RWF25 is unrealistically low.

Required

Calculate the planning and operational variances.

Solution

With the benefit of hindsight, the **realistic standard should have been RWF40**. The variance caused by favourable or adverse **operating** performance should be calculated by comparing actual results against this realistic standard.

	RWF
Revised standard cost of actual production (8,000 × RWF40)	320,000
Actual cost	304,000
Total **operational** variance	16,000 (F)

The variance is favourable because the actual cost was lower than would have been expected using the revised basis.

The **planning** variance reveals the extent to which the original standard was at fault.

Revised standard cost	8,000 units × RWF40 per unit	320,000
Original standard cost	8,000 units ×RWF25 per unit	200,000
Planning variance		120,000 (A)

It is an adverse variance because the original standard was too optimistic, overestimating the expected profits by understating the standard cost. More simply, it is adverse because the revised cost is much higher than the original cost.

	RWF
Planning variance	120,000 (A)
Operational variance	16,000 (F)
Total	104,000 (A)

If **traditional variance analysis** had been used, the total cost variance would have been the same, but all the **'blame'** would appear to lie on actual results and operating inefficiencies (rather than some being due to faulty planning).

	RWF
Standard cost of 8,000 units (× RWF25)	200,000
Actual cost of 8,000 units	304,000
Total cost variance	104,000 (A)

Example

Suppose a budget is prepared which includes a raw materials cost per unit of product of RWF2,000 (2 kg of copper at RWF1,000 per kg). Due to a rise in world prices for copper during the year, the average market price of copper rises to RWF1,500 per kg. During the year, 1,000 units were produced at a cost of RWF3,250,000 for 2,200 kg of copper.

What are the planning and operational variances?

Solution

Operational variance

	RWF ‘000
Actual cost (for 1,000 units)	3,250
Revised standard cost (for 1,000 units) (2,000 kg × Rwf1.50k)	3,000
Total operational variance	250 (A)

Planning variance

	RWF '000
Revised standard cost (1,000 × 2 kg × Rwf1,500)	3,000
Original standard cost (1,000 × 2 kg × Rwf1,000)	2,000
Total planning variance	1,000 (A)

Operational price and usage variances

So far we have only considered planning and operational variances in total, without carrying out the usual two-way split. In the question above, for instance, we identified a total operational variance for materials of RWF250,000 without considering whether this operational variance could be split between a usage variance and a price variance.

This is not a problem so long as you retain your grasp of knowledge you already possess. You know that a **price** variance measures the difference between the actual amount of money paid and the amount of money that should have been paid for that quantity of materials (or whatever).

Thus, in our example:

	RWF '000
Actual price of actual materials (2,200 kg)	3,250
Revised standard price of actual materials (RWF1,500 × 2,200 kg)	3,300
Operational price variance	50 (F)

The variance is favourable because the materials were purchased more cheaply than would have been expected.

Similarly, a **usage** variance measures the difference between the actual physical quantity of materials used or hours taken and the quantities that should have been used or taken for the actual volume of production. Those physical differences are then converted into money values by applying the appropriate standard cost.

In our example we are calculating **operational variances**, so we are not interested in planning errors. This means that the **appropriate standard cost is the revised standard cost** of RWF1.50k.

Actual quantity should have been	2,000 kgs
but was	2,200 kgs
Operational usage variance in kgs	200 kgs (A)
× revised standard cost per kg in RWF '000	× 1,500
Operational usage variance in RWF '000	300,000 (A)

The two variances of course reconcile to the total variance as previously calculated.

	RWF
Operational price variance	50,000 (F)
Operational usage variance	(300,000) (A)
Total operational variance	250,000 (A)

Operational variances for labour and overheads

Precisely the same argument applies to the calculation of operational variances for labour and overheads, and the examples already given should be sufficient to enable you to do the next question.

Question

A new product requires three hours of team labour per unit at a standard rate of RWF6,000 per hour. In a particular month the budget is to produce 500 units. Actual results were as follows.

Team Hours worked	1,700
Production	540 units
Wages cost	RWF10,500,000

Within minutes of production starting it was realised that the job was extremely messy and the labour force could therefore claim an extra RWF 250 per hour in 'dirty money'.

Required

Calculate planning and operational variances in as much detail as possible.

Answer

Keep calm and calculate the *total* variance in the normal way to begin with. Then you will understand what it is that you have to analyse. Next follow through the workings shown above, substituting the figures in the exercise for those in the example.

Total labour variance

	RWF '000
540 units should have cost (× 3 hrs × Rwf6,000)	9,720
but did cost	10,500
	780 (A)

Planning variance

	RWF '000
Revised standard cost (540 × 3 hrs × RWF6,250)	10,125
Original standard cost (540 × 3 hrs × RWF6,000)	9,720
	405 (A)

Operational rate variance

	RWF '000
Actual cost of actual units	10,500
Revised cost of actual units (1,700 × RWF6,250)	10,625
	125 (F)

Operational efficiency variance

540 units should have taken (× 3 hrs)	1,620 hrs
but did take	1,700 hrs
Operational efficiency variance in hours	80 hrs
× revised standard rate per hour RWF '000	× 6.250
Operational efficiency variance in RWF '000	500 (A)

Planning and operational sales variances

Our final calculations in this section deal with planning and operational sales variances.

Example: Planning and operational sales variances

Dimsek budgeted to make and sell 400 units of its product, the role, in the four-week period no 8, as follows.

	RWF '000
Budgeted sales (100 units per week)	40,000
Variable costs (400 units × RWF60,000)	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 week 3. As a consequence, the company lost one week's production and sales. Actual results in period 8 were as follows.

	RWF'000
Sales (320 units)	32,000
Variable costs (320 units × RWF60,000)	19,200
Contribution	12,800
Fixed costs	10,000

Actual profit	2,800

In retrospect, it is decided that the optimum budget, given the loss of production facilities in the third week, would have been to sell only 300 units in the period.

Required

Calculate appropriate planning and operational variances.

Solution

The **planning** variance **compares the revised budget** with the **original budget**.

Revised sales volume, given materials shortage	300 units
Original budgeted sales volume	400 units
Planning variance in units of sales	100 units(A)
× standard contribution RWF ‘000 per unit	× 40
Planning variance in RWF ‘000	4,000 (A)

Arguably, **running out of raw materials is an operational error** and so the loss of sales volume and contribution from the materials shortage is an opportunity cost that could have been avoided with better purchasing arrangements. The operational variances are variances calculated in the usual way, except that actual results are compared with the revised standard or budget. There is a sales volume variance which is an **operational variance**, as follows.

Actual sales volume	320 units
Revised sales volume	300 units
Operational sales volume variance in units	20 units (F)
(possibly due to production efficiency or marketing efficiency)	
× standard contribution per unit in RWF ‘000	40
RWF ‘000	800 (F)

These variances can be used as **control information** to reconcile budgeted and actual profit.

	RWF ‘000	RWF ‘000
Operating statement, period 8		
Budgeted profit		6,000
Planning variance	4,000 (A)	
Operational variance – sales volume	800 (F)	
		3,200 (A)
Actual profit in period 8		2,800

You will have noticed that in this example sales volume variances were **valued at contribution forgone**, and there were no fixed cost volume variances. This is because contribution forgone, 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).

Example

KSO budgeted to sell 10,000 units of a new product during 20X0. The budgeted sales price was RWF10,000 per unit, and the variable cost RWF3,000 per unit.

Although actual sales in 20X0 were 10,000 units and variable costs of sales were RWF30,000,000, sales revenue was only Rwf5,000 per unit. With the benefit of hindsight, it is realised that the budgeted sales price of RWF10,000 was hopelessly optimistic, and a price of RWF4,500 per unit would have been much more realistic.

Required

Calculate planning and operational variances.

Solution

The only variances are selling price variances.

Planning (selling price) variance

	Total
	RWF '000
Revised budget (10,000 × Rwf4,500)	45,000
Original budget (10,000 × Rwf10,000)	100,000
Planning variance	55,000 (A)

The original variance was too optimistic and so the planning variance is an adverse variance.

Operational (selling price) variance

	RWF'000
Actual sales (10,000 × Rwf5,000)	50,000
Revised sales (10,000 × Rwf4,500)	45,000

Operational (selling price) variance	5,000 (F)

The total difference between budgeted and actual profit of RWF50,000,000 (A) is therefore analysed as follows.

	RWF '000
Operational variance (selling price)	5,000 (F)
Planning variance	55,000 (A)
	50,000 (A)

Question

PG budgeted sales for 20X8 were 5,000 units. The standard contribution is RWF9,600 per unit. A recession in 20X8 meant that the market for PG's products declined by 5%. PG's market share also fell by 3%. Actual sales were 4,500 units.

Required

Calculate planning and operational variances for sales volume.

Answer

Planning variance

	Units
Original budgeted sales	5,000
Revised budget sales (–5%)	4,750
	250 A
@ Contribution per unit of RWF9,600	RWF2,400,000

Operational variance

	Units
Revised budget sales	4,750
Actual sales	4,500
	250 A
@ Contribution per unit of RWF9,.600	RWF2,400,000

The fall in **market size** is uncontrollable by the management of PG and therefore results in a **planning** variance. The fall in **market share** is controllable and forms part of the **operational** variance.

Exam Focus Point

The examiner is very keen that candidates should understand the practical problems involved with these variances and do not just concentrate on the mechanics of the calculations.

Calculating a revised budget

The syllabus requires you to be able to calculate a revised budget, which could involve revising standards for sales, materials and/or labour so that only operational variances are highlighted when actual results are compared to the revised budget.

Example: revised budget

A company produces Widgets and Splodgets which are fairly standardised products. The following information relates to period 1.

The standard selling price of Widgets is RWF50,000 each and Splodgets RWF100,000 each. In period 1, there was a special promotion on Splodgets with a 5% discount being offered. All units produced are sold and no inventory is held.

To produce a Widget they use 5 kg of X and in period 1, their plans were based on a cost of X of RWF3,000 per kg. Due to market movements the actual price changed and if they had purchased efficiently the cost would have been RWF4,500 per kg. Production of Widgets was 2,000 units.

A Splodget uses raw material Z but again the price of this can change rapidly. It was thought that Z would cost RWF30,000 per tonne but in fact they only paid RWF25,000 per tonne and if they had purchased correctly the cost would have been less as it was freely available at only RWF23,000 per tonne. It usually takes 1.5 tonnes of Z to produce 1 Splodget and 500 Splodgets are usually produced.

Each Widget takes 3 hours to produce and each Splodget 2 hours. A labour team is paid Rwf5,000 per hour. At the start of period 1, management negotiated a job security package with the workforce in exchange for a promised 5% increase in efficiency – that is, that the workers would increase output per hour by 5%.

Fixed overheads are usually RWF12,000,000 every period and variable overheads are RWF3,000 per labour hour.

Required

Produce the original budget and a revised budget allowing for controllable factors in a suitable format.

Solution

Original budget for Period 1

	RWF '000
Sales revenue ((2,000 × RWF50,000) + (500 ×RWF100,000))	150,000
Material costs X (2,000 × 5kg × RWF3,000)	30,000
Material costs Z (500 × RWF30,000 × 1.5)	22,500
Labour costs ((2,000 × 3 × RWF5,000) + (500 × 2 × RWF5,000))	35,000
Variable overheads ((2,000 × 3 × RWF3,000) + (500 × 2 × RWF3,000))	21,000
Fixed overheads	12,000
Profit	29,500

Revised budget for Period 1

	RWF '000
Sales revenue ((2,000 × RWF50,000) + (500 × RWF95,000))	147,500
Material costs X (2,000 × 5kg × RWF4,500)	45,000
Material costs Z (500 × RWF23,000 × 1.5)	17,250
Labour costs ((2,000 × 3 × RWF5,000) + (500 × 2 × RWF5,000)) × 0.95	33,250
Variable overheads ((2,000 × 3 × RWF3,000) + (500 × 2 × RWF3,000)) × 0.95	19,950
Fixed overheads	12,000
Profit	20,050

When should budget revisions be allowed?

A budget revision should be allowed if something has happened which is **beyond the control** of the organisation or individual manager and which makes the original budget unsuitable for use in performance management.

Any adjustment should be **approved by senior management** who should look at the issues involved **objectively** and **independently**. **Operational issues** are the issues that a budget is attempting to control so they should **not** be subject to revision. However, it can be very **difficult to establish** what is due to operational problems (controllable) and what is due to planning (uncontrollable).

The value of planning and operational variances

Advantages of a system of planning and operational variances

- The analysis highlights those variances which are **controllable** and those which are **non-controllable**.
- **Managers' acceptance** of the use of variances for performance measurement, and their **motivation**, is likely to increase if they know they will not be held responsible for poor planning and faulty standard setting.
- The **planning and standard-setting processes** should improve; standards should be more accurate, relevant and appropriate.
- Operational variances will provide a **'fairer' reflection of actual performance**.

The limitations of planning and operational variances, which must be overcome if they are to be applied in practice.

- It is difficult to **decide in hindsight** what the **realistic standard** should have been.
- It may become **too easy to justify all the variances as being due to bad planning**, so no operational variances will be highlighted.
- Establishing realistic revised standards and analysing the total variance into planning and operational variances can be a **time consuming** task, even if a spreadsheet package is devised.

- Even though the intention is to provide more meaningful information, **managers may be resistant** to the very idea of variances and refuse to see the virtues of the approach. Careful presentation and explanation will be required until managers are used to the concepts.

BEHAVIOURAL ASPECTS OF STANDARD COSTING

The **role of standards and variances** in the modern business environment is open to question.

Standard costing and new technology

Standard costing has traditionally been associated with labour-intensive operations, but it can be applied to capital-intensive production too.

It is quite possible that with advanced manufacturing technology variable overheads are incurred in relation to machine time rather than labour time, and **standard costs should reflect this** where appropriate.

With **computer aided design/computer aided manufacture (CADCAM)** systems, the planning of manufacturing requirements can be computerised, so that standard costs can be constructed by computer, saving administrative time and expense while providing far **more accurate standards**.

Total quality management (TQM)

In the context of **TQM**, quality means getting it right first time and keeping ahead of the game.

Total quality management (TQM) is the process of applying a zero defects philosophy to the management of all resources and relationships within an organisation as a means of developing and sustaining a culture of continuous improvement which focuses on meeting customers' expectations.

Mark Lee Inman listed 'eight requirements of quality' in an ACCA *Students' Newsletter* article, which could be seen as the **characteristics of total quality management programmes**.

a) Organisation wide there must be acceptance that the only thing that matters is the customer.

b) There should be recognition of the all-pervasive nature of the customer-supplier relationship, including internal customers; passing sub-standard material to another division is not satisfactory

c) Instead of relying on inspection to a predefined level of quality, the cause of the defect in the first place should be prevented.

d) Each employee or group of employees must be personally responsible for defect-free production or service in their domain.

e) There should be a move away from 'acceptable' quality levels. Any level of defects must be unacceptable.

f) All departments should try obsessively to get things right first time; this applies to misdirected phone calls and typing errors as much as to production.

g) Quality certification programmes should be introduced.

h) The cost of poor quality, i.e. correcting mistakes as well as losing customers, should be emphasised; good quality generates savings.

Standard costing and TQM

Standard costing concentrates on **quantity** and ignores other factors contributing to effectiveness. In a **total quality environment**, however, quantity is not an issue; quality is. Effectiveness in such an environment therefore centres on high quality output (produced as a result of high quality input and the elimination of non-value adding activities) and the cost of failing to achieve the required level of effectiveness is measured not in variances, but in terms of **internal and external failure costs**, neither of which would be identified by a traditional standard costing analysis.

Standard costing systems might measure, say, **labour efficiency** in terms of individual tasks and level of **output.** In a total quality environment, labour is more likely to be viewed as a number of **multi-task** teams who are responsible for the completion of a part of the production process. The effectiveness of such a team is more appropriately measured in terms of **re-working** required, **returns** from customers, **defects** identified in subsequent stages of production and so on.

Traditional feedback control would seek to eliminate an adverse material price variance by requiring managers to source cheaper, possibly lower quality supplies. This may run counter to the aim of maximising quality of output.

Can standard costing and TQM co-exist?

Arguably, there is little point in running both a total quality management programme and a standard costing system simultaneously.

a) Predetermined standards are at odds with the philosophy of **continual improvement** inherent in a total quality management programme.

b) Continual improvements are likely to alter methods of working, prices, quantities of inputs and so on, whereas standard costing is most appropriate in a stable, standardised and repetitive environment.

c) Material standard costs often incorporate a planned level of scrap. This is at odds with the TQM aim of **zero defects** and there is no motivation to 'get it right first time'.

d) Attainable standards, which make some allowance for wastage and inefficiencies are commonly set. The use of such standards conflicts with the **elimination of waste** which is such a vital ingredient of a TQM programme.

e) Standard costing control systems make individual managers **responsible** for the variances relating to their part of the organisation's activities. A TQM programme, on the other hand, aims to make **all personnel** aware of, and responsible for, the importance of supplying the customer with a quality product.

Standard costing and new philosophy

It has been argued that traditional variance analysis is unhelpful and **potentially misleading** in the modern organisation, and can make managers focus their attention on the wrong issues, for example - **over-producing** and stockpiling finished goods, because higher production volumes mean that overheads are spread over more units. Here are two examples.

a) **Efficiency variance**. Adverse efficiency variances should be avoided, which means that managers should try to prevent idle time and to keep up production. In a TQM environment using just-in-time manufacturing, action to eliminate idle time could result in the manufacture of unwanted products that must be held in store and might eventually be scrapped. Efficiency variances could focus management attention on the wrong problems.

b) **Materials price variance**. In a JIT environment, the key issues with materials purchasing are supplier reliability, materials quality and delivery in small order quantities. Purchasing managers shouldn't be shopping around every month looking for the cheapest price. Many JIT systems depend on long-term contractual links with suppliers, which means that material price variances are not relevant for control purposes.

The **role of standards and variances in the modern business environment** is viewed as follows by George Brown (a previous ACCA examiner).

> 'The rate of change in product type and design due to technological improvement, customer requirements and increased competition has led to rapid change in how businesses operate. The need to respond to customer demands for speedy availability of products, shortening product life cycles and higher quality standards has contributed to a number of changes in the way businesses operate…just-in-time systems…total quality programmes…..greater emphasis on the value chain…..accurate product costing and pricing information……improved speed and flexibility of information availability…' ('Standard costing – a status check')

Standard costing, on the other hand, is most appropriate in a stable, standardised and repetitive environment and one of the main objectives of standard costing is to ensure that processes conform to standards, that they do not vary and that variances are eliminated. This may seem **restrictive and inhibiting in the business environment of the twenty first century**. (In fact, in the article referred to above, George Brown attempts to show that concerns about the restrictive and inhibiting nature of standard costing have been raised since it was first used and that efforts have continuously been made (such as planning and operating variances) to redesign standards and variances to maintain their relevance in an environment of change.)

Other problems with using standard costing in today's environment

a) Variance analysis concentrates on only a **narrow range of costs**, and does not give sufficient attention to issues such as quality and customer satisfaction.

b) Standard costing places **too much emphasis on direct labour costs**. Direct labour is only a small proportion of costs in the modern manufacturing environment and so this emphasis is not appropriate.

c) Many of the variances in a standard costing system focus on the control of **short-term variable costs**. In most modern manufacturing environments, the majority of costs, including direct labour costs, tend to be fixed in the short run.

d) The use of standard costing relies on the existence of **repetitive operations** and relatively **homogeneous** output. Nowadays many organisations are forced continually to respond to customers' changing requirements, with the result that output and operations are not so repetitive.

e) Standard costing systems were **developed** when the **business environment** was more **stable** and **less prone to change**. The current business environment is more dynamic and it is not possible to assume stable conditions.

f) Standard costing systems **assume** that **performance to standard is acceptable**. Today's business environment is more focused on continuous improvement.

g) Most standard costing systems produce **control statements weekly or monthly**. The modern manager needs much more prompt control information in order to function efficiently in a dynamic business environment.

The role in modern business of standards and variances

Two surveys ((Puxty and Lyall (1989) and Drury *et al* (1993)) have confirmed the **continued wide use of standard costing systems**. Drury *et al*, for instance, showed that 76% of the responding organisations operated a standard costing system.

- **Planning**. Even in a TQM environment, budgets will still need to be quantified. For example, the planned level of prevention and appraisal costs needs to be determined. Standards, such as returns of a particular product should not exceed 1% of deliveries during a budget period, can be set.

- **Control**. Cost and mix changes from plan will still be relevant in many processing situations.

- **Decision making**. Existing standards can be used as the starting point in the construction of a cost for a new product.

- **Performance measurement**. If the product mix is relatively stable, performance measurement may be enhanced by the use of a system of planning and operational variances.

- **Product pricing**. Target costs may be compared with current standards, and the resulting 'cost gap' investigated with a view to reducing it or eliminating it using techniques such as value engineering.

- **Improvement and change**. Variance trends can be monitored over time.

- **Accounting valuations**. Although the operation of a JIT system in conjunction with backflush accounting will reduce the need for standard costs and variance analysis, standards may be used to value residual inventory and the transfers to cost of sales account.

CHAPTER ROUNDUP

- A planning and operational approach to variance analysis divides the total variance into those variances which have arisen because of inaccurate planning or faulty standards (**planning variances**) and those variances which have been caused by adverse or favourable operational performance, compared with a standard which has been revised in hindsight (**operational variances**).

- The **role of standards and variances** in the modern business environment is open to question.

- In the context of **TQM**, quality means getting it right first time and improving continuously.

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STUDY UNIT 18

Divisional Performance And Transfer Pricing Issues

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EXAM GUIDE

The topics in this chapter provide plenty of material for an exam question. Indeed, you may find a full question testing your knowledge of transfer pricing. Expect written or calculation questions.

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DIVISIONAL STRUCTURE AND PERFORMANCE MEASURES

In this section we look at three performance measures relevant in a divisionalised structure. These are Return on Investment, Residual Income and Economic Value Added ®.

Return on Investment (ROI) and **Residual Income (RI)** were discussed previously when we considered the scope of strategic performance measures in the private sector. In this chapter we will just pick out the salient features that apply to their use in divisionalised structures.

Divisional performance: return on investment (ROI)

Return on investment (ROI) is a form of ROCE and is calculated as:

$$\frac{\text{Profit before Interest and Tax x 100}}{\text{Operations Management Capital Employed}}$$

ROI is normally applied to investment centres or profit centres. These normally reflect the existing organisation structure of the business.

Evaluation of ROI

You may like to consider the following factors when evaluating the use of ROI as a divisional performance measure.

a) **Comparisons**. It permits comparisons to be drawn between investment centres that differ in their absolute size.

b) **Aggregation**. ROI is a very convenient method of measuring the performance for a division or company as an entire unit.

c) **Using an identical target return.** This may not be suitable for many divisions or investment centres as it makes **no allowance** for the different **risk** of each investment centre.

d) **Misleading impression of improved performance**. If an investment centre maintains the **same annual profit**, and keeps the **same assets** without a policy of regular non-current asset replacement, its **ROI** will **increase year by year as the assets get older**. This can give a false impression of improving 'real' performance over time.

e) **Valuation and classification of assets**. Many of the criticisms of ROI arise from the valuation of assets used in the denominator. Refer back to Chapter 12 for a full explanation of the problems in measuring asset values. Chapter 12 also refers to the tricky decision of when to classify expenditure as assets.

f) **Short-term perspective.** Since **managers** will be judged on the basis of the ROI that their centre earns each year, they are likely to be **motivated** into taking those decisions, which **increase** their centre's **short-term ROI**. So, in the short term, a desire to increase ROI might lead to projects being taken on without **due regard to their risk**

g) **Lack of goal congruence**. An investment might be desirable from the group's point of view, but would not be in the individual investment centre's 'best interest' to undertake. Furthermore, any decisions which **benefit** the company in the **long term** but which **reduce** the ROI in the immediate **short term** would **reflect badly** on the manager's reported performance.

Divisional performance: residual income (RI)

Residual income is a measure of the centre's profits after deducting a notional or imputed interest cost.

Its use highlights the finance charge associated with funding.

Evaluation of RI

You may like to consider the following factors when evaluating the use of RI. Think about how it compares to ROI as a possible divisional performance measure.

a) **Usefulness in decision-making**. Residual income **increases in the following circumstances.**

    (i) Investments earning above the cost of capital are undertaken

    (ii) Investments earning below the cost of capital are eliminated

   Thus it leads managers to make the correct investment decision to benefit the company as a whole.

b) **Flexibility compared to ROI** since a different cost of capital can be applied to investments with different risk characteristics.

c) **Does not allow comparisons between investment centres.** RI cannot be used to make comparisons between investment centres as it is an absolute measure of performance.

d) **Difficulty in deciding on an appropriate and accurate measure of the capital employed**. As we discussed above, there can be some difficulty in knowing what values to place on assets.

e) **Does not relate the size of a centre's income to the size of the investment**, other than indirectly through the interest charge.

Divisional performance: Economic Value Added (EVA®)

EVA ® is an alternative absolute performance measure. It is similar to RI and is calculated as follows.

EVA = net operating profit after tax (NOPAT) less capital charge

where the capital charge = weighted average cost of capital × net assets

® Economic value added (EVA) is a registered trade mark owned by Stern Stewart & Co. It is a specific type of residual income (RI) calculated as follows.

   EVA = net operating profit after tax (NOPAT) less capital charge where the capital charge = weighted average cost of capital x net assets

You can see from the formula that the calculation of EVA is very similar to the calculation of RI.

EVA and RI are similar because both result in an absolute figure, which is calculated by subtracting an imputed interest charge from the profit earned by the investment centre. However there are differences as follows.

a) The profit figures are calculated differently. EVA is based on an '**economic profit**' which is derived by making a series of adjustments to the accounting profit.

b) The notional capital charges use **different bases for net assets**. The replacement cost of net assets is usually used in the calculation of EVA.

The calculation of EVA is different from RI because the net assets used as the basis of the imputed interest charge are usually valued at their **replacement cost** and are **increased by any costs that have been capitalised** (see below).

There are also differences in the way that NOPAT is calculated compared with the profit figure that is used for RI, as follows.

a) Costs which would normally be treated as expenses, but which are considered within an EVA calculation as **investments building for the future**, are added back to NOPAT to derive a figure for 'economic profit'. These costs are included instead as assets in the figure for net assets employed, i.e. as investments for the future. Costs treated in this way include items such as **goodwill, research and development expenditure and advertising costs**.

b) Adjustments are sometimes made to the depreciation charge, whereby accounting depreciation is added back to the profit figures, and **economic depreciation** is subtracted instead to arrive at NOPAT. Economic depreciation is a charge for the fall in asset value due to wear and tear or obsolescence.

c) Any lease charges are excluded from NOPAT and added in as a part of capital employed.

Another point to note about the calculation of NOPAT, which is the same as the calculation of the profit figure for RI, is that **interest** is excluded from NOPAT because interest costs are taken into account in the capital charge.

Example: calculating EVA

An investment centre has reported operating profits of RWF21 million. This was after charging RWF4 million for the development and launch costs of a new product that is expected to generate profits for four years. Taxation is paid at the rate of 25% of the operating profit.

The company has a risk adjusted weighted average cost of capital of 12% per annum and is paying interest at 9% per annum on a substantial long term loan.

The investment centre's non-current asset value is RWF50 million and the net current assets have a value of RWF22 million. The replacement cost of the non-current assets is estimated to be RWF64 million.

Required

Calculate the investment centre's EVA for the period.

Solution

Calculation of NOPAT

	RWF m
Operating profit	21
Add back development costs	4
Less one year's amortisation of development costs (RWF4 million/4)	(1)
	24
Taxation at 30%	(8)
NOPAT	16

Calculation of economic value of net assets

	RWF million
Replacement cost of net assets (RWF22 million + RWF64 million)	86
Add back investment in new product to benefit future	3
Economic value of net assets	89

Calculation of EVA

The capital charge is based on the **weighted average cost of capital**, which takes account of the cost of share capital as well as the cost of loan capital. Therefore the correct interest rate is 12%.

	RWF million
NOPAT	16.00
Capital charge (12% × RWF89 million)	(10.68)
EVA	5.32

Example: calculating EVA

Read the article referred to on the previous page and then try the question here which uses that method. This is how EVA was tested in the December 2007 exam.

Question

B division of Z Ltd has operating profits and assets as below:

	RWF m
Gross profit	156
Less: Non-cash expenses	8
Amortisation of goodwill	5
Interest @ 10%	15
Profit before tax	128
Tax @ 30%	38
Net profit	90
Total equity	350
Long-term debt	150
	500

Z Ltd has a target capital structure of 25% debt/75% equity. The cost of equity is estimated at 15%. The capital employed at the start of the period amounted to RWF450,000,000. The division had non-capitalised leases of RWF20 million throughout the period. Goodwill previously written off against reserves in acquisitions in previous years amounted to RWF40 million.

Required
Calculate EVA® for B division and comment on your results.

Answer

EVA

NOPAT	RWF m	RWF m
Net profit		90
Add back:		
Non-cash expenses	8	
Amortisation of goodwill	5	
Interest (net of 30% tax) 15 × 0.7	10.5	23.5
		113.5

Assets	
At start of period	450
Non-capitalised leases	20
Amortised goodwill	40
	510

WACC

Equity 15% × 75%	0.1125
Debt (10% × 0.7) × 25%	0.0175
WACC	0.13

EVA	NOPAT	113.5
	Capital charge	
	13% × RWF510 m	66.3
		47.2

RI

Net profit	90
Capital charge	
13% × RWF 500m	65
	25

The EVA for B division is RWF47.2m, higher than its RI. This is despite the higher net asset value and is caused by treating expenses, such as amortisation, in line with economic, not accountancy, principles. The business is creating value as its return (however calculated) is greater than the group's WACC. The division's ROI is 18% vs WACC of 13% (based on target not actual capital structure).

Its "economic" ROI is 22.3%.

Evaluation of EVA

The advantages of EVA include the following.

a) **Real wealth for shareholders.** Maximisation of EVA will create real wealth for the shareholders.

b) **Less distortion by accounting policies**. The adjustments within the calculation of EVA mean that the measure is based on figures that are closer to cash flows than accounting profits.

c) **An absolute value.** The EVA measure is an absolute value, which is easily understood by non-financial managers.

d) **Treatment of certain costs as investments thereby encouraging expenditure.** If management are assessed using performance measures based on traditional accounting policies they may be unwilling to invest in areas such as advertising and development for the future because **such costs will immediately reduce the current year's accounting profit**. EVA recognises such costs as investments for the future and thus they do not immediately reduce the EVA in the year of expenditure.

EVA does have some drawbacks.

a) **Focus on short-term performance.** It is still a relatively **short-term measure, which** can encourage managers to focus on short term performance.

b) **Dependency on historical data**. EVA is based on historical accounts, which may be of **limited use as a guide to the future**. In practice, the influences of accounting policies on the starting profit figure may not be completely negated by the adjustments made to it in the EVA model.

c) **Number of adjustments needed to measure EVA**. Making the necessary adjustments can be problematic as sometimes a **large number of adjustments** are required.

d) **Comparison of like with like**. Investment centres, which are larger in size, may have larger EVA figures for this reason. **Allowance for relative size** must be made when comparing the relative performance of investment centres.

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MEASURING PERFORMANCE

One of the problems of measuring managerial performance is **segregating managerial performance from the economic performance of their department or division**.

Managerial performance

The distinction between the manager's performance and that of the division is very important. C. T. Horngren provides a good illustration .

> 'The most skilful divisional manager is often put in charge of the sickest division in an attempt to change its fortunes. Such an attempt may take years, not months. Furthermore the manager's efforts may merely result in bringing the division up to a minimum acceptable ROI. The division may continue to be a poor profit performer in comparison with other divisions. If top management relied solely on the absolute ROI to judge management, the skilful manager would be foolish to accept such a trouble-shooting assignment.'

It is difficult to devise performance measures that relate specifically to a manager to judge his or her performance as a manager. It is possible to calculate statistics to assess the manager as an employee like any other employee (days absent, professional qualifications obtained, personability and so on), but this is not the point. As soon as the issue of **ability as a manager** arises it is necessary to **consider him or her in relation to his/her area of responsibility**. If we want to know how good a manager is at marketing the only information there is to go on is the marketing performance of their division (which may or may not be traceable to his/her own efforts).

In summary then, **managers** should only be assessed on results within their control.

Divisional performance should be based on **total economic performance** to provide an assessment of the measure of the worth of the division to the organisation.

Profit statement

A possible profit statement for a division might look as follows:

	RWF
Sales revenue	X
Variable costs	(X)
Contribution	X
Controllable fixed costs	(X)
Controllable profit	X
Non-controllable fixed costs	(X)
Divisional profit	X

Contribution should be an acceptable measure of managerial performance unless it contains imposed transfers and transfer prices.

Controllable profit may be a more appropriate measure of managerial performance where managers can make decisions about equipment rental or labour costs. It is more acceptable when managers are free to secure services either in house or from third parties. Deprecation is likely to be included and this will only be controllable to the extent that managers control investment decisions.

Divisional profit is unlikely to be an acceptable managerial measure. It is suitable for assessing the economic performance of the divisions provided the allocation of fixed costs is reasonable.

WHEN TRANSFER PRICING IS REQUIRED

It is necessary for **control purposes** that some **record** of the market in inter-divisional goods or services should be kept. One way of doing this is through the accounting system. Inter-divisional work can be given a cost or a charge: a transfer price.

Introduction to transfer pricing

Where there are transfers of goods or services between divisions of an organisation, the **transfers could be made 'free' or 'as a favour'** to the division receiving the benefit. For example, if a garage and car showroom has two divisions, one for car repairs and servicing and the other for car sales, the servicing division will be required to service cars before they are sold and delivered to customers. There is no requirement for this service work to be charged for: the servicing division could do its work for the car sales division without making any record of the work done.

Unless the cost or value of such work is recorded, however, management cannot keep a proper check on the amount of resources (such as labour time) being used up on new car servicing. It is necessary for **control purposes** that some **record** of the inter-divisional services should be kept, and one way of doing this is **through the accounting system**. Inter-divisional work can be given a cost or charge: a transfer price.

A **transfer price** is the price at which goods or services are transferred from one department to another, or from one member of a group to another.

Criteria for design of a transfer pricing policy

Transfer prices are a way of promoting **divisional autonomy**, ideally without prejudicing **divisional performance measurement** or discouraging overall **corporate profit maximisation**.

Divisional autonomy

Transfer prices are particularly appropriate for **profit centres** because if one profit centre does work for another the size of the transfer price will affect the costs of one profit centre and the revenues of another.

However, a danger with profit centre accounting is that the business organisation will divide into a number of **self-interested segments**, each acting at times against the wishes and interests of other segments. A profit centre manager might take decisions in the best interests of his own part of the business, but against the best interests of other profit centres and possibly the organisation as a whole.

A task of head office is therefore to try to prevent dysfunctional decision making by individual profit centres. To do this, it must reserve some power and authority for itself and so profit centres **cannot** be allowed to make entirely **autonomous decisions**.

Just how much authority head office decides to keep for itself will vary according to individual circumstances. A **balance** ought to be kept between **divisional autonomy** to provide incentives and motivation, and retaining **centralised authority** to ensure that the organisation's profit centres are all working towards the same target, the benefit of the organisation as a whole (in other words, retaining **goal congruence** among the organisation's separate divisions).

Divisional profit maximisation

Profit centre managers tend to put their own profit **performance** above everything else. Since profit centre performance is measured according to the profit they earn, no profit centre will want to do work for another and incur costs without being paid for it. Consequently, profit centre managers are likely to dispute the size of transfer prices with each other, or disagree about whether one profit centre should do work for another or not. Transfer prices **affect behaviour and decisions** by profit centre managers.

Corporate profit maximisation

When there are disagreements about how much work should be transferred between divisions, and how many sales the division should make to the external market, there is presumably a **profit-maximising** level of output and sales for the organisation as a whole. However, unless each profit centre also maximises its own profit at this same level of output, there will be inter-divisional disagreements about output levels and the profit-maximising output will not be achieved.

The ideal solution

Ideally a transfer price should be set at a level that overcomes these problems.

a) The transfer price should provide an 'artificial' selling price that enables the transferring division to **earn a return** for its efforts, and the receiving division to **incur a cost** for benefits received.

b) The transfer price should be set at a level that enables profit centre performance to be **measured 'commercially'** (that is, it should be a **fair** commercial price).

c) The transfer price, if possible, should encourage profit centre managers to agree on the amount of goods and services to be transferred, which will also be at a level that is consistent with the organisation's aims as a whole such as **maximising company profits**.

In practice it is very difficult to achieve all three aims.

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THE 'GENERAL RULE'

We shall see eventually that the **ideal transfer price** should **reflect the opportunity cost of sale to the supplying division and the opportunity cost to the buying division.** However, this 'general rule' requires extensive qualification, and you will need to work through the rest of this chapter before we return to it and you fully appreciate what it means. In the meantime, be content with Horngren's formulation of the problem:

'Is there an all-pervasive rule for transfer pricing that leads toward optimal decisions for the organisation as a whole? No. Why? Because the three criteria of goal congruence, managerial effort, and sub-unit autonomy must all be considered simultaneously.'

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THE USE OF MARKET PRICE

Transfer prices may be based on **market price** (or an **adjusted market price**) where there is an external market for the item being transferred.

Market price as the transfer price

If an **external market** price exists for transferred goods, profit centre managers will be aware of the price they could charge or the price they would have to pay for their goods on the external market, and so will **compare** this price with the internal transfer price.

Example: transferring goods at market value

A company has two profit centres, A and B. Centre A sells half of its output on the open market and transfers the other half to B. Costs and external revenues in an accounting period are as follows.

	A	*B*	*Total*
	RWF	RWF	RWF
External sales	8,000	24,000	32,000
Costs of production	12,000	10,000	22,000
Company profit			10,000

Required

What are the consequences of setting a transfer price at market value?

Solution

If the transfer price is at market price, A would be happy to sell the output to B for RWF8,000, which is what A would get by selling it externally instead of transferring it.

	A		*B*		*Total*
	RWF	RWF	RWF	RWF	RWF
Market sales		8,000		24,000	32,000
Transfer sales		8,000		–	
		16,000		24,000	
Transfer costs	–		8,000		
Own costs	12,000		10,000		22,000
		12,000		18,000	
Profit		4,000		6,000	10,000

The consequences, therefore, are as follows.

a) A earns the same profit on transfers as on external sales. B must pay a commercial price for transferred goods, and both divisions will have their profit measured fairly.

b) A will be indifferent about selling externally or transferring goods to B because the profit is the same on both types of transaction. B can therefore ask for and obtain as many units as it wants from A.

A **market-based** transfer price therefore seems to be the **ideal** transfer price.

Adjusted market price

However, internal transfers are often **cheaper** than external sales, with **savings** in selling and administration costs, bad debt risks and possibly transport/delivery costs. It would therefore seem reasonable for the buying division to expect a **discount** on the external market price.

The transfer price might be slightly less than market price, so that A and B could **share the cost savings** from internal transfers compared with external sales. It should be possible to reach agreement on this price and on output levels with a minimum of intervention from head office.

The merits of market value transfer prices

Divisional autonomy

In a decentralised company, divisional managers should have the **autonomy** to make output, selling and buying **decisions, which appear to be in the best interests of the division's performance.** (If every division optimises its performance, the company as a whole must inevitably achieve optimal results.) Thus a **transferor division should be given the freedom to sell output on the open market,** rather than to transfer it within the company.

'Arm's length' transfer prices, which give profit centre managers the freedom to negotiate prices with other profit centres as though they were independent companies, will tend to result in a market-based transfer price.

Corporate profit maximisation

In most cases where the transfer price is at market price, **internal transfers** should be **expected**, because the **buying division** is likely to **benefit** from a better quality of service, greater flexibility, and dependability of supply. **Both divisions** may **benefit** from cheaper costs of administration, selling and transport. A market price as the transfer price would therefore **result in decisions, which would be in the best interests of the company or group as a whole**.

Divisional performance measurement

Where a **market price exists**, but the **transfer price is a different amount** (say, at standard cost plus), divisional managers will **argue** about the volume of internal transfers.

For example, if division X is expected to sell output to division Y at a transfer price of Rwf8 per unit when the open market price is Rwf10, its manager will decide to sell all output on the open market. The manager of division Y would resent the loss of his cheap supply from X, and would be reluctant to buy on the open market. A wasteful situation would arise where X sells on the open market at Rwf10, where Y buys at Rwf10, so that administration, selling and distribution costs would have been saved if X had sold directly to Y at Rwf10, the market price.

The disadvantages of market value transfer prices

Market value as a transfer price does have certain disadvantages.

a) The market price may be a **temporary** one, induced by adverse **economic conditions**, or dumping, or the market price might depend on the volume of output supplied to the external market by the profit centre.

b) A transfer price at market value might, under some circumstances, act as a disincentive to use up any **spare capacity** in the divisions. A price based on incremental cost, in contrast, might provide an incentive to use up the spare resources in order to provide a marginal contribution to profit.

c) Many products **do not have an equivalent** market price so that the price of a similar, but not identical, product might have to be chosen. In such circumstances, the option to sell or buy on the open market does not really exist.

d) The **external market** for the transferred item might be **imperfect**, so that if the transferring division wanted to sell more externally, it would have to **reduce** its price.

COST-BASED APPROACHES TO TRANSFER PRICING

Problems arise with the use of **cost-based** transfer prices because one party or the other is liable to perceive them as unfair.

Cost-based approaches to transfer pricing are often used in practice, because in practice the following conditions are common.

a) There is **no external market** for the product that is being transferred.

b) Alternatively, although there is an external market it is an **imperfect** one because the market price is affected by such factors as the amount that the company setting the transfer price supplies to it, or because there is only a limited external demand.

In either case there will not be a suitable market price upon which to base the transfer price.

Transfer prices based on full cost

Under this approach, the **full cost** (including fixed overheads absorbed) incurred by the supplying division in making the 'intermediate' product is charged to the receiving division. If a **full cost plus** approach is used a **profit margin** is also included in this transfer price.

An **intermediate product** is one that is used as a component of another product, for example car headlights or food additives.

Example: transfers at full cost (plus)

Consider the example introduced in Section 5.1.1, but with the additional complication of imperfect intermediate and final markets. A company has 2 profit centres, A and B. Centre A can only sell **half** of its maximum output externally because of limited demand. It transfers the other half of its output to B, which also faces limited demand. Costs and revenues in an accounting period are as follows.

	A	*B*	*Total*
	RWF ‘000	RWF ‘000	RWF ‘000
External sales	8,000	24,000	32,000
Costs of production in the division	12,000	10,000	22,000
Profit			10,000

There are no opening or closing inventories. It does not matter here whether marginal or absorption costing is used and we shall ignore the question of whether the current output levels are profit maximising and congruent with the goals of the company as a whole.

Transfer price at full cost only

If the transfer price is at full cost, A in our example would have 'sales' to B of RWF6,000 (costs of RWF12,000 × 50%). This would be a cost to B, as follows.

	A		*B*		*Company as a whole*
	RWF ‘000	RWF ‘000	RWF	RWF	RWF
Open market sales		8,000		24,000	32,000
Transfer sales		6,000		–	
Total sales, incl. transfers		14,000		24,000	
Transfer costs			6,000		
Own costs	12,000		10,000		22,000
Total costs, incl. transfers		12,000		16,000	
Profit		2,000		8,000	10,000

The transfer sales of A are self-cancelling with the transfer costs of B so that total profits are unaffected by the transfer items. The transfer price simply spreads the total profit of RWF10,000 between A and B.

The obvious drawback to the transfer price at cost is that **A makes no profit** on its work, and the manager of division A would much prefer to sell output on the open market to earn a profit, rather than transfer to B, regardless of whether or not transfers to B would be in the best interests of the company as a whole. Division A needs a profit on its transfers in order to be motivated to supply B; therefore transfer pricing at cost is inconsistent with the use of a profit centre accounting system.

Transfer price at full cost plus

If the transfers are at cost plus a margin of, say, 25%, A's sales to B would be RWF7,500 (RWF12,000 × 50% × 1.25).

	A		B		Total
	RWF	RWF	RWF	RWF	RWF
Open market sales		8,000		24,000	32,000
Transfer sales		7,500		–	
		15,500		24,000	
Transfer costs			7,500		
Own costs	12,000		10,000		22,000
		12,000		17,500	
Profit		3,500		6,500	10,000

Compared to a transfer price at cost, **A gains some profit** at the expense of B. However, A makes a bigger profit on external sales in this case because the profit mark-up of 25% is less than the profit mark-up on open market sales. The choice of 25% as a profit mark-up was arbitrary and unrelated to external market conditions.

Divisional autonomy, divisional performance measurement and corporate profit maximisation

In the above case the transfer price **fails on all three criteria** for judgement.

a) Arguably, it does not give A fair revenue or charge B a reasonable cost, and so their profit **performance** is distorted. It would certainly be unfair, for example, to compare A's profit with B's profit.

b) Given this unfairness it is likely that the **autonomy** of each of the divisional managers is under threat. If they cannot agree on what is a fair split of the external profit a decision will have to be imposed from above.

c) It would seem to give A an incentive to sell more goods externally and transfer less to B. This may or may not be in the best interests of the **company as a whole**.

Example

Suppose, in the example above, that the cost per unit of A's output is RWF9 in variable costs and RWF6 in fixed costs. B's own costs are RWF25 including a fixed element of RWF10. What is the minimum price that B should charge for its products to break even?

Answer

A produces RWF12,000/(RWF9 + RWF6) = 800 units and transfers half of them to B for RWF6,000. The cost for each unit that B buys is therefore RWF6,000/400 = RWF15. From B's perspective this is a **variable** cost. B's costs are as follows.

	Cost per unit
	RWF
Variable cost: transfers from A	15
Own variable costs	15
	30

From B's perspective it must charge more than RWF30 per unit to earn a contribution. However, from the overall perspective, RWF6 of the 'variable' cost of transfers is **fixed**. The variable cost is really RWF9 + RWF15 = RWF24, and any price above this will earn a contribution for the organisation as a whole.

Transfer price at marginal cost

A marginal cost approach entails charging the marginal cost that has been incurred by the supplying division to the receiving division. As above, we shall suppose that A's cost per unit is RWF15, of which RWF6 is fixed and RWF9 variable.

	A		*B*		*Company as a whole*	
	RWF	RWF	RWF	RWF	RWF	RWF
Market sales		8,000		24,000		32,000
Transfer sales (Rwf6,000 × 9/15)		3,600		–		
		11,600		24,000		
Transfer costs	–		3,600			
Own variable costs	7,200		6,000		13,200	
Own fixed costs	4,800		4,000		8,800	
Total costs and transfers		12,000		13,600		22,000
(Loss)/Profit		(400)		10,400		10,000

Divisional autonomy, divisional performance measurement and corporate profit maximisation

a) This result is deeply unsatisfactory for the manager of division A who could make an additional RWF4,400 (RWF(8,000 – 3,600)) profit if no goods were transferred to division B.

b) Given that the manager of division A would prefer to transfer externally, head office are likely to have to insist that internal transfers are made.

c) For the company overall, external transfers only would cause a large fall in profit, because division B could make no sales at all.

The problem is that with a transfer price at marginal cost the **supplying division does not cover its fixed costs.**

FIXED COST AND TRANSFER PRICING

Fixed costs in the supplying division can be accounted for in a number of ways to ensure that it at least breaks even.

There are a number of ways in which this problem could be overcome.

Sharing contribution

Each division can be given a **share** of the overall contribution earned by the organisation, but it is probably necessary to decide centrally what the shares should be, undermining **divisional autonomy**. Alternatively central management could impose a range within which the transfer price should fall, and allow divisional managers to **negotiate** what they felt was a fair price between themselves.

Two-part charging system

Transfer prices are set at variable cost and once a year there is a transfer of a fixed fee to the supplying division, representing an allowance for its fixed costs. Care is needed with this approach. It risks sending the message to the supplying division that it need not control its fixed costs because the company will **subsidise any inefficiencies**. On the other hand, if fixed costs are incurred because spare capacity is kept available for the needs of other divisions it is reasonable to expect those other divisions to pay a fee if they 'booked' that capacity in advance but later failed to utilise it. The main problem with this approach once more is that it is likely to conflict with **divisional autonomy**.

Dual pricing

Be careful not to confuse this term with 'two-part' transfer pricing. Dual pricing means that two separate transfer prices are used.

a) For the transfer of goods from the supplying division to the receiving division the transfer price is set at variable cost. This ensures that the receiving division makes optimal **decisions** and it leads to corporate profit maximisation.

b) For the purposes of **reporting results** the transfer price is based on the *total* costs of the transferring division, thus avoiding the possibility of reporting a loss.

This method is not widely used in practice.

Addressing organisational structure

One final possibility that may be worth mentioning. Given that the problems are caused by the divisional structure, might it not be better to address the **structure**, for example by **merging the two divisions**, or ceasing to treat the transferring division as a profit centre. This may not be practical. Some would argue that the benefits of decentralisation in terms of motivation outweigh any costs that might arise due to slight inefficiencies.

STANDARD COST VERSUS ACTUAL COST

Standard costs should be used for transfer prices to avoid encouraging inefficiency in the supplying division.

When a transfer price is based on cost, **standard cost** should be used, not actual cost. A transfer of actual cost would give no incentive to **control costs**, because they could all be passed on. Actual cost-*plus* transfer prices might even encourage the manager of A to overspend, because this would increase the divisional profit, even though the company as a whole (and division B) suffers.

Suppose, for example, that A's costs should have been RWF12,000, but actually were RWF16,000. Transfers (50% of output) would cost RWF8,000 actual, and the cost plus transfer price is at a margin of 25% (Rwf8,000 × 125% = Rwf10,000).

	A		*B*		*Total*
	RWF	RWF	RWF	RWF	RWF
Market sales		8,000		24,000	32,000
Transfer sales		10,000		–	
		18,000		24,000	
Transfer costs	–		10,000		
Own costs	16,000		10,000		26,000
		16,000		20,000	
Profit		2,000		4,000	6,000

A's overspending by RWF4,000 has reduced the total profits from RWF10,000 to RWF6,000.

In this example, B must bear much of the cost of A's overspending, which is clearly unsatisfactory for responsibility accounting. If, however, the transfer price were at standard cost plus instead of actual cost plus, the transfer sales would have been RWF7,500, regardless of A's overspending.

	A		*B*		*Total*
	RWF	RWF	RWF	RWF	RWF
Market sales		8,000		24,000	32,000
Transfer sales		7,500		–	
		15,500		24,000	
Transfer costs	–		7,500		
Own costs	16,000		10,000		
		16,000		17,500	26,000
Profit/(loss)		(500)		6,500	6,000

The entire cost of the overspending by A of RWF4,000 is now borne by division A itself as a comparison with the first table of figures in this section will show.

COST-BASED APPROACHES WITH NO EXTERNAL MARKET

With **no external market**, the transfer price should be set in the range where variable cost in the supplying division ≤ net marginal revenue in the receiving division.

Unlimited capacity and no external market

So far we have considered the use of cost-based approaches where the following factors applied.

a) There was a **limit on the maximum output** of the supplying division.

b) There was a **limit** to the amount that could be sold in the **intermediate market**.

We found that a **marginal cost** based approach led to the **best decisions** for the organisation overall, but that this was **beset with problems** in maintaining divisional autonomy and measuring divisional performance fairly.

We shall now consider whether this finding changes in different conditions. We shall remove the limit on output and demand for the final product, but assume that there is *no* intermediate market at all.

Example: unlimited capacity and no intermediate market

Motivate Ltd has two profit centres, P and Q. P transfers *all* its output to Q. The variable cost of output from P is RWF5,000 per unit, and fixed costs are RWF1,200,000 per month. Additional processing costs in Q are RWF4,000 per unit for variable costs, plus fixed costs of RWF800k. Budgeted production is 400 units per month, and the output of Q sells for RWF15k per unit. The transfer price is to be based on standard full cost plus. From what *range* of prices should the transfer price be selected, in order to motivate the managers of both profit centres to both increase output and reduce costs?

Solution

Any transfer price based on **standard** cost plus will motivate managers to cut costs, because favourable variances between standard costs and actual costs will be credited to the division's profits. Managers of each division will also be willing to increase output above the budget of 400 units provided that it is profitable to do so; that is:

a) In P, provided that the transfer price exceeds the variable cost of RWF5,000 per unit

b) In Q, provided that the transfer price is less than the difference between the fixed selling price (RWF15k) and the variable costs in Q itself (RWF4,000). This amount of RWF11,000 (RWF15k – RWF4k) is sometimes called **net marginal revenue**

The range of prices is therefore between RWF5,001 and RWF10,999.

Let's do a check. Suppose the transfer price is RWF9,000. With absorption based on the **budgeted** output of 400 units what would divisional profits be if output and sales are 400 units or 500 units?

Overheads per unit are RWF1,200,000/400 = RWF3,000, so the full cost of sales is RWF(5k + 3k) = RWF8k in division P. In division Q, full cost is RWF(4k + 2k) = RWF6,000, plus transfer costs of RWF9,000.

At 400 units:

	P	*Q*	*Total*
	RWF '000	RWF '000	RWF '000
Sales	–	6,000	6,000
Transfer sales	3,600	–	
Transfer costs	–	(3,600)	
Own full cost of sales	(3,200)	(2,400)	(5,600)
	400	0	400
Under/over absorbed overhead	0	0	0

Profit/(loss)	400	0	400

At 500 units:

	P	*Q*	*Total*
	RWF ‘000	RWF ‘000	RWF ‘000
Sales	–	7,500	7,500
Transfer sales	4,500	–	–
Transfer costs	–	(4,500)	–
Own full cost of sales	(4,000)	(3,000)	(7,000)
	500	0	500
Over absorbed overhead (100 × RWF3; 100 × RWF2)	300	200	500
Profit/(loss)	800	200	1,000

Increasing output improves the profit performance of both divisions and the company as a whole, and so decisions on output by the two divisions are likely to be **goal congruent**.

Summary

To summarise the **transfer price should be set in the range** where:

Variable cost in supplying division	**≤**	**Selling price minus variable costs (net marginal revenue) in the receiving division**

In fact, if there is no external market, and if the transferred item is the major product of the transferring division, there is a strong argument for suggesting that profit centre accounting is a waste of time.

Profit centres cannot be judged on their commercial performance because there is no way of gauging what a fair revenue for their work should be. It would be more appropriate, perhaps, to treat the transferring 'division' as a cost centre, and to judge performance on the basis of cost variances.

OPPORTUNITY COSTS AND TRANSFER PRICES

If a profit-maximising output level has been established, the transfer price should be set such that there is not a more profitable opportunity for individual divisions. In other words transfer prices should include **opportunity costs** of transfer.

The ideal transfer price

Ideally, a transfer price should be set that enables the individual **divisions** to maximise their profits at a level of output that maximises profit for the **company as a whole**. The transfer price which achieves this is unlikely to be a market-based transfer price (if there is one) and is also unlikely to be a simple cost plus based price.

An opportunity cost approach

If optimum decisions are to be taken transfer prices should reflect **opportunity costs.**

a) If profit centre managers are given sufficient autonomy to make their own output and selling decisions, and at the same time their performance is judged by the company according to the profits they earn, they will be keenly aware of all the commercial opportunities.

b) If transfers are made for the good of the company as a whole, the commercial benefits to the company ought to be **shared** between the participating divisions.

Transfer prices can therefore be reached by:

a) Recognising the levels of output, external sales and internal transfers that are best for the **company as a whole**, and

b) Arriving at a transfer price that ensures that all divisions maximise their profits at this same level of output. The transfer price should therefore be such that there is **not a more profitable opportunity** for individual divisions. This in turn means that the opportunity costs of transfer should be covered by the transfer price.

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TRANSFER PRICING WHEN INTERMEDIATE PRODUCTS ARE IN SHORT SUPPLY

When an **intermediate resource is in short supply** and **acts as a limiting factor** on production in the supplying division, the cost of transferring an item is the variable cost of production plus the contribution obtainable from using the scarce resource in its next most profitable way.

Example: scarce resources

Suppose, for example, that division A is a profit centre that produces three items, X, Y and Z. Each item has an external market.

	X	*Y*	*Z*
External market price, per unit	RWF48,000	RWF46,000	RWF40,000
Variable cost of production in division A	RWF33,000	RWF24,000	RWF28,000
Labour hours required per unit in division A	3	4	2

Product Y can be transferred to division B, but the maximum quantity that might be required for transfer is 300 units of Y.

The maximum **external** sales are 800 units of X, 500 units of Y and 300 units of Z.

Instead of receiving transfers of product Y from division A, division B could buy similar units of product Y on the open market at a slightly cheaper price of RWF45,000 per unit.

What should the transfer price be for each unit if the total labour hours available in division A are 3,800 hours or 5,600 hours?

Solution

Hours required to meet maximum demand:

External sales:	Hours
X (3 × 800)	2,400
Y (4 × 500)	2,000
Z (2 × 300)	600
	5,000
Transfers of Y (4 × 300)	1,200
	6,200

Contribution from external sales:

	X	*Y*	*Z*
Contribution per unit	RWF15,000	RWF22,000	RWF12,000
Labour hours per unit	3 hrs	4 hrs	2 hrs
Contribution per labour hour	RWF5,000	RWF5,500	RWF6,000
Priority for selling	3rd	2nd	1st
Total hours needed	2,400	2,000	600

a) If only **3,800 hours** of labour are available, division A would choose, **ignoring transfers** to B, to sell:

	Hours
300 Z (maximum)	600
500 Y (maximum)	2,000
	2,600
400 X (balance)	1,200
	3,800

To transfer 300 units of Y to division B would involve forgoing the sale of 400 units of X because 1,200 hours would be needed to make the transferred units.

Opportunity cost of transferring units of Y, and the appropriate transfer price:

	RWF per unit
Variable cost of making Y	24,000
Opportunity cost (contribution of Rwf5 per hour	
available from selling X externally): benefit forgone (4 hours × Rwf5k)	20,000
Transfer price for Y	44,000

The transfer price for Y should, in this case, be less than the external market price.

b) If **5,600 hours** are available, there is enough time to meet the full demand for external sales (5,000) and still have 600 hours of spare capacity, before consideration of transfers. However, 1,200 hours are needed to produce the full amount of Y for transfer (300 units), and so 600 hours need to be devoted to producing Y for transfer instead of producing X for external sale.

This means that the **opportunity cost** of transfer is:

(i) the variable cost of 150 units of Y produced in the 600 'spare' hours (RWF24k/unit);

(ii) the variable cost of production of the remaining 150 units of Y (RWF24k per unit), plus the **contribution forgone** from the external sales of X that could have been produced in the 600 hours now devoted to producing Y for transfer (RWF5 per labour hour). An average transfer price per unit could be negotiated for the transfer of the full 300 units (see below), which works out at RWF34 per unit.

	RWF '000
150 units × Rwf24k	3,600
150 units × RWf24k	3,600
600 hours × RWF5k per hour	3,000
Total for 300 units	10,200

In both cases, the opportunity cost of receiving transfers for division B is the price it would have to pay to purchase Y externally –RWF45k per unit. Thus:

Maximum labour hours in A	*Opportunity cost to A of transfer*	*Opportunity cost to B of transfer*
	RWF '000	RWF '000
3,800	44	45
5,600	34 (average)	45

In each case any price between the two opportunity costs would be sufficient to persuade B to order 300 units of Y from division A and for division A to agree to transfer them.

Central information

The only way to be sure that a profit-maximising transfer policy will be implemented is to **dictate the policy from the centre**. This means that the following information must be available centrally.

a) A precise **breakdown of costs in each division** at all levels of output

b) **Market information** for each market, indicating the level of demand at a range of prices

c) Perhaps most vitally, knowledge of the **likely reaction of divisional managers** to a centrally imposed policy that undermines their autonomy and divisional profits

Why not try to explain **in your own words** why transfer prices should reflect opportunity costs?

If you cannot do so, start reading this section again. You probably would not be able to do a Paper P5 transfer pricing question unless you can give this explanation.

Optimal transfer prices: an extended example

A group of highly integrated divisions wishes to be advised as to how it should set transfer prices for the following inter-divisional transactions:

a) Division L sells all its output of product LX to Division M. To one kilogram of LX, Division M adds other direct materials and processes it to produce two kilograms of product MX which it sells outside the group. The price of MX is influenced by volume offered and the following cost and revenue data are available:

Division L

The variable costs per kg of LX are RWF4,000 of direct materials and RWF2,000 of direct labour.

The following cost increases are expected at different levels of production per annum:

Direct materials	At 60,000 kg pa increase to RWF5,000 per kg	
	At 90,000 kg pa increase to RWF5,500 per kg	
	At 100,000 kg pa increase to RWF6,000 per kg	
Direct labour	At 80,000 kg pa increases to RWF2,500 per kg	
	At 100,000 kg pa increases to RWF3,000 per kg	
Fixed overhead	Under 70,000 kg	RWF210m pa
	70,000 – 79,999 kg	RWF 260m pa
	80,000 – 89,999 kg	RWF280m pa
	90,000 or more kg	RWF 310m pa

Division M

To produce one kilogram of product MX, the variable cost incurred for each half-kilogram of LX used is made up of RWF1.50 of other direct materials and RWF3.50 processing cost.

The following cost increases are expected at different levels of production of MX per annum:

Other direct materials	At 140,000 kg pa increase to RWF1,750k per kg	
	At 160,000 kg pa increase to RWF2,000k per kg	
Processing	At 180,000 kg pa increases to RWF 4,000k per kg	
		RWF ‘000
Fixed overhead	Under 120,000 kg	250,000 pa
	120,000 – 139,999 kg	280,000 pa
	140,000 – 159,999 kg	290,000 pa
	160,000 – 199,999 kg	320,000 pa
	200,000 or more kg	360,000 pa
Selling price	Up to 199,999 kg	RWF 16,000k per kg
	200,000 or more kg	RWF 15,500k per kg

b) Division N manufactures two products, NA and NB, whose variable production cost and selling prices per unit are:

Product	*NA*		*NB*	
	RWF	RWF	RWF	RWF
Direct materials	4,000		3,000	
Direct labour	4,000		6,000	
Production cost		8,000		9,000
Selling price		16,000		25,000

Direct labour is costed at RWF 500 per hour. Fixed overhead is RWF 36,000,000 per annum and total capacity is 960,000 man-hours per annum.

Division N sells product NA either to Division P or outside the group and Division P can buy from either source. Product NB is sold only outside the group. When NA and NB are sold outside the group, variable selling costs of RWF1,000 and RWF2,000 per unit respectively are incurred.

Required

a) Recommend, with supporting calculations and explanations, the most appropriate narrow range of transfer price per kg for product LX between the two divisions; assume that any changes in output are in steps of 10,000 kg of product LX and 20,000 kg of product MX.

b) Recommend, with supporting calculations and explanations:

   (i) The most appropriate transfer price of product NA between Divisions N and P:

      (1) On the assumption that Division N can just sell all of, but no more than, its capacity;

      (2) On the assumption that Division N could sell more than its existing capacity, though the market price stays the same;

(ii) In the case of (i) (2) above, what quantities of NA Division P should buy from Division N.

Discussion and solution

Part (a) of the question is long and the calculations might easily be confusing. The **ratio** of 1 kg of LX to 2 kg of MX also complicates the figure-work. It is probably tempting to calculate **unit contribution** rather than **unit net profit**, but in this case it is probably easier to work out unit full costs, because of the stepped changes in fixed costs.

Step 1 The first step in a solution is to work out what is best for the group as a whole.

MX costs and profits can be calculated on a unit basis first and then total profitability at each level of output derived.

	Quantity of MX ('000 kg)							
	100	*120*	*140*	*160*	*180*	*200*	*220*	*240*
Division L cost (1 kg LX per 2 kg MX)								
	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000	RWF '000
Direct materials	2.00	2.50	2.50	2.50	2.75	3.00	3.00	3.00
Direct labour	1.00	1.00	1.00	1.25	1.25	1.50	1.50	1.50
Fixed overhead	2.10	1.75	1.86	1.75	1.72	1.55	1.41	1.29
Total	5.10	5.25	5.36	5.50	5.72	6.05	5.91	5.79
Division M costs								
Other materials	1.50	1.50	1.75	2.00	2.00	2.00	2.00	2.00
Processing cost	3.50	3.50	3.50	3.50	4.00	4.00	4.00	4.00
Fixed overhead	2.50	2.33	2.07	2.00	1.78	1.80	1.64	1.50
Total	7.50	7.33	7.32	7.50	7.78	7.80	7.64	7.50
Full unit cost	12.60	12.58	12.68	13.00	13.50	13.85	13.55	13.29
Sales price	16.00	16.00	16.00	16.00	16.00	15.50	15.50	15.50
Unit profit	3.40	3.42	3.32	3.00	2.50	1.65	1.95	2.21
Total profit (RWF m)	340	410	465	480	450	330	429	530

Below 200,000 kg, profit is maximised at 160,000 kg of MX (RWF480 m) but this profit figure is exceeded when output rises to 240,000 kg and beyond, by which time profit is rising by RWF100 m per extra 20,000 kg of MX. Division M ought to make 240,000 kg or more of MX, up to capacity output.

Step 2 So how do we calculate the **ideal transfer price**? First of all, the transfer price must be **higher than RWF5.79k** per ½ kg of LX, but **not more than RWF(5.79k + 2.21k) = RWF8k** per ½ kg of LX. At the lower price, Division L would make no profit at 240,000 kg of MX and at the higher price, Division M would make no profit.

Step 3 The selection of a transfer price is further complicated by the **changing unit costs** at lower levels of output. The transfer price must give each division an incentive not to want to restrict output to less than 240,000 kg of MX.

a) Left to its own devices Division M will produce **140,000 kg** because its unit costs are minimised at this level. So Division M will be willing to offer Division L a transfer price that persuades it to produce 70,000 kg and this must at least cover Division L's unit costs at this level of RWF5.36k per half kg.

b) However, overall profit is maximised at the 240,000 kg level, where unit costs for Division L are **RWF**430 (**RWF**5.79k – **RWF**5.36k) higher.

$$240{,}000x > 140{,}000(x + 0.43k)$$

$$100{,}000x > 60{,}200$$

$$x > 600$$

Our analysis suggests that unless Division L earns a unit profit of at least 600 francs, the division's manager will need a lot of persuading to increase output above 70,000 kg (enough for 140,000 kg of MX).

c) In the case of Division M, a similar analysis can be applied. Unit costs are **RWF**180 per kg lower at 140,000 kg of output, and so if the unit profit at 240,000 kg is **RWF**y, we want a transfer price where:

$$240{,}000y > 140{,}000(y + 180)$$
$$100{,}000y > 25{,}200$$
$$y > 250$$

This suggests that unless Division M makes a profit per kg of at least 250 Francs at 240,000 kg of output the division's manager might prefer to halt production and sales at 140,000 kg.

Step 4 The range of transfer prices per kg of MX is therefore narrower than the **RWF**5.79k to **RWF**8k range we began with. Division L should have a profit of at least RWF600 per kg of MX at 240,000 kg of output and so the minimum transfer price should be (**RWF**5,790 + **RWF**600) **RWF6,390** per kg of MX. Division M should have a profit of at least RWF 250 and so the maximum transfer price should be (**RWF**8,000 **– RWF250**) **RWF7750**.

Conclusion for Division L and Division M. The transfer price per kg of MX should be in the range RWF6,390 – RWF7,750, so that the transfer price range per kg of LX (2:1) is RWF12,780 – RWF15,500.

Let's now turn our attention to part (b). The situation facing Division N is probably a bit easier to understand.

a) If Division N can sell all of its capacity but no more, the **opportunity cost** of transferring NA instead of selling it will be the external revenue per unit of NA less the variable selling costs – i.e. RWF(16,000 – 1,000) = RWF15,000 per unit.

b) In part (2) of the question, N's existing capacity acts as a constraint on total output: labour hours become a scarce resource.

	NA	*NB*
	RWF '000	RWF '000
Contribution before variable selling costs	8	16
Variable selling costs	1	2
Net contribution	7	14
Labour hours per unit	8	12
Contribution per labour hour	RWF875	RWF1,167

Transferring NA to Division P (rather than making NB) would force Division N to forgo contribution of Rwf1,167 per labour hour, and the transfer price of NA should reflect this opportunity cost:

	RWF '000
Variable cost of making NA	8.0
Opportunity cost of lost contribution on NB (8 hrs × RWF1,167)	9.3
Transfer price of NA, per kg	17.3

c) Since the external market price of NA is only RWF16,000, Division P should buy all its supplies externally, and buy nothing from Division N. This would leave Division N free to make NB exclusively, and earn a contribution of RWF1,167 per labour hour on all its external sales.

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TRANSFER PRICING AND A RANGE OF LIMITING FACTORS

If a supplying division is subject to a **range of limiting factors**, the optimum production plan can be derived using a **linear programming model.**

Example: transfer pricing with a range of limiting factors

LP Ltd has two divisions, division 1 and division 2. Division 1 produces liquid A, all of which is transferred to division 2, and liquid B which can either be sold externally or transferred to division 2. Division 2 uses these liquids to produce its powdered products, X and Y.

Production of liquid A is restricted due to a shortage of skilled labour so that only 4,000 litres can be produced. Liquid B can also only be produced in limited numbers due to a scarcity of ingredients. Only 6,000 litres of liquid B can be made. Details of costs and revenues are as follows.

	A	*B*	*X*	*Y*
	RWF '000	RWF '000	RWF '000	RWF '000
Variable cost (division 1)	4	6	–	–
Variable cost (division 2)	–	–	7	5
Selling price	–	9	30	35

One sachet of powder X requires 1 litre of liquid A and 2 litres of liquid B.

One sachet of powder Y requires 2 litres of liquid A and 2 litres of liquid B.

Required

Formulate a linear programming model to determine the optimum production levels and transfer prices.

Solution

Step 1 **Work out the contribution obtained from each product**

This needs to take account of the usage of A and B by X and Y.

	B	*X*	*Y*
Variable costs	6	7	5
Liquid A (l litre/2 litres)	–	4	8
Liquid B (2 litres/2 litres)	–	12	12
	6	23	25
Selling price	9	30	35
Contribution	3	7	10

Step 2 **Formulate objective function**

The objective is to maximise the corporate contribution by producing the optimum quantities of products B, X and Y. Algebraically this is expressed as follows.

Maximise 3B + 7X + 10Y

Step 3 **Define constraints**

The constraints are as follows.

$$1X + 2Y \leq 4{,}000 \text{ (labour shortage)}$$

$$B + 2X + 2Y \leq 6{,}000 \text{ (ingredients shortage)}$$

$$B, X, Y \geq 0$$

In many exam questions you will only be required to formulate the model, not solve it; *read the question carefully!!*.

In practice, as you probably remember, where there are **more than two variables** in the objective function and more than a few constraints a **computer software package** is needed.

The **output** from the model will show **how many sachets of X and Y should be produced and how many litres, if any, of B should be sold externally.** The output also provides a means of calculating the ideal transfer price, because it indicates the shadow price of scarce resources.

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SHADOW PRICE AND TRANSFER PRICES

Shadow prices replace opportunity costs when determining transfer prices if there are constraints on production.

The **shadow price** is the maximum extra amount that it would be worth paying to obtain one extra unit of a scarce resource. To put it another way, the shadow price is the opportunity cost of the scarce resource, the amount of benefit forgone by not having the availability of the extra resources.

We already know that an **optimal transfer price** can be calculated by **adding together the variable cost of the intermediate product and the opportunity cost of making the transfer.** In our example, let us suppose that the shadow price of liquid A is RWF3,000 and of liquid B, RWF2,000.

	A	*B*
	RWF '000	RWF '000
Variable cost	4	6
Shadow price	3	2
Transfer price	7	8

This solution might be tested by the divisional manager of the supplying division by applying his own linear programming model attempting to maximise the contribution from external sales of B (which we shall call B1) and from transfers of A and B.

Maximise 3A + 2B + 3B1

$$\begin{aligned} \text{Subject to} \quad A &\leq 4{,}000 \\ B + B1 &\leq 6{,}000 \\ A, B, B1 &\geq 0 \end{aligned}$$

This would give the same optimum production levels as the original linear programme, because it is derived from the same information.

For division 2, however, these transfer prices would result in each product yielding a contribution of nil. In effect this means that the **optimal solution must be centrally imposed,** otherwise the manager of division 2 will have no incentive to produce X and Y at all.

NEGOTIATED TRANSFER PRICES

In practice, **negotiated** transfer prices, **market-based** transfer prices and **full cost-based** transfer prices are the methods normally used.

A transfer price based on opportunity cost is often **difficult to identify**, for lack of suitable information about costs and revenues in individual divisions. In this case it is likely that transfer prices will be set by means of **negotiation**. The agreed price may be finalised from a mixture of accounting arithmetic, politics and compromise.

The process of negotiation will be improved if **adequate information** about each division's costs and revenues are made available to the other division involved in the negotiation. By having a free flow of cost and revenue information, it will be easier for divisional managers to identify opportunities for improving profits, to the benefit of both divisions involved in the transfer.

A negotiating system that might enable **goal congruent plans** to be agreed between profit centres is as follows.

a) Profit centres **submit plans** for output and sales to head office, as a preliminary step in preparing the annual budget.

b) Head office **reviews these plans**, together with any other information it may obtain. Amendments to divisional plans might be discussed with the divisional managers.

c) Once divisional plans are acceptable to head office and **consistent** with each other, head office might let the divisional managers arrange budgeted transfers and transfer prices.

d) Where divisional plans are **inconsistent** with each other, head office might try to establish a plan that would maximise the profits of the company as a whole. Divisional managers would then be asked to negotiate budgeted transfers and transfer prices on this basis.

e) If divisional managers fail to agree a transfer price between themselves, a head office **'arbitration' manager** or team would be referred to for an opinion or a decision.

f) Divisions **finalise their budgets** within the framework of agreed transfer prices and resource constraints.

g) Head office **monitors the profit performance** of each division.

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MULTINATIONAL TRANSFER PRICING

Multinational transfer pricing needs to take account of a range of factors.

- Exchange rate fluctuations
- Anti-dumping legislation
- Exchange controls
- Taxation in different countries
- Competitive pressures
- Import tariffs
- Repatriation of funds

Globalisation, the rise of the **multinational corporation** and the fact that more than **60% of world trade takes place within multinational organisations** mean that international transfer pricing is very important.

Factors to consider when setting multinational transfer prices

The level at which a transfer price should be set is even less clear cut for organisations operating in a number of countries, when even more factors need to be taken into consideration. Moreover, the manipulation of profits through the use of transfer pricing is a common area of confrontation between multinational organisations and host country governments.

Factors to consider	Explanation
Exchange rate fluctuation	The value of a transfer of goods between profit centres in different countries could depend on fluctuations in the currency exchange rate.
Taxation in different countries	If taxation on profits is 20% of profits in Country A and 50% on profits in Country B, a company will presumably try to 'manipulate' profits (by means of raising or lowering transfer prices or by invoicing the subsidiary in the high-tax country for 'services' provided by the subsidiary in the low-tax country) so that profits are maximised for a subsidiary in Country A, by reducing profits for a subsidiary in Country B. Some multinationals set up marketing subsidiaries in countries with low tax rates and transfer products to them at a relatively low transfer price. When the products are sold to the final customer, a low rate of tax will be paid on the difference between the two prices.
Import tariffs	Suppose that Country A imposes an import tariff of 20% on the value of goods imported. A multi-national company has a subsidiary in Country A which imports goods from a subsidiary in Country B. In such a situation, the company would minimise costs by keeping the transfer price to a minimum value.
Exchange controls	If a country imposes restrictions on the transfer of profits from domestic subsidiaries to foreign multinationals, the restrictions on the transfer can be overcome if head office provides some goods or services to the subsidiary and charges exorbitantly high prices, disguising the 'profits' as sales revenue, and transferring them from one country to the other. The ethics of such an approach should, of course, be questioned.
Anti-dumping legislation	Governments may take action to protect home industries by preventing companies from transferring goods cheaply into their countries. They may do this, for example, by insisting on the use of a fair market value for the transfer price.
Competitive pressures	Transfer pricing can be used to enable profit centres to match or undercut local competitors.
Repatriation of funds	By inflating transfer prices for goods sold to subsidiaries in countries where inflation is high, the subsidiaries' profits are reduced and funds repatriated, thereby saving their value.

Transfer prices and tax

Tax authorities obviously recognise the **incentive to set transfer prices to minimise taxes and import tariffs**. Many **tax authorities** have the **power** to **modify transfer prices in computing tariffs or taxes on profit**, although a **genuine arms-length market price should be acceptable**.

a) For instance, UK government legislation restricts how far companies can declare their profits in a low taxation country. Some scope for profit apportionment between divisions clearly exists, however. HM Revenue and Customs has the power to adjust the taxable income of the UK party to a cross-border transaction to the figure that would have resulted if the **prices actually used had been between two unrelated parties** (**'arm's length' price**).

b) And in the USA, multinational organisations must follow an Internal Revenue Service Code specifying that transfers must be priced at 'arm's length' market values, or at the values that would be used if the divisions were independent companies. Even with this rule, companies have some leeway in deciding an appropriate 'arm's length' price.

To meet the multiple objectives of transfer pricing, companies may choose to maintain **two sets of accounting records, one for tax reporting and one for internal management reporting**. The tax authorities may interpret the use of two sets of records as **suggestive of profit manipulation**, however.

Double taxation agreements between countries mean that companies pay tax on specific transactions in one country only. If a company sets an unrealistically low transfer price, however, the company will pay tax in both countries (double taxation) if it is spotted by the tax authorities.

Most countries now accept the Organisation for Economic Co-operation and Development **(OECD) 1995 guidelines**. These aim to standardise national approaches to transfer pricing and provide guidance on the application of the 'arm's length' price. This can be determined in three main ways.

a) **Comparable uncontrolled price method** is the most widely used and involves setting the arm's length price on the basis of the **externally verified** prices of similar products. In other words, the market price or an approximation to one is used. It can be difficult to make meaningful comparisons, however, as most international trade is carried out between related companies.

b) **Resale price method** involves deducting a percentage from the selling price of the final product to allow for profit.

c) **Cost-plus method.** This method is used where there is no market price and so the comparable uncontrolled price method cannot be used.

These methods are of **little use** in determining arm's length prices for **intangible assets** such as a trade name, however, and much of the information required is not in the public domain. Setting transfer prices is therefore not straightforward.

Many countries are tightening their regulations in response to the OECD guidelines. In the UK, for example, it used to be up to the tax authorities to detect cases of inappropriate transfer pricing. Under self-assessment, it is now the duty of the tax payer to provide the correct information. A penalty of 100% of any tax adjustment is payable for failing to demonstrate a reasonable attempt at using an arm's length price in a tax return. The taxpayer may enter into an Advanced Pricing Agreement (APA) with the two tax authorities involved. This is done in advance to avoid dispute, double taxation and penalties.

Example: arm's length transfer price

Suppose division A produces product B in a country where the income tax rate is 30% and transfers it to division C, which operates in a country with a 40% rate of income tax. An import duty equal to 25% of the price of product B is also assessed. The full cost per unit is RWF290,000, the variable cost RWF160,000.

Required

The tax authorities allow either variable or full cost transfer prices. Determine which should be chosen.

Solution

Effect of transferring at RWF290,000 instead of RWF160,000

	RWF '000
Income of A is RWFk130 higher and so A pays RWFk130 × 30% more income tax	(39.0)
Income of C is RWFk130 lower and so C pays RWFk130 × 40% less income tax	52.0
Import duty is paid by C on an additional RWFk130, and so C pays RWFk130 × 25% more duty	(32.5)
Net effect (cost) of transferring at RWFk290 instead of RWFk160	(19.5)

The pros and cons of different transfer pricing bases

a) A transfer price at **market value** is usually encouraged by the tax and customs authorities of both host and home countries as they will receive a fair share of the profits made but there are problems with its use.

   (i) Prices for the same product may vary considerably from one country to another.

   (ii) Changes in exchange rates, local taxes and so on can result in large variations in selling price.

   (iii) A division will want to set its prices in relation to the supply and demand conditions present in the country in question to ensure that it can compete in that country.

b) A transfer price at **full cost** is usually acceptable to tax and customs authorities since it provides some indication that the transfer price approximates to the real cost of supplying the item and because it indicates that they will therefore receive a fair share of tax and tariff revenues.

c) Transfer prices at **variable cost** are unlikely to be acceptable to the tax authorities of the country in which the supplying division is based as all the profits are allocated to the receiving division and the supplying division makes a loss equal to the fixed costs incurred.

d) In a multinational organisation, **negotiated** transfer prices may result in overall sub-optimisation because no account is taken of factors such as differences in tax and tariff rates between countries.

CHAPTER ROUNDUP

- EVA ® is an alternative absolute performance measure. It is similar to RI and is calculated as follows.

  EVA = net operating profit after tax (NOPAT) less capital charge

  where the capital charge = weighted average cost of capital × net assets

- EVA and RI are similar because both result in an absolute figure, which is calculated by subtracting an imputed interest charge from the profit earned by the investment centre. However there are differences as follows.

  a) The profit figures are calculated differently. EVA is based on an '**economic profit**' which is derived by making a series of adjustments to the accounting profit.

  b) The notional capital charges use **different bases for net assets**. The replacement cost of net assets is usually used in the calculation of EVA.

- One of the problems of measuring managerial performance is **segregating managerial performance from the economic performance of their department or division**.

- It is necessary for **control purposes** that some **record** of the market in inter-divisional goods or services should be kept. One way of doing this is through the accounting system. Inter-divisional work can be given a cost or a charge: a transfer price.

- Transfer prices are a way of promoting **divisional autonomy**, ideally without prejudicing **divisional performance measurement** or discouraging overall **corporate profit maximisation**.

- Transfer prices may be based on **market price** (or an **adjusted market price**) where there is an external market for the item being transferred.

- Problems arise with **cost-based** transfer prices because one party or the other is liable to perceive them as unfair.

- **Fixed costs** in the supplying division can be accounted for in a number of ways to ensure that it at least breaks even.

- **Standard costs** should be used for transfer prices to avoid encouraging inefficiency in the supplying division.
- With **no external market**, the transfer price should be set in the range where variable cost in the supplying division ≤ net marginal revenue in the receiving division.
- If a profit-maximising output level has been established, the transfer price should be set such that there is not a more profitable opportunity for individual divisions. In other words transfer prices should include **opportunity costs** of transfer.
- When an **intermediate resource is in short supply** and **acts as a limiting factor** on production in the supplying division, the cost of transferring an item is the variable cost of production plus the contribution obtainable from using the scarce resource in its next most profitable way.
- If a supplying division is subject to a range of limiting factors, the optimum production plan can be derived using a **linear programming model.**
- **Shadow prices** replace opportunity costs when determining transfer prices if there are constraints on production.
- In practice, **negotiated** transfer prices, **market-based** transfer prices and **full cost-based** transfer prices are the methods normally used.
- **Multinational transfer pricing** needs to take account of a range of factors.

  – Exchange rate fluctuations
  – Anti-dumping legislation
  – Taxation in different countries
  – Competitive pressures
  – Import tariffs
  – Repatriation of funds
  – Exchange controls

STUDY UNIT 19

Value Based Management

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EXAM GUIDE

Remember that the main capability required is to be able **to identify and assess the impact of current developments [..] organisational performance.** So you must think about how you would use the information here in a broad discussion of performance management. You may also be asked to explain a particular approach or framework as part of a larger question.

Exam Focus Point

Exam questions on this syllabus part are likely to require you to draft a report. Make sure that you keep your answer to the point. Always refer back to the question and what it asks of you.

VALUE-BASED MANAGEMENT APPROACHES

The following explanation of value-based management is based on an article in the McKinsey quarterly 1994, adapted from a book *Valuation: Measuring and Managing the Value of Companies, Second edition by Tom Copeland, Tim Koller and Jack Murrin*. 1994 John Wiley and Sons.

VBM aligns an organisation's overall aspirations, analytical techniques, and management processes with the key drivers of value. So, VBM takes the idea of creating value through return on future cash flow and embeds this in the organisational culture in its strategy, as well as making this a performance measure to be used throughout the organisation.

What is value-based management?

Value-based management (VBM) starts with the philosophy that the **value of a company** is measured by **its discounted future cash flows**. Value is created only when companies invest capital at returns that exceed the cost of that capital.

VBM **extends this philosophy** by focusing on how companies use the idea of value creation to make both major strategic and everyday operating decisions. So VBM is an approach to management that **aligns the strategic**, **operational** and **management processes** to focus management decision making on what activities create value.

Principles

VBM focuses on better decision making at all levels in an organisation. Hierarchical command-and-control structures cannot work well, especially in large multi-divisional organisations. Managers need to use **value-based performance measures** for making better decisions. This means that they must manage the statement of financial position (balance sheet) as well as the income statement, and maintain a balance between long- and short-term perspectives. This approach to performance measurement is known as the **value mindset**.

The Value mindset

VBM requires companies to move on from only using traditional financial performance measures, such as earnings or earnings growth as these do not focus enough on value creation. Companies should set also **goals** in terms of **discounted cash flow value**, the most direct measure of value creation. These targets can then be cascaded down the organisation as shorter-term, more objective financial performance targets.

However, non-financial goals such as customer satisfaction, product innovation, and employee satisfaction are also important as these inspire and guide the entire organisation.

The most prosperous companies are usually the ones that combine their financial and non-financial goals to have a balanced approach to performance review and measurement.

A **value mindset** means that senior managers are fully aware that their ultimate financial objective is maximising value. They have clear rules for deciding when other objectives (such as employment or environmental goals) outweigh this objective; and that they have a solid analytical understanding of which performance variables drive the value of the company.

Planning, target setting, performance measurement, and incentive systems need to be linked to value creation at the different levels of the organisation. Management processes and systems encourage managers and employees to behave in a way that maximises the value of the organisation.

a) **For the head of a business unit**, the objective may be stated as value creation measured in financial terms.

b) **A functional manager's goals** could be expressed in terms of customer service.

c) A **manufacturing manager** might focus on operational measures such as cost per unit, cycle time, or defect rate.

The focus of VBM should be on the **why** and **how** of **changing the organisation's corporate culture**. A value-based manager balances an awareness of organisational behaviour with using valuation as a performance metric and decision-making tool.

Case Study

How VBM works

The article explains how VBM works in practice.

'When VBM is working well, an organisation's management processes provide decision makers at all levels with the right information and incentives to make value-creating decisions.

Take the **manager of a business unit**. VBM would provide him or her with the information to quantify and compare the value of alternative strategies and the incentive to choose the value-maximising strategy. Such an incentive is created by specific financial targets set by senior management, by evaluation and compensation systems that reinforce value creation, and – most importantly – by the strategy review process between manager and superiors. In addition, the manager's own evaluation would be based on long- and short-term targets that measure progress toward the overall value creation objective.

Line managers and supervisors can have targets and performance measures that are tailored to their particular circumstances but driven by the overall strategy.

A **production manager** might work to targets for cost per unit, quality, and turnaround time. At the top of the organisation, on the other hand, VBM informs the board of directors and corporate centre about the value of their strategies and helps them to evaluate mergers, acquisitions, and divestitures. Value-based management can best be understood as a marriage between a value creation mindset and the management processes and systems that are necessary to translate that mindset into action. Taken alone, either element is insufficient. Taken together, they can have a huge and sustained impact.'

Value drivers

VBM requires that management understand the performance variables that create the value of the business that is the key **value drivers**. Management cannot act directly on value, but can respond to things it *can* influence such as customer satisfaction, cost, and capital expenditure.

A **value driver** is any variable that affects the value of the company.

Value drivers need to be ranked in terms of their **impact on value** and **responsibility assigned** to individuals who can help the organisation meet its targets.

Value drivers must be matched to the appropriate level of management so that they are consistent with the decision variables that are directly under the control of line management.

Value drivers are useful at three levels in the organisation.

a) **Generic**, where operating margins and invested capital are combined to compute ROIC; (ROIC Return on Invested Capital is the USA equivalent of ROCE, Return on Capital Employed (UK))

b) **Business unit**, where variables such as customer mix are particularly relevant;

c) **Grass roots**, where value drivers are precisely defined and tied to specific decisions that front-line managers have under their control.

So value drivers are usually cascaded in 'trees' down the organisation so that each layer of management has clear targets relevant to areas under their control.

These 'trees' are then usually linked into ROIC trees, which are in turn linked into multi-period cash flows and valuation of the business unit.

It can be difficult to **identify key value drivers** because it requires an organisation to think about its processes in a different way and existing reporting systems are often not equipped to supply the necessary information. Mechanical approaches based on available information and purely financial measures rarely succeed. What is needed instead is a creative process involving much trial and error. Nor can value drivers be considered in isolation from each other. The article suggests that a good way of relating a range of value drivers is to use **scenario analysis**. It is a way of assessing the impact of different sets of mutually consistent assumptions on the value of a company or its business units.

Management processes

VBM also requires that managers must establish **processes** that ensure all line managers **adopt value-based thinking** as an improved way of making decisions. VBM must eventually involve every decision maker in the company.

The article notes that there are **four essential management processes** that collectively govern the adoption of VBM. These four processes are linked across the company at the **corporate, business-unit, and functional levels**. The four processes which run in order are expressed below as steps:

Step 1 A company or business unit **develops a strategy** to maximise value.

Step 2 This strategy translates into short- and long-term **performance targets** defined in terms of the key value drivers.

Step 3 **Action plans and budgets** are drawn up to define the steps that will be taken over the next year or so to achieve these targets.

Step 4 Finally **performance measurement and incentive systems** are set up to monitor performance against targets and to encourage employees to meet their goals.

a) **Strategy development**

Corporate level. Under VBM, senior management devises a corporate strategy that explicitly maximises the overall value of the company, including buying and selling business units as appropriate. This should be built on a thorough understanding of business-unit strategies.

Business-unit level. Alternative strategies, should be weighed up and the one chosen with the highest value. The chosen strategy should spell out how the business unit will achieve a competitive advantage that will permit it to create value. The VBM elements of the strategy then apply. They include:

(i) **Assessing the results of the valuation** and the key assumptions driving the value of the strategy.

(ii) **Assessing the value of the alternative strategies that were discarded**, along with the reasons for rejecting them.

(iii) **Looking at resource requirements**. Business-unit managers need to focus on the statement of financial position (balance sheet) and also consider human resource requirements.

(iv) **Summarising the strategic plan projections**, by focusing on the key value drivers. These should be supplemented by an analysis of the Return on Invested Capital (ROIC) over time and relative to competitors.

(v) **Analysing alternative scenarios** to assess the effect of competitive threats or opportunities.

b) **Target setting**

The next step, after strategies for maximising value are agreed, is to translate these into specific targets. In applying VBM to target setting, several general principles are helpful:

(i) **Base targets on key value drivers**. This should cover both financial and non-financial targets. The latter serve to prevent manipulation of short-term financial targets.

(ii) **Tailor the targets to the different levels within an organisation**. So that senior business-unit managers should have targets for overall financial performance and unit-wide non-financial objectives. Functional managers need functional targets, such as cost per unit and quality.

(iii) **Link short-term targets to long-term ones**. The article gives the example of setting linked performance targets for ten years, three years, and one year. The ten-year targets express a company's aspirations; the three-year targets define how much progress it has to make within that time in order to meet its ten-year aspirations; and the one-year target is a working budget for managers.

The article notes that 'Ideally, targets should be expressed in terms of value, but since value is always based on long-term future cash flows and depends on an assessment of the future, short-term targets need a more immediate measure derived from actual performance over a single year.

Economic profit is a short-term financial performance measure that is tightly linked to value creation. It is defined as: *Economic profit = Invested capital x (Return on invested capital – Weighted average cost of capital)*

Economic profit measures the gap between what a company earns during a period and the minimum it must earn to satisfy its investors. Maximising economic profit over time will also maximize company value.'

c) **Action plans and budgets**

Then, management must translate strategy into the specific steps that an organisation will take to achieve its targets, particularly in the short term through action plans. The plans must identify the actions that the organisation will take so that it can pursue its goals in a methodical manner.

d) **Performance measurement**

Finally performance measurement and incentive systems will track progress in achieving targets and motivate managers and other employees to achieve them. VBM may force a company to modify its traditional approach to these systems by linking performance measures to long-term value creation and strategy. In particular, it shifts performance measurement from being **accounting driven** to being **management driven**. Key principles include:

(i) **Tailor performance measurement to the business unit**. Each business unit should have its own performance measures which it can influence.

(ii) **Link performance measurement to a unit's short- and long-term targets**. Performance measurement systems are often based almost exclusively on accounting results.

(iii) **Combine financial and operating performance in the measurement**. Financial performance is often reported separately from operating performance, whereas an integrated report would better serve managers' needs.

(iv) **Identify performance measures that serve as early warning indicators**. Early warning indicators might be simple non-financial indicators such as market share or sales trends. Once performance measurements are an established part of corporate culture and managers are familiar with them, it is time to revise the compensation system.

The pitfalls of VBM

Case Study

Value-based management is not without some problems however as the article illustrates.

'A few years ago, the chief planning officer of a large company gave us a preview of a presentation intended for his chief financial officer and board of directors. For about two hours we listened to details of how each business unit had been valued, complete with cash flow forecasts, cost of capital, separate capital structures, and the assumptions underlying the calculations of continuing value. When the time came for us to comment, we had to give the team A+ for their valuation skills. Their methodology was impeccable. But they deserved an F for management content. None of the company's significant strategic or operating issues were on the table. The team had not even talked to any of the operating managers at the group or business-unit level. Scarcely relevant to the real decision makers, their presentation was a staff-captured exercise that would have no real impact on how the company was run. Instead of value-based management, this company simply had value veneering. '.

CHAPTER ROUNDUP

- VBM aligns an organisation's overall aspirations, analytical techniques, and management processes with the **key drivers of value**. So, VBM takes the idea of creating value through return on future cash flow and embeds this in the organisational culture in its strategy, as well as making this a performance measure to be used throughout the organisation.

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STUDY UNIT 20

Performance Hierarchy

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EXAM GUIDE

In the exam for **this paper**, you should **focus** on the implication of mission and objectives for **performance management.** In other words, this is **not**, emphatically, a **paper about strategy** as such.

MISSION STATEMENTS AND VISION

Vision is oriented towards the future, to give a sense of direction to the organisation. **Mission** describes an organisation's basic purpose, what it is trying to accomplish.

Underlying the behaviour and management processes of most organisations are one or two **guiding ideas**, which **influence the organisation's activities**. Management writers typically analyse these into two categories: vision and mission.

Mission:	What is the business for?
Vision:	Where is the business going?

Case Study

Beyond petroleum

Vision

In the early 1990s, BP articulated its 'vision' as follows:

'With our bold, innovative strategic agenda, BP will be the world's most successful oil company in the 1990s and beyond.'

In the early 2000s, BP effectively rebranded itself, with an advertising campaign with the strapline 'beyond petroleum'. Although petrol is the world's principal source of global warming, BP is trying to promote an 'environmentally conscious' message, by repositioning itself as an energy company and investing more in alternative or renewable sources of energy such as solar power.

Arguably, the 'vision' has changed. From the stated desire to be the world's most successful oil company, BP has moved to a state 'beyond' petroleum. The point is that as a business progresses, its vision will need to be “updated”.

But what about **mission**? Mission describes the **purpose** of the company, in other words why it exists at all. Many organisations interpret their mission in terms of stakeholders, typically the owners or shareholders and customers.

BP once described itself as follows:

'BP is a family of businesses principally in oil and gas exploration and production, refining and marketing, chemicals and nutrition. In everything we do we are committed to creating wealth, always with integrity, to reward the stakeholders in BP – our shareholders, our employees, our customers and suppliers and the community.'

Case Study

The *Times Online* reported the result of research by Bain & Company *(Bain & Company's Management Tools 2005 survey)* which found that 72% of companies have a vision or mission statement. However the survey also reported that 88% of companies had them back in 1993.

The survey concluded that 'They are a fashion staple which is in decline'.

Vision

A **vision** for the future has three aspects.

a) What the business *is* now

b) What it *could* be in an ideal world

c) What the ideal world would be like

A **vision** gives a **general sense of direction** to the company. A vision, it is hoped, enables **flexibility** to exist in the context of a **guiding idea**.

Mission

Mission 'describes the organisation's basic function in society, in terms of the products and services it produces for its clients'. (Mintzberg)

Case Study

The Co-op

The Co-operative movement (The Co-operative Group is the UKs larget mutual business – owned by its members most of whom are customers) in the UK is a good example of the role of mission. Its mission is not simply profit. Being owned by suppliers/customers rather than external shareholders, it has always, since its foundation, had a wider social concern.

“The Co-op” has been criticised by some analysts on the grounds that it is insufficiently profitable, certainly in comparison with supermarket chains such as Tesco in the UK or Simba and Nakumatt in Rwanda. The Co-op has explicit **social** objectives, however. In some cases it will retain stores which, although too small to be as profitable as a large supermarket, provide an important social function in the communities which host them.

Of course, the Co-op's performance as a retailer can be improved, but judging it on the conventional basis of profitability ignores its social objectives.

An expanded definition of mission includes four elements.

Elements of mission	Detail
Purpose	**Why does the company exist?** • To create wealth for shareholders? • To satisfy the needs of all stakeholders (including employees, society at large, for example)?
Strategy	Mission provides the commercial logic for the company, and so defines the following. • Nature of its business • Products/services it offers; competitive position • The competences and competitive advantages by which it hopes to prosper, and its way of competing
Policies and standards of behaviour	The mission needs to be converted into everyday performance. For example, a firm whose mission covers excellent customer service must deal with simple matters such as politeness to customers, speed at which phone calls are answered and so forth.
Values and culture	Values are the basic, perhaps unstated, beliefs of the people who work in the organisation

Mission statements

A **mission statement** should be brief, flexible and distinctive, and is likely to place an emphasis on serving the customer.

Although many organisations do not have a clearly defined mission, they are becoming increasingly common, especially in larger organisations, and are usually set out in the form of a mission statement. This **written declaration of an organisation's central mission** is a useful concept that can:

a) Provide a ready reference point against which to make decisions

b) Help guard against there being different (and possibly misleading) interpretations of the organisation's stated purpose

c) Help to present a clear image of the organisation for the benefit of customers and the general public

Most mission statements will address some of the following aspects.

a) The **identity** of the persons for whom the organisation exists (such as shareholders, customers and employees)

b) The **nature of the firm's business** (such as the products it makes or the services it provides, and the markets it produces for)

c) Ways of **competing** (such as reliance on quality, innovation, technology and low prices; commitment to customer care; policy on acquisition versus organic growth; and geographical spread of its operations)

d) **Principles of business** (such as commitment to suppliers and staff; social policy, for example, on non-discrimination or environmental issues)

e) **Commitment to customers**

A number of questions need to be considered when a mission statement is being formulated.

a) Who is to be served and satisfied?

b) What need is to be satisfied?

c) How will this be achieved?

Case Study

The *Financial Times* reported the result of research by the Digital Equipment Corporation into a sample of 429 company executives.

- 80% of the sample have a formal mission statement.
- 80% believed mission contributes to profitability.
- 75% believe they have a responsibility to implement the mission statement.

Mission statements might be reproduced in a number of places (at the front of an organisation's annual report, on publicity material, in the chairman's office, in communal work areas and so on) as they are used to communicate with those inside and outside the organisation.

There is no standard format, but they should possess certain characteristics.

a) **Brevity –** easy to understand and remember

b) **Flexibility –** to accommodate change

c) **Distinctiveness –** to make the firm stand out

d) **Open-ended –** not stated in quantifiable terms

They tend to **avoid commercial terms** (such as profit) and **do not refer to time frames** (some being carved in stone or etched on a plaque!).

A mission does not have to be internally oriented. Some of the most effective focus outwards – on customers and/or competitors. Most mission statements tend to place an **emphasis on serving the customer.**

Case Study

a) **Private sector organisations** (such as Bank of Kigali Ltd, Bralirwa Ltd or Agro-Live) traditionally seek to make a profit, but increasingly companies try to project other images too, such as being environmentally friendly, being a good employer, or being a provider of friendly service. Here's one such example.

   The Bank of Kigali: Vision: Bank of Kigali aspires to be the leading provider of most innovative financial solutions in the region.

   And the mission: Our mission is to be the leader in creating value for our stakeholders by providing the best financial services to businesses and individual customers, through motivated and professional staff.

   Public sector organisations (such as district councils, universities, colleges and hospitals) provide services and increasingly seek to project quality, value for money, green issues, concern for staff (equal opportunities) and so on as missions. This is illustrated by the following examples.

   For instance: 'The University of Bradford (in UK) makes knowledge work through accessible programmes of teaching, learning and research with particular emphasis on applied and multi-disciplinary areas of study. It aims to support students in developing the knowledge, understanding and skills that will enable them to fulfil their intellectual and personal potential, and thereby make a mature and critical contribution to society. It aims to attract and retain high quality academic staff, actively engaged in teaching and research.'

   (University of Bradford)

   Voluntary and community sector organisations cover a wide range of organisations including charities, trades unions, pressure groups and religious organisations. They usually exist either to serve a particular need or for the benefit of their membership. Such organisations do need to raise funds but they will rarely be dedicated to the pursuit of profit. Their mission statements are likely to reflect the particular interests they serve (and perhaps the values of their organisation). Here are some examples.

'We work to preserve the diversity and abundance of life on earth and the health of ecological systems by:

(i) Protecting natural areas and wild populations of plants and animals

(ii) Promoting sustainable approaches to the UK of renewable natural resources

(iii) Promoting more efficient use of resources and energy and the maximum reduction of pollution'

(The World Wide Fund for Nature)

b) The following statements were taken from annual reports of the organisations concerned. Are they mission statements? If so, are they any good?

(i) Before its succession of mergers, **Glaxo, now GlaxoSmithKline,** described itself as 'an integrated research-based group of companies whose corporate purpose is to create, discover, develop, manufacture and market throughout the world, safe, effective medicines of the highest quality which will bring benefit to patients through improved longevity and quality of life, and to society through economic value.'

(ii) **The British Film Institute** claimed 'The BFI is the UK national agency with responsibility for encouraging and conserving the arts of film and television. Our aim is to ensure that the many audiences in the UK are offered access to the widest possible choice of cinema and television, so that their enjoyment is enhanced through a deeper understanding of the history and potential of these vital and popular art forms.'

Mission and planning

Although the mission statement might be seen as a set of abstract principles, it can play an important **role in the planning process**.

a) **Inspires planning**. Plans should develop activities and programmes consistent with the organisation's mission.

b) **Screening**. Mission also acts as a yardstick by which plans are judged.

c) Mission also affects the **implementation** of a planned strategy, in the culture and business practices of the firm.

Factors to incorporate in a mission statement

- The business areas in which the organisation will operate
- The organisation's reason for existence
- The stakeholder groups served by the organisation

GOALS AND OBJECTIVES: AN INTRODUCTION

Goals and **objectives** are set out to give flesh to the mission in any particular period.

Definitions

There is much confusion over the terms 'goals' and 'objectives'. Some writers use the terms interchangeably while others refer to them as two different concepts, unfortunately with no consistency as to which term refers to which concept.

Here we will use the following definitions/distinctions.

- (Shorter-term) **objectives** are the means by which (longer-term) **goals** can ultimately be achieved.
- **Goals** are based on an individual's value system whereas **objectives** are based on practical needs.
- **Goals** are therefore more subjective than **objectives**.

In particular, **operational goals** can be **expressed as quantified (SMART) objectives:** **S**pecific, **M**easurable, **A**ttainable, **R**esults-oriented, **T**ime-bounded

a) Mission: deliver a quality service

b) Goal: enhance manufacturing quality

c) Objectives: over the next twelve months, reduce the number of defects to 1 part per million

Non-operational goals or **aims** cannot be expressed as objectives.

a) A university's goal might be to **'seek truth'**. This cannot really be expressed as a quantified objective. To 'increase truth by 5% this year' does not make a great deal of sense.

b) **Customer satisfaction** is a goal, but satisfying customers and ensuring that they remain satisfied is a continuous process that does not stop when one target has been reached.

In practice, most organisations set themselves quantified objectives in order to enact the corporate mission.

Features of goals and objectives in organisations

a) **Goal congruence.** Goals should be consistent with each other.

(i) **Across all departments.** There should be **horizontal** consistency. In other words, the goals set for different parts of the organisation should be consistent with each other.

(ii) **At all levels.** Objectives should be consistent **vertically**, in other words at all levels in the organisation.

(iii) **Over time.** Objectives should be consistent with each other over time.

b) An objective should **identify the beneficiaries** as well as the nature and size of the benefit.

Types of goal, how they are developed and set

Goal	Comment
Ideological goals	These goals focus on the organisation's mission. They are shared sets of beliefs and values.
Formal goals	These are imposed by a dominant individual or group such as shareholders. People work to attain these goals as a route to their personal goals.
Shared personal goals	Individuals reach a consensus about what they want out of an organisation (e.g. a group of academics who decide they want to pursue research).
System goals	Derive from the organisation's existence as an organisation, independent of mission.

Organisations set goals in a number of different ways.

Goals can be **set** in many different ways: top down; bottom up; imposed; consensus; precedent.

Method	Comment
Top-down	Goals and objectives are structured from 'top to bottom', a cascading process down the hierarchy, with goals becoming more specific the 'lower' down the hierarchy.
Bottom-up	People in individual departments set their own goals, which eventually shape the overall goals of the organisation.
By precedent	Some goals are set simply because they have been set before (e.g. last year's sales targets plus 5%)
By 'diktat'	A few key individuals dictate what the goals should be.
By consensus	Goals and objectives are achieved by a process of discussion amongst managers – reputedly, Japanese companies employ this approach.

The **setting** of **objectives** is very much a **political process**: objectives are formulated following **bargaining** by the various interested parties.

a) Shareholders want profits leading to dividends and capital growth.

b) Employees want salaries and good working conditions.

c) Managers want power.

d) Customers demand quality products and services.

These **conflicting** requirements make it **difficult** to **maximise** the **objectives** of any **one particular group**. The objectives have to **change over time**, too, to reflect the changing membership of the groups.

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CORPORATE OBJECTIVES

Corporate objectives concern the firm as a whole. **Unit objectives** are specific to individual units of an organisation.

Corporate objectives are set as part of the corporate planning process. Basically, the **corporate planning process** is concerned with the **selection** of **strategies** which will **achieve** the **corporate objectives** of the organisation.

Corporate objectives versus unit objectives

Corporate objectives should relate to the **key factors for business success.**

a) Profitability
b) Market share
c) Growth
d) Cash flow
e) Return on capital employed
f) Risk
g) Customer satisfaction
h) Quality
i) Industrial relations
j) Added value
k) Earnings per share

Similar objectives can be developed for each **strategic business unit (SBU).** (An SBU is a part of the company that for all intents and purposes has its own distinct products, markets and assets.)

Unit objectives, on the other hand, **are specific to individual units of an organisation**.

Types	Examples
Commercial	• Increase the number of customers by x% (an objective of a sales department) • Reduce the number of rejects by 50% (an objective of a production department) • Produce monthly reports more quickly, within 5 working days of the end of each month (an objective of the management accounting department)
Public sector	• Introduce x% more places at nursery schools (an objective of a local education department) • Respond more quickly to calls (an objective of a local police station, fire department or hospital ambulance service)
General	• Resources (e.g. cheaper raw materials, lower borrowing costs, 'top-quality college graduates') • Market (e.g. market share, market standing) • Employee development (e.g. training, promotion, safety) • Innovation in products or processes • Productivity (the amount of output from resource inputs) • Technology

Primary and secondary objectives

An organisation has many objectives: even a mission may have multiple parts. It has been argued that there is a **limit** to the **number of objectives** that a manager can **pursue effectively**. Too many and the manager cannot give adequate attention to each and/or the focus may inadvertently be placed on minor ones. Some objectives are more important than others. It has therefore been suggested that there should be one **primary corporate objective** (restricted by certain constraints on corporate activity) and other **secondary objectives**. These are **strategic objectives** which should **combine to ensure the achievement of the primary corporate objective**.

a) For example, if a company sets itself a **primary objective** of **growth in profits**, it will then have to develop strategies by which this primary objective can be achieved.

b) **Secondary objectives** might then be concerned with sales growth, continual technological innovation, customer service, product quality, efficient resource management (e.g. labour productivity) or reducing the company's reliance on debt capital.

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SUBSIDIARY OR SECNDARY OBJECTIVES

Primary corporate objectives are supported by **secondary objectives**, for example for product development or market share. In practice there may be a trade-off between different objectives.

Whatever primary objective(s)is (are) set, **subsidiary objectives** will then be **developed beneath** them.

Types of subsidiary objective

Financial

We will be considering these in the next chapter.

Technological

a) A commitment to product design and production methods using current and new technology

b) A commitment to improve current products through research and development work

c) A commitment to a particular level of quality

Product market

Objectives for products and markets	Comment
Market leadership	Whether the organisation wants to be the market leader, or number two in the market etc.
Coverage	Whether the product range needs to be expanded
Positioning	Whether there should be an objective to shift position in the market – e.g. from producing low-cost for the mass market to higher-cost specialist products
Expansion	Whether there should be a broad objective of 'modernising' the product range or extending the organisation's markets

Product market objectives are **key**, as the organisation satisfies its shareholders by operating in product market areas. Most major product market objectives are **set at corporate level**.

Others

a) Objectives for the **organisation structure** are particularly important for growing organisations.

b) **Productivity objectives**. When an organisation is keenly aware of a poor profit record, cost reduction will be a primary consideration. Productivity objectives are often quantified as targets to reduce unit costs **and increase output per employee** by a certain percentage each year.

c) **Expansion or consolidation** objectives are concerned with the question of whether there is a need to expand, or whether there is a need to consolidate for a while.

Ranking objectives and trade-offs

Where there are multiple objectives a **problem of ranking** can arise.

a) **There is never enough time or resources** to achieve all of the desired objectives.

b) **There are degrees of accomplishment**. For example, if there is an objective to achieve a 10% annual growth in earnings per share, an achievement of 9% could be described as a near-success. When it comes to ranking objectives, a target ROI of, say, 25% might be given greater priority than an EPS growth of 10%.

When there are **several key objectives**, **some** might be **achieved only at the expense of others.** For example, attempts to achieve a good cash flow or good product quality, or to improve market share, might call for some sacrifice of short-term profits.

For example, there might be a choice between the following two options.

Option A	15% sales growth, 10% profit growth, a RWF10 million negative cash flow and reduced product quality and customer satisfaction
Option B	8% sales growth, 5% profit growth, a RWF5 million surplus cash flow, and maintenance of high product quality/customer satisfaction

If the firm chose option B in preference to option A, it would be trading off sales growth and profit growth for better cash flow, product quality and customer satisfaction. It may feel that the long-term effect of reduced quality would negate the benefits under Option A.

One of the tasks of strategic management is to ensure **goal congruence**. Some objectives may not be in line with each other, and different stakeholders have different sets of priorities.

Departmental plans and objectives

Implementation involves three tasks.

a) **Document the responsibilities** of divisions, departments and individual managers.

b) **Prepare responsibility charts** for managers at divisional, departmental and subordinate levels.

c) **Prepare activity schedules** for managers at divisional, departmental and subordinate levels.

Responsibility charts

Responsibility charts can be drawn up for management at all levels in the organisation, including the board of directors. They show the **control points** that indicate what needs to be achieved and how to recognise when things are going wrong. For each manager, a responsibility chart will have **four main elements**.

a) The manager's major **objective**

b) The manager's general **programme for achieving** that objective

c) **Sub-objectives**

d) Critical **assumptions** underlying the objectives and the programme

Example: responsibility charts for marketing director

a) **Major objective and general programme:** to achieve a targeted level of sales, by selling existing well-established products, by breaking into new markets and by a new product launch

b) **Sub-objectives:** details of the timing of the product launch; details and timing of promotions, advertising campaigns and so on

c) **Critical assumptions:** market share, market size, competitors' activity and so on

Activity schedules

Successful implementation of corporate plans also means **getting activities started** and **completed on time**. Every manager should have an **activity schedule** in addition to his responsibility chart, which identifies what **activities he must carry out and the start-up and completion dates** for each activity.

Critical dates might include equipment installation dates and product launch dates. In some markets, the launch date for a new product or new model can be extremely important, with an aim to gain maximum exposure for the product at a major trade fair or exhibition. New car models must be ready for a major motor show, for example. If there is a delay in product launch there might be a substantial loss of orders which the trade fair could have generated.

Consequently, **to ensure co-ordination**, the various **functional objectives** must be **interlocked**.

a) **Vertically** from top to bottom of the business.

b) **Horizontally**, for example, the objectives of the production function must be linked with those of sales, warehousing, purchasing, R&D and so on.

c) **Over time**. Short-term objectives can be regarded as intermediate milestones on the road towards long-term objectives.

Hierarchy of objectives

The hierarchy of objectives which emerges is this.

Mission
↓
Goals
↓
Objectives
↓
Strategy
↓
Tactics
↓
Operational plans

↑ Increasing coverage of aspects of the organisation

Objectives are normally established within this hierarchical structure. Each level of the hierarchy derives its objectives from the level above, so that all ultimately are founded in the organisation's mission. Objectives therefore cascade down the hierarchy so that, for example, strategies are established to achieve objectives and they, in turn, provide targets for the purposes of tactical planning.

SOCIAL AND ETHICAL OBLIGATIONS

Goals and objectives are often set with **stakeholders** in mind. For a business, adding value for shareholders is a prime corporate objective, but other stakeholders need to be satisfied. There is no agreement as to the extent of the **social** or **ethical** responsibilities of a business.

Public opinion and attitudes, and **legal and political pressures**, mean that organisations can **no longer concentrate solely on financial corporate objectives**. Environmental and social obligations now play a part in shaping an organisation's objectives.

Stakeholder approach

An organisation's stakeholders have a significant impact on its social and ethical obligations.

Stakeholders are groups of people or individuals who have a legitimate interest in the activities of an organisation. They include customers, employees, the community, shareholders, suppliers and lenders.

There are three broad types of stakeholder in an organisation.

a) **Internal** stakeholders (employees, management)

b) **Connected** stakeholders (shareholders, customers, suppliers, financiers)

c) **External** stakeholders (the community, government, pressure groups)

The stakeholder approach suggests that **corporate objectives** are, or should be, **shaped** and **influenced** by **those** who have **sufficient involvement or interest** in the organisation's operational activities.

Internal stakeholders: employees and management

Because employees and management are so **intimately connected** with the company, their objectives are likely to have a **strong influence** on how it is run. They are interested in the following issues.

a) The **organisation's continuation and growth**. Management and employees have a special interest in the organisation's continued existence.

b) Managers and employees have **individual interests** and goals which can be harnessed to the goals of the organisation.

(i) Jobs/careers	(iii) Benefits	(v) Promotion
(ii) Money	(iv) Satisfaction	

For managers and employees, an organisation's social obligations will include the provision of safe working conditions and anti-discrimination policies.

Connected stakeholders

Increasing shareholder value should assume a **core role** in the strategic management of a business. If **management performance** is **measured and rewarded by reference to changes in shareholder value** then shareholders will be happy, because managers are likely to **encourage long-term share price growth**.

Connected stakeholder	Interests to defend
Shareholders (corporate strategy)	• Increase in shareholder wealth, measured by profitability, P/E ratios, market capitalisation, dividends and yield • Risk
Bankers (cash flows)	• Security of loan • Adherence to loan agreements
Suppliers (purchase strategy)	• Profitable sales • Long-term relationship • Payment for goods
Customers (product market strategy)	• Goods as promised • Future benefits

Even though **shareholders** are deemed to be interested in return on investment and/or capital appreciation, many want to **invest** in **ethically-sound** organisations.

External stakeholders

External stakeholder groups – the government, local authorities, pressure groups, the community at large, professional bodies – are likely to have quite diverse objectives.

External stakeholder	Interests to defend
Government	• Jobs, training, tax revenues
Interest/pressure groups / charities / 'civil society'	• Pollution • Rights • Other

It is external stakeholders in particular who **induce social and ethical obligations**.

Social responsibility

Why should organisations play an active social role in the society within which they function?

a) **'The public' is a stakeholder in the business**. A business only succeeds because it is part of a wider society. Giving to charity is one way of **enhancing the reputation** of the business.

b) **Charitable donations** and artistic **sponsorship** are a useful medium of **public relations** and can reflect well on the business.

c) Involving managers and staff in **community activities** is good **work experience**.

d) It helps create a **value culture** in the organisation and a sense of mission, which is good for motivation.

e) In the long term, upholding the community's values, responding constructively to criticism, contributing towards community well-being might be good for business, as it **promotes the wider environment** in which businesses flourish.

f) There is increasing **political pressure** on businesses to be socially responsible. Such activities help 'buy off' environmentalists.

Case Study

Arriva plc

Arriva plc (Arriva was acquired by Deutsche Bahn of Germany in 2010) operated bus and train services in the UK and Europe. It had a revenue of $1.6bn and 33,000 employees. Here is an extract from its 2005 accounts.

'**A community focus**

We know that we are an important part of the communities we serve. By the very nature of our business, we have a responsibility to these communities across the UK and mainland Europe. For that reason, our community relations activities are at the heart of our commitment to corporate responsibility. Our Community Relations Committee, which is chaired by an executive director, Steve Clayton, includes representatives from across the Group and it continues to work towards the vision we established in 2004: 'As a people business, we value, encourage and celebrate the contribution our employees and others make to the communities we serve.' Arriva has worked hard to establish a series of long-term partnerships giving not only financial, but also practical support. One such partnership is with Age Concern. As part of this developing partnership, in 2004 we supported Age Concern’s information technology (IT) project in Hertfordshire to help older people take part in computer training. A facility was established to help them use IT in a number of areas, including keeping in touch with family and friends, finding out information such as bus and train timetables and ordering shopping for home delivery. Arriva’s support has meant that this project was able to continue throughout 2005. We have joined forces with the Wales Deaf Rugby Union as official sponsor of the team in another successful partnership. In addition to supporting the development of deaf rugby in communities right across Arriva’s rail network, the partnership is also helping us to understand better the needs of people who are hard of hearing and ensure we offer the best possible service to all our customers.

Employees in the Community

Our employees are involved in our Community Relations Programme and vote each year for their ‘Charity of the Year’ for the UK. This has been running for six years and provides employees with the opportunity to select a charity that they would like the Group to support for 12 months. Our employees voted for Cancer Research UK as the 2006 Charity of the Year for the third year running. In the Netherlands, some of the charities we have supported during 2005 include ‘Doo een Wens’, the Dutch Make a Wish Foundation whose aim is to grant the wishes of children with life-threatening illnesses around the world; ‘Cool Flevoland’, a youth panel initiative which aims to improve young people’s interest in politics and social themes, and ‘Dance4Life’ which has been set up by young people to fight the spread of Aids. Many of our employees across the UK and mainland Europe make valuable contributions to their local communities outside of their working life with Arriva. We value this and we recognise many of their efforts through our Community Action Awards. Employees are encouraged to tell us about their charitable work. In return, they are put forward for consideration of an award, which is donated to the organisation they support. In 2005, we presented 57 cash awards to our employees for their chosen causes.

Business in the Community

We are a national member of Business in the Community (BITC) and we actively support some of its initiatives. BITC is a charitable organisation which helps businesses contribute to the social and economic regeneration of local communities. During 2005, Arriva employees from the north east of England took part in a reading programme with a local primary school, which selected pupils it felt would benefit from extra support. They listened to the children read and helped with the reading process. The project proved enjoyable and worthwhile for both the children and volunteers. We were also named as one of BITC’s top ten overall performers in the Race for Opportunity awards. This recognises efforts that organisations make to ensure that their workforce is diverse and that differences are valued and understood.'

There are **three contrasting views** about a corporation's responsibilities.

a) If the company **creates** a social problem, it must **fix** it (eg Exxon (see below)).

b) The multinational corporation has the resources to fight poverty, illiteracy, malnutrition, illness and so on. This approach **disregards who** actually **creates** the problem.

Case Study

Such an approach dates back to Henry Ford, who said 'I do not believe that we should make such an awful profit on our cars. A reasonable profit is right, but not too much. So it has been my policy to force the price of the car down as fast as production would permit, and give the benefits to the users and the labourers, with surprisingly enormous benefits to ourselves.'

c) Companies **already discharge their social responsibility**, simply by increasing their profits and thereby contributing more in taxes. If a company was expected to divert more resources to solve society's problems, this would represent a double tax.

The social audit

Social audits involve five key elements.

a) Recognising a firm's rationale for engaging in socially responsible activity

b) Identification of programmes which are congruent with the mission of the company

c) Determination of objectives and priorities related to this programme

d) Specification of the nature and range of resources required

e) Evaluation of company involvement in such programmes past, present and future

Whether or not a social audit is used depends on the degree to which social responsibility is part of the **corporate philosophy**.

Case Study

In the USA, social audits on environmental issues have increased since the Exxon Valdez catastrophe in 1989 in which millions of gallons of crude oil were released into Alaskan waters.

Conclusion

The importance of corporate social responsibility reporting is evident from facts included in 'How to be good' by Cathy Hayward (*Financial Management*, October 2002).

a) A Mori poll has found that [92 per cent of the British public believe that multinational companies should meet the highest human health, animal welfare and environmental standards wherever they are operating, and] that almost 90 per cent of British people believe the government should protect the environment, employment conditions and health even when this conflicts with the interests of multinationals.

b) A survey by the National Union of Students in UK has shown that more than 75 per cent of student jobseekers would not work for an "ethically unsound" employer.'

Ethics and ethical conduct

Whereas **social responsibility** deals with the organisation's **general stance towards society**, and affects the **activities** the organisation **chooses** to do, **ethics** relates far more to **how** an organisation **conducts** individual transactions.

We previously looked at the ethical issues that might impact on **drawing up strategic plans** as well as **affecting performance**. In this chapter we consider how ethical obligations should be considered when **pursuing** corporate objectives.

Organisations are coming under increasing pressure from a number of **sources** to behave more ethically.

a) Government
b) UK and European legislation
c) Treaty obligations (such as the Kyoto Summit)
d) Consumers
e) Employers
f) Pressure groups

These sources of pressure expect an **ethical attitude towards** the following.

a) Stakeholders
b) Animals
c) Green issues (such as pollution and the need for re-cycling)
d) The disadvantaged
e) Dealings with unethical companies or countries

A clear example of unethical conduct is **bribery**.

a) In some countries, government officials routinely demand bribes, to supplement their meagre incomes. For example customs officials demand 'commission' before releasing documentation enabling goods to move from the warehouse.

b) More serious bribes occur when companies bid for large public sector contracts, and pay substantial amounts to politicians and key decision makers.

The boundary between dubious ethics and criminality has shifted over the years, particularly with increased standards of corporate governance. **Insider dealing,** whereby individuals benefit from unpublished information which may affect the share price, used to be normal practice (a perk of working in stock broking); now it is a crime.

Attitudes to corporate ethics

Reidenbach and Robin usefully distinguish between **five different attitudes to corporate ethics**. The following is an adapted version of a report in the *Financial Times*.

a) **Amoral organisations**

Such organisations are prepared to **condone any actions that contribute to the corporate aims** (generally the owner's short-term greed). Getting away with it is the only criterion for success. Getting caught will be seen as bad luck. In a nutshell, there is **no set of values other than greed**. Obviously, this company gets away without a written code.

b) **Legalistic organisations**

Such organisations **obey the letter of the law but not necessarily the spirit of it**, if that conflicts with economic performance. Ethical matters will be ignored until they become a problem. Frequent problems would lead to a formal code of ethics that says, in effect, 'Don't do anything to harm the organisation'.

c) **Responsive companies**

These organisations take the view – perhaps cynically, perhaps not – that there is **something to be gained from ethical behaviour.** It might be recognised, for example, that an enlightened attitude towards staff welfare enabled the company to attract and retain higher calibre staff. If such a company has a formal code of ethics it will be one that reflects concern for all stakeholders in the business.

d) **Emerging ethical (or 'ethically engaged') organisations**

They take an **active** (rather than a reactive) **interest in ethical issues**.

'Ethical values in such companies are part of the culture. Codes of ethics are action documents, and contain statements reflecting core values. A range of ethical support measures are normally in place, such as ethical review committees; hotlines; ethical audits; and ethics counsellors or ombudsmen.

Problem solving is approached with an awareness of the ethical consequence of an action as well as its potential profitability, and pains are taken to uphold corporate values.'

e) **Ethical organisations**

These organisations have a **'total ethical profile'**: a philosophy that informs everything that the company does and a commitment on the part of everyone to carefully selected core values.

Case Study

The Co-operative Bank (a mutual organisation and part of the Co-operative Group in the UK), which has a strong record of ethical reporting, publishes a partnership report. This is an independently-audited ethical and ecological health check that considers how the bank is meeting its obligations to customers, employees and their families, members, suppliers, local communities, national and international society and past and future generations.

According to an article in *Financial Management* ('How to be good,' Cathy Hayward, October 2002), the ethical and ecological positioning of the Co-operative bank contributed more than £20 million, or 20 per cent, of its profits in 2001. Almost a third of its current account customers (the bank's key market) were with the bank primarily because of its ethical policies, according to a survey.

Corporate codes and corporate culture

Case Study

The following extraxct is from a UK newspaper but is a good illustration:

'Shocking tactics including bribery, fabrication and plagiarism are being used by unscrupulous drug companies to get their research published in influential medical journals, according to a damning new report.

Only a week after controversial research on the MMR (MMR = Measles, Mumps and Rubella) vaccine was discredited by the journal which published it following a 'fatal conflict of interest', an influential committee has revealed the widespread use of underhand tactics by researchers.

And the **Committee on Public Ethics (COPE)** is urging the editors of scientific journals to sign up to a new **code of conduct** aimed at preventing conflicts of interest and mistakes in published research.

The right kind of report appearing in a scientific journal can be worth millions of pounds for drug companies and manufacturers of medical equipment. In addition, industries such as tobacco, alcohol and health, and even junk foods, hope to cite studies masquerading as independent research in support of their products.

Articles in scientific journals can also be used to knock out competitors or quieten down public concern about controversial issues.

In one of the cases cited by the report a journal published a paper on passive smoking in which the authors failed to declare financial support from the tobacco industry.

On another occasion, a high-ranking government official telephoned an editor in an attempt to stop an article being written which was critical of some government research.

In one of the most disturbing examples, a team of scientists was forced to withdraw a paper after refusing to detail how they had been allowed to analyse blood taken from babies.

Tactics have also included bribery. On one occasion an editor was telephoned by a representative who said she would guarantee to buy 1,000 reprints if the journal would continue to consider for publication a study that conflicted with a policy the journal had just introduced. 'And I will buy you a dinner at any restaurant you choose,' added the representative.

Plagiarism is also seen as a growing problem in scientific papers, especially where Internet search engines allow researchers to cull information from other papers.

A spectacular example saw authors copy another study almost wholesale, but change the number of patients, the type of surgery, the regimen of one of the drugs and add data for another drug.

‘If we don’t have strict **ethics**, how can we trust medical research?’

The revelations follow the controversy surrounding Dr Andrew Wakefield’s work on the MMR vaccine, published in the Lancet in 1998. It emerged 10 days ago that Wakefield had been looking for evidence to support a legal action by parents claiming the vaccine had harmed their children at the same time.

The research, linking MMR to autism in children, sparked a major controversy and led to large numbers of parents refusing to allow their children to be treated with the jab.

Lancet editor Dr Richard Horton said the situation represented a 'fatal conflict of interest' and called into question whether Wakefield’s paper should have been published.

His comments came as the General Medical Council prepared to open an investigation into the way Wakefield carried out his study.

Last week, Sir Liam Donaldson, England’s chief medical officer, accused Wakefield of peddling 'poor science'. Wakefield has insisted he has done nothing wrong and says the science behind his study still stands.

COPE, which represents more than 178 editors around the world, is now publishing a guide for the editors of science publications. It puts them under an obligation to ensure the accuracy of the material they publish, **maintain scientific integrity** and **ensure business needs do not compromise intellectual standards**.

Editors are also asked to be willing to correct, clarify and retract material or issue apologies when necessary.

The new code warns them that they can be held responsible for publishing 'unethical' research. It advises that systems should be in place for managing **conflicts of interest** relating to journal editors, their staff, authors and the reviewers who vet papers before they are published.

The code was drafted by Dr Richard Smith, editor of the British Medical Journal - the Lancet’s main rival.

He said: 'Like everybody else we are much more interested in other people’s accountability than we are our own. Editors are peculiarly unaccountable because of their traditions of editorial freedom, and there are no bodies that attempt to regulate medical and scientific editors.'

A spokeswoman for the Medical Research Council said: 'We in no way ever approve of such tactics to get research approved. We expect scientists to abide by the highest **ethical standards** in their work.'

Bill O’ Neill, the Scottish secretary of the British Medical Association, said: 'I don’t think anyone would question the need for strict rules. If we don’t have **rigorous ethics** then how can we trust research?'

Source: *Scotsman News*, March 2004

Many commentators would argue that the introduction of a **code of ethics** is **inadequate** on its own. To be effective a code needs to be **accompanied** by **positive attempts to foster guiding values, aspirations and patterns of thinking that support ethically sound behaviour –** in short a **change of culture**.

Increasingly organisations are responding to this challenge by devising **ethics training programmes** for the entire workforce, instituting comprehensive **procedures for reporting and investigating ethical concerns** within the company, or even setting up an **ethics office** or department to supervise the new measures. About half of all major companies now have a formal code of some kind.

Lynne Paine *(Harvard Business Review,* March – April 1994) suggests that ethical decisions are becoming more important as, in the US at least, penalties for companies which break the law are becoming tougher. Paine describes two approaches to the management of ethics in organisations.

a) A **compliance-based** approach is primarily designed to ensure that the company and its personnel act within the letter of the law. Mere compliance is not an adequate means for addressing the full range of ethical issues that arise every day.

b) An **integrity-based approach** combines a concern for the law with an emphasis on managerial responsibility for ethical behaviour. When integrated into the day-to-day operations of an organisation, such strategies can help prevent damaging ethical lapses.

It would seem to follow that the imposition of social and ethical responsibilities on management should come from within the organisation itself, and that the organisation should issue its own code of conduct for its employees.

Code of conduct

A **corporate code** typically contains a **series of statements setting out the company's values and explaining how it sees its responsibilities towards stakeholders.**

The impact of a corporate code

A code of conduct can set out the company's expectations, and in principle a code may address many of the problems that the organisations may experience. However, **merely issuing a code is not enough**.

a) The **commitment of senior management** to the code needs to be real, and it needs to be very clearly communicated to all staff. Staff need to be persuaded that expectations really have changed.

b) Measures need to be taken to **discourage previous behaviours** that conflict with the code.

c) **Staff need to understand** that it is in the **organisation's best interests** to change behaviour, and become committed to the same ideals.

d) Some employees – including very able ones – may find it very difficult to buy into a code that they **perceive may limit their own earnings** and/or restrict their freedom to do their job.

e) In addition to a general statement of ethical conduct, **more detailed statements** (codes of practice) will be needed to set out formal procedures that must be followed.

Case Study

An extract from Google's Code of Conduct

'Our informal corporate motto is 'Don't be evil'. We Googlers generally relate those words to the way we serve our users – as well we should. But being 'a different kind of company' means more than the products we make and the business we're building; it means making sure that our core values inform our conduct in all aspects of our lives as Google employees.

The Google **Code of Conduct** is the code by which we put those values into practice. This document is meant for public consumption, but its most important audience is within our own walls. This code isn't merely a set of rules for specific circumstances but an intentionally expansive statement of principles meant to inform all our actions; we expect all our employees, temporary workers, consultants, contractors, officers and directors to study these principles and do their best to apply them to any and all circumstances which may arise.

The core message is simple: being Googlers means striving toward the highest possible standard of **ethical business conduct**. This is a matter as much practical as ethical; we hire great people who work hard to build great products, but our most important asset by far is our reputation as a company that warrants our users' faith and trust. That trust is the foundation upon which our success and prosperity rests, and it must be re-earned every day, in every way, by every one of us.

So please do read this code, and then read it again, and remember that as our company evolves, The Google Code of Conduct will evolve as well. Our core principles won't change, but the specifics might, so a year from now, please read it a third time. And always bear in mind that each of us has a personal responsibility to do everything we can to incorporate these principles into our work, and our lives.'

THE SHORT TERM AND LONG TERM

The **S/L trade-off** refers to the balance of organisational activities aiming to achieve long-term and short-term objectives when they conflict or where resources are scarce.

Long-term and short-term objectives

Objectives may be long term and short term.

a) For example, a company's **primary objective** might be to increase its earnings per share from RWF300 to RWF500 in the next **five years**. A number of **strategies** for achieving the objective might then be selected.

   (i) Increasing profitability in the next twelve months by cutting expenditure

   (ii) Increasing export sales over the next three years

   (iii) Developing a successful new product for the domestic market within five years

b) **Secondary objectives** might then be re-assessed to include the following.

   (i) The objective of improving manpower productivity by 10% within twelve months.

   (ii) Improving customer service in export markets with the objective of doubling the number of overseas sales outlets in selected countries within the next three years.

   (iii) Investing more in product-market research and development, with the objective of bringing at least three new products to the market within five years.

Targets cannot be set without an awareness of what is realistic. Quantified targets for achieving the primary objective, and targets for secondary objectives, must therefore emerge from a realistic 'position audit'.

Trade-offs between short-term and long-term objectives

Just as there may have to be a trade-off between different objectives, so too might there be a need to make trade-offs between short-term objectives and long-term objectives. This is referred to as **S/L trade-off**.

The **S/L trade-off** refers to the balance of organisational activities aiming to achieve long term and short-term objectives when they are in conflict or where resources are scarce.

Some **decisions involve the sacrifice of longer-term objectives.**

a) Postponing or abandoning capital expenditure projects, which would eventually contribute to growth and profits, in order to protect short term cash flow and profits.

b) Cutting R&D expenditure to save operating costs, and so reducie the prospects for future product development.

c) Reducing quality control, to save operating costs (but also adversely affect reputation and goodwill).

d) Reducing the level of customer service, to save operating costs (but sacrifice goodwill).

e) Cutting training costs or recruitment (so the company might be faced with skills shortages).

Steps that could be taken to control S/L trade-offs, so that the 'ideal' decisions are taken, include the following.

a) **Making short-term targets realistic**. If budget targets are unrealistically tough, a manager will be forced to make S/L trade-offs.

b) **Providing sufficient management information** to allow managers to see what trade-offs they are making. Managers must be kept aware of long-term aims as well as shorter-term (budget) targets.

c) **Evaluating managers' performance** in terms of contribution to long-term as well as short-term objectives.

THE PLANNING GAP AND STRATEGIES TO FILL IT

Forecasts based on current performance may reveal a **gap** between the firm's objectives and the likely outcomes. New strategies (e.g. market penetration, market development, product development, diversification, withdrawal) are developed to fill the gap.

Strategic planners need to consider the extent to which new strategies are needed to enable the organisation to achieve its objectives. One technique whereby this can be done is **gap analysis**.

Gap analysis

Gap analysis involves comparing an organisation's ultimate objective (most commonly expressed in terms of demand, but may be reported in terms of profit, ROCE and so on) and the expected performance of planned and current projects.

Purpose of gap analysis

a) Determine the organisation's targets for achievement over the planning period

b) Establish what the organisation would be expected to achieve if it 'did nothing' (did not develop any new strategies, but simply carried on in the current way with the same products and selling to the same markets)

This **difference is the 'gap'**. **New strategies** will then have to be developed which will **close this gap**, so that the organisation can expect to achieve its targets over the planning period. We cover these strategies below.

The planning gap is not the gap between the current position of the organisation and the forecast desired position.

Rather, it's the gap between the forecast position from continuing with current activities, and the forecast of the desired position.

A **forecast based on doing nothing** will probably provide an unrealistic estimate of future performance, but it is **useful**.

a) The forecast is used to determine the requirement for new strategies and so it must exclude such strategies.

b) Including the impact of strategies of which the organisation has little or no experience will produce an even more inaccurate forecast.

c) It reduces the complexity involved in the forecasting exercise.

d) It provides an assessment of what could be achieved without taking on new risk.

Forecasts must cover a period far enough into the future to reveal any significant gap. **How far ahead** an organisation needs to plan, however, will depend on the **lead time for corrective action to take effect**, which in turn depends on the **nature of the organisation's business** and the **type of action required**.

Closing the gap with product-market strategies

A **product-market strategy** considers the mix of products and markets. The aim of such strategies is to close the gap found by gap analysis.

Product-market mix is a short hand term for the **products/services** a firm sells (or a service which a public sector organisation provides) and the **markets** it sells them to.

Product-market mix: Ansoff's growth vector matrix

The Ansoff matrix identifies various options.

- **Market penetration**: current products, current markets
- **Market development**: current products, new markets
- **Product development**: new products, current markets
- **Diversification**: new products, new markets

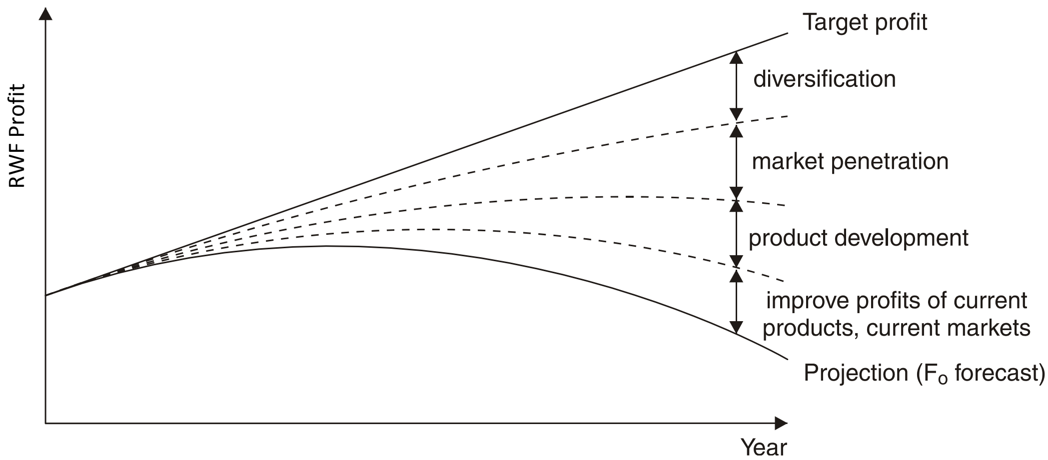
All of these can secure growth.

Igor Ansoff drew up a **growth vector matrix**, describing how a combination of a firm's activities in current and new markets, with existing and new products, can lead to **growth**. Ansoff's original model was a four cell matrix based on product and market.

We look at Ansoff's matrix in more detail in Study Unit 21. All you need to know here is that the matrix is used to indicate **strategies** for **closing the gap** found by gap analysis.

Closing the profit gap and product-market strategy

The aim of product-market strategies is to **close the profit gap** that is found by gap analysis. A mixture of strategies may be needed to do this.



It is worth remembering that **divestment** is a product-market option to close the profit gap, if the business is creating losses.

A related question is what do you do with spare capacity – go for market penetration, or go into new markets. Many companies begin exporting into new overseas markets to use surplus capacity.

The strategies in the Ansoff matrix are not mutually exclusive. A firm can quite legitimately pursue a penetration strategy in some of its markets, while aiming to enter new markets.

OPERATIONAL PERFORMANCE

Operations can make or break strategies. They are directly focused on value-adding activities.

The Study Guide requires you to **'identify and discuss the characteristics of operational performance'**.

Operations are the day to day activities that are carried out in order to achieve specific targets and objectives. Here are some examples.

Sector	Operations carried out by …
Fast-food	Staff employed at a McDonald's checkout
Bank	Dealer on the Forex markets
Law	Solicitor finalising the details of a contract for a client
Call centre	People hosting the switch board
Media	TV camera-person, or presenter Website construction
Manufacturing	Assembly line worker
Construction	Building site operations

These examples show that operations are directly focused on **activities which immediately add value to the customer**.

Unlike strategy, which involves taking decisions, operations have the following **characteristics**.

a) **Customer-facing**, in service industries

b) **Specialised**, as the tasks are closely defined

c) **More likely to be routine**, but this is not true of all 'operations'

d) **Limited in scope**

e) Characterised by **short time horizons**

f) **Easier to automate** than some management tasks

The significance of operations

a) Many operational activities require **expert or specialised skills –** such as surgery.

b) Operations can be areas of **significant risk** for a company and its customers.

c) Operations are **'moments of truth'** between the firm and its customers. A company's reputation can be made or broken by the quality of its goods and services, which are determined by operational quality and consistency.

d) The **operational infrastructure** comprises the most **significant element of cost** for most businesses.

e) The most **well-designed strategy** can be **destroyed by poor implementation** at operational level.

f) Operations and the deployment of operational activities are a key determinant of **organisation structure**.

PLANNING AND CONTROL AT DIFFERENT LEVELS IN THE PERFORMANCE HIERARCHY

Planning and **control** occurs at all levels of the performance hierarchy to different degrees.

Planning

Although it implies a 'top down' approach to management, we could describe **a cascade of goals, objectives and plans** down through the layers of the organisation. The **plans** made at the **higher levels** of the performance hierarchy provide a **framework** within which the plans at the lower levels must be achieved. The **plans** at the **lower levels** are the **means** by which the plans at the higher levels are achieved.

It could therefore be argued that without the plans allied directly to the vision and corporate objective the operational-level and departmental plans have little meaning. **Planning** could therefore be deemed as **more significant** at the **higher levels** of the performance hierarchy than the lower levels.

This is not to say that planning at an operational level is not important. It is just that the two types of planning are different.

Level	Detail
Corporate plans	• Focused on overall performance • Environmental influence • Set plans and targets for units and departments • Sometimes qualitative (e.g. a programme to change the culture of the organisation) • Aggregate
Operational plans	• Based on objectives about 'what' to achieve • Specific (e.g. acceptable number of 'rings' before a phone is answered) • Little immediate environmental influence • Likely to be quantitative • Detailed specifications • Based on 'how' something is achieved • Short time horizons

Control

Consider how the activities of **planning** and **control** are **inter-related**.

a) **Plans** set the targets.

b) **Control** involves two main processes.

(i) **Measure** actual results against the plan.

(ii) **Take action** to adjust actual performance to achieve the plan or to change the plan altogether.

Control is therefore **impossible without planning.**

The essence of control is the **measurement of results** and **comparing** them with the original **plan**. Any deviation from plan indicates that **control action** is required to make the results conform more closely with plan.

Feedback

Feedback occurs when the results (outputs) of a system are used to control it, by adjusting the input or behaviour of the system.

A business organisation uses feedback for control.

a) **Negative feedback** indicates that results or activities must be brought back on course, as they are deviating from the plan.

b) **Positive feedback** results in control action continuing the current course. You would normally assume that positive feedback means that results are going according to plan and that no corrective action is necessary: but it is best to be sure that the control system itself is not picking up the wrong information.

c) **Feedforward control** is control based on **forecast** results: in other words if the forecast is bad, control action is taken well in advance of actual results.

There are two types of feedback.

a) **Single loop feedback** is control, like a thermostat, which regulates the output of a system. For example, if sales targets are not reached, control action will be taken to ensure that targets will be reached soon. The plan or target itself is not changed, even though the resources needed to achieve it might have to be reviewed.

b) **Double loop feedback** is of a different order. It is information used to **change the plan itself**. For example, if sales targets are not reached, the company may need to change the plan.

Control at different levels

You might think that control can only occur at **the lower-levels** of the performance hierarchy, as that is the type of control you have encountered in your studies to date (standard costing, budgetary control). Such **control** has the following **features.**

a) Exercised externally by management or, in the case of empowered teams, by the staff themselves

b) Immediate or rapid feedback

c) Single loop feedback (i.e. little authority to change plans or targets)

Control does occur at the **higher-levels of the hierarchy**, however, and has the following **characteristics**.

a) Exercised by external stakeholders (e.g. shareholders)

b) Exercised by the market

c) Double loop feedback (i.e. relatively free to change targets)

d) Often feedforward elements

Summary

The best way to envisage the differences is by **two case examples**.

Case Study

a) **Call centres**

Staff who in call centres are subject to precise controls and targets.

(i) The longest time a phone should ring before it is answered

(ii) Speed of dealing with the caller's query

(iii) Rehearsal of a 'script', or use of precise responses or prompts from software

Staff who take too long dealing with queries may be counselled or dismissed.

The targets are precisely and exactly linked to the service provided and provide rapid feedback. Control and planning is exercised over the process of delivery.

b) **Senior management**

Senior management initiate the planning process, but their time is planned to a far less rigid degree than people at operational level.

For example, the Chief Executive of Network Rail in the UK is responsible to shareholders but, given the nature of the industry and its reliance on UK government subsidies, must also be accountable to other stakeholders. The market is mainly concerned with results. Controls over corporate governance – over how the company is run – are mainly to do with ensuring the transparency and integrity of the governance process.

CHAPTER ROUNDUP

- **Vision** is oriented towards the future, to give a sense of direction to the organisation. **Mission** describes an organisation's basic purpose, what it is trying to accomplish.
- A **mission statement** should be brief, flexible and distinctive, and is likely to place an emphasis on serving the customer.
- **Goals** and **objectives** are set out to give flesh to the mission in any particular period.
- **Goals** can be **set** in many different ways: top down; bottom up; imposed; consensus; precedent.
- **Corporate objectives** concern the firm as a whole. **Unit objectives** are specific to individual units of an organisation.
- **Primary corporate objectives** are supported by **secondary objectives**, for example for product development or market share. In practice there may be a trade-off between different objectives.
- Goals and objectives are often set with **stakeholders** in mind. For a business, adding value for shareholders is a prime corporate objective, but other stakeholders need to be satisfied. There is no agreement as to the extent of the **social** or **ethical** responsibilities of a business.
- The **S/L trade-off** refers to the balance of organisational activities aiming to achieve long-term and short-term objectives when they conflict or where resources are scarce.
- Forecasts based on current performance may reveal a **gap** between the firm's objectives and the likely outcomes. New strategies (eg market penetration, market development, product development, diversification, withdrawal) are developed to fill the gap.
- A **product-market strategy** considers the mix of products and markets. The aim of such strategies is to close the gap found by gap analysis.
- The Ansoff matrix identifies various options.

  – **Market penetration**: current products, current markets
  – **Market development**: current products, new markets
  – **Product development**: new products, current markets
  – **Diversification**: new products, new markets

All of these can secure growth.

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- **Planning** and **control** occurs at all levels of the performance hierarchy to different degrees.

STUDY UNIT 21

Competitive Strategies

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EXAM GUIDE

The use of decision-making techniques to enhance performance is a core area of the syllabus. This chapter explains **three models** that could well be tested as a part of a longer question. You could also be asked to **discuss problems** in performance measurement, as part of a question. This is likely to be in response to a scenario given in a question.

Exam Focus Point

In the past, examiners have commented on how students do not answer the question set. A common fault is candidates writing all they know on a particular topic without **applying** that knowledge to the question set. You must make sure that you know the material in this chapter well so that you can select which models to **evaluate** when answering a question. This advice also applies in deciding what problems to **discuss** when considering a scenario that you are given to analyse.

STRATEGIC MODELS USED IN PLANNING AND ASSESSING BUSINESS PERFORMANCE

In this section, we review three strategic models that aid the formulation of strategy and the appraisal of business performance. Each model looks at a different aspect of the business environment in which a business operates.

a) **Porter's Five forces** considers the **sources of competition** in an industry or sector.

b) The **Boston Consulting Group matrix** helps management **assess** products, services and strategic business units in terms of their **market potential**. This is measured in terms of market share and market growth and can therefore suggest the attractiveness of entering or remaining in an industry or sector.

c) The **Ansoff growth vector matrix** uses a **matrix** consisting of new or existing products and/or markets to generate **possible strategies** to use to achieve **growth**.

Remember that the models are useful but they have limitations. Some of these are mentioned below so bear these in mind when you evaluate their usefulness in performance management and apply them to particular scenarios.

Porter's Five Forces Model

Porter's Five Forces Model suggests the importance of pressure from five competitive forces on profit.

a) **Threat of new entrants** (which will be affected by barriers to entry and expected reaction from existing firms).

b) **Threat of substitutes** (which will be determined by the level of innovation of existing producers, the ability of existing competitors to finance responses to the threat and the propensity of buyers to substitute).

c) **Bargaining power of buyers** (which will be linked to the number of buyers).

d) **Bargaining power of suppliers** (supplier power and the impact on costs being greater when there are fewer of them).

e) **Rivalry between existing competitors** (the strength of rivalry being determined by number of competitors, market power, brand identity, producer differences cost structure and so on).

The threat of new entrants (and barriers to entry to keep them out)

A new entrant into an industry will bring extra capacity and more competition. The strength of this threat is likely to vary from industry to industry and depends on two things.

a) The strength of the **barriers to entry**. Barriers to entry discourage new entrants.

b) The likely **response of existing competitors** to the new entrant.

Barriers to entry

a) **Scale economies**. High fixed costs often imply a high breakeven point, and a high breakeven point depends on a large volume of sales. If the market as a whole is not growing, the new entrant has to capture a large slice of the market from existing competitors. This is expensive (although Japanese companies have done this in some cases).

b) **Product differentiation**. Existing firms in an industry may have built up a good brand image and strong customer loyalty over a long period of time. A few firms may promote a large number of brands to crowd out the competition.

c) **Capital requirements**. When capital investment requirements are high, the barrier against new entrants will be strong, particularly when the investment would possibly be high-risk.

d) **Switching costs**. Switching costs refer to the costs (time, money, convenience) that a customer would have to incur by switching from one supplier's products to another's. Although it might cost a **consumer** nothing to switch from one brand of frozen peas to another, the potential costs for the **retailer or distributor** might be high.

e) **Access to distribution channels**. Distribution channels carry a manufacturer's products to the end-buyer. New distribution channels are difficult to establish, and existing distribution channels hard to gain access to.

f) **Cost advantages of existing producers, independent of economies of scale** include:

(i) Patent rights
(ii) Experience and know-how (the learning curve)
(iii) Government subsidies and regulations

(iv) Favoured access to raw materials

Case Study

Japanese firms

A little while ago, it was assumed that, following the success of Japanese firms worldwide in motor vehicles (*Nissan*, *Honda*, *Toyota*) and consumer electronics (e.g. *Sony*, *JVC*, *Matsushita*), no Western companies were safe from Japanese competition. *Kao* (household goods), *Suntory* (drinks), *Nomura* (banking and securities) were seen as successors to firms such as *Procter and Gamble* and *Heineken*.

This has not happened: for example, Japanese pharmaceutical firms, such as *Green Cross*, have not achieved the world domination (anticipated in 1982). US and European firms are still dominant in this industry.

Perhaps cars and consumer electronics are the exception rather than the rule. The reason for this might be distribution. Normally, outsiders do not find it easy to break into established distribution patterns. However, distribution channels in cars and consumer electronics offered outsiders an easy way in.

a) The car industry is vertically integrated, with a network of exclusive dealerships. Given time and money, the Japanese firms could simply build their own dealerships and run them as they liked, with the help of local partners. This barrier to entry was not inherently complex.

b) Consumer electronics

(i) In the early years, the consumer electronics market was driven by technology, so innovative firms such as Sony and Matsushita could overcome distribution weaknesses with innovative products, as they had plenty to invest. This lowered entry barriers.

(ii) Falling prices changed the distribution of hifi goods from small specialist shops to large cut-price outlets. Newcomers to a market are the natural allies of such new outlets: existing suppliers prefer to shun 'discount' retailers to protect margins in their current distribution networks.

Japanese firms have not established dominant positions in:

a) Healthcare, where national pharmaceuticals wholesalers are active as 'gatekeepers'

b) Household products, where there are strong supermarket chains

c) Cosmetics, where department stores and specialist shops offer a wide choice.

Entry barriers might be **lowered** by the impact of change:

a) Changes in the environment

b) Technological changes

c) Novel distribution channels for products or services

The threat from substitute products

A **substitute product** is a good or service produced by **another industry** which satisfies the same customer needs.

Case Study

Supermarkets

The major supermarket chains in the UK are all able to provide substitutes for most of the products stocked by the other chains. This means that they must keep prices competitive with each other.

Supermarkets have also expanded into products offered by specialist retailers such as electrical goods and books. This means these retailers also have substitutes for their products and must keep their prices linked to those of the supermarkets for equivalent products.

The bargaining power of buyers

Customers want better quality products and services at a lower price. Satisfying this want might force down the profitability of suppliers in the industry. Just how strong the position of customers will be depends on a number of factors.

a) How much the customer buys
b) How critical the product is to the customer's own business
c) Switching costs (i.e. the cost of switching supplier)
d) Whether the products are standard items (hence easily copied) or specialised
e) The customer's own profitability: a customer who makes low profits will be forced to insist on low prices from suppliers
f) Customer's ability to bypass the supplier (or take over the supplier)
g) The skills of the customer purchasing staff, or the price-awareness of consumers
h) When product quality is important to the customer, the customer is less likely to be price-sensitive, and so the industry might be more profitable as a consequence

Case Study

Jewellery

The market for high end jewellery is one where the customer is concerned with quality ahead of price. Customers do set themselves price limits but they are more concerned with reputation and the implied worth to the recipient of the jewellery.

The bargaining power of suppliers

Suppliers can exert pressure for higher prices. The ability of suppliers to get higher prices depends on several factors.

a) Whether there are just **one or two dominant suppliers** to the industry, able to charge monopoly or oligopoly prices

b) The threat of **new entrants** or substitute products to the **supplier's industry**

c) Whether the suppliers have **other customers** outside the industry, and do not rely on the industry for the majority of their sales

d) The **importance of the supplier's product** to the customer's business

e) Whether the supplier has a **differentiated product** which buyers need to obtain

f) Whether **switching costs** for customers would be high

Case Study

De Beers and the diamond trade

De Beers established a near monopoly over the supply of diamonds to the diamond trade from the 1930's the beginning of the 21st century. During the twentieth century, De Beers sold between 85% and 90% of the diamonds mined worldwide. Diamond dealers traditionally had to source their rough diamonds from De Beers. Prices were kept high and supply was rationed. In fact, diamonds are not rare as there are diamond mines in many countries including Canada and Australia.

In July 2004 De Beers pleaded guilty in a US court to price fixing and had to pay a $10m fine. One rival, the Lev Leviev Group, decided to invest in its own diamond mining operations, thereby bypassing De Beers entirely.

Source: various including BBC website

The rivalry amongst current competitors in the industry

The **intensity of competitive rivalry** within an industry will affect the profitability of the industry as a whole. Competitive actions might take the form of price competition, advertising battles, sales promotion campaigns, introducing new products for the market, improving after sales service or providing guarantees or warranties. Competition can stimulate demand, expanding the market, or it can leave demand unchanged, in which case individual competitors will make less money, unless they are able to cut costs.

Factors determining the intensity of competition

a) **Market growth**. Rivalry is intensified when firms are competing for a greater market share in a total market where growth is slow or stagnant.

b) **Cost structure**. High fixed costs are a temptation to compete on price, as in the short run any contribution from sales is better than none at all. A perishable product produces the same effect.

c) **Switching**. Suppliers will compete if buyers can switch easily (e.g. Coke vs. Pepsi).

d) **Capacity**. A supplier might need to achieve a substantial increase in output capacity, in order to obtain reductions in unit costs.

e) **Uncertainty**. When one firm is not sure what another is up to, there is a tendency to respond to the uncertainty by formulating a more competitive strategy.

f) **Strategic importance**. If success is a prime strategic objective, firms will be likely to act very competitively to meet their targets.

g) **Exit barriers** make it difficult for an existing supplier to leave the industry. These can take many forms.

   (i) Non-current assets with a low **break-up value** (e.g. there may be no other use for them, or they may be old)

   (ii) The cost of **redundancy payments** to employees

   (iii) If the firm is a division or subsidiary of a larger enterprise, consider the **effect of withdrawal on the other operations** within the group

   (iv) The **reluctance of managers** to admit defeat, their loyalty to employees and their fear for their own jobs

   (v) **Government pressures** on major employers not to shut down operations, especially when competition comes from foreign producers rather than other domestic producers

Using the five forces model: a caution

The five forces model provides a comprehensive framework for analysing the competitive environment. However, it must be used with caution. It's very comprehensiveness can encourage a feeling of omniscience in those who use it: a sense that all factors have been duly considered and dealt with. Unfortunately, no one is actually omniscient. Any analysis must pursue as high a degree of **objectivity** as possible. If there is too much subjectivity, unfounded complacence will result.

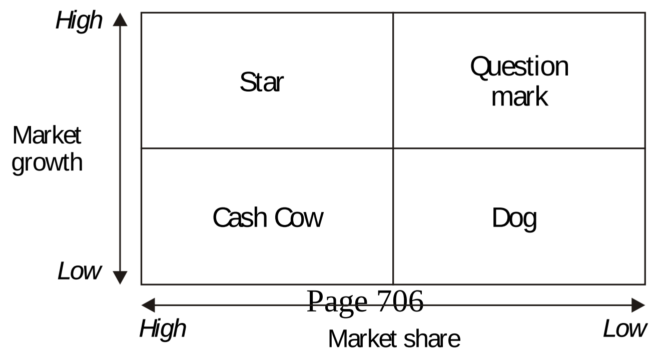
The creation in the UK of direct motor insurance selling by *Direct Line Insurance* is a case in point. Existing motor insurers' view of the threat from new entrants was that the need to create a distribution network of local agents and brokers was an **effective barrier to entry**. Direct Line's centralised call-centre approach simply **bypassed the barrier**.

The effect of subjectivity appears at an early stage in any analysis using the five forces approach. It is necessary to define with great care just what **market** or **market segment** one is dealing with. For a large organisation, or one operating in a complex environment, this may be extremely difficult. **BPP's** provision of classroom training in accountancy is a good example. The market for training for potential chartered accountants is subject to considerable **customer** bargaining power, since there are a few large firms that predominate. ACCA and CIMA courses, on the other hand, are more subject to the rivalry of existing **competitors**, since, as well as other commercial training providers, universities and local technical colleges are also sources of competition.

The need for careful analysis is, perhaps, most demanding in the area of substitute products or services. It takes a particular alertness to discern potential substitutes in the early stages of their development.

Boston Consulting Group (BCG) Portfolio matrix

The **BCG portfolio matrix** provides a method of positioning products through their life cycles in terms of market growth and market share.



a) **Stars** are products with a **high share** of a **high growth market.** In the short term, items require investment in excess of the cash they generate in order to maintain their market position, but promise high returns in the future.

b) In due course, however, stars will become **cash cows**, with a **high share** of a **low growth** (mature) **market.** They require very little investment and generate high levels of cash income. The important strategic feature of cash cows is that they are already generating high cash returns, which can support the stars.

c) **Question marks** are competitive products with a **low share** of a **high growth market.** They have the potential to become stars but a question mark hangs over their ability to achieve sufficient market retention to justify further investment.

d) **Dogs** are products with a **low share** of a low growth market. They should be allowed to die, or be killed off.

The matrix must be managed so that an organisation's product range is balanced. Four basic strategies can be adopted.

a) **Build.** This involves increasing the market share, even at the expense of short-term profits. A 'build' strategy might be to turn a question mark into a star. A **penetration pricing policy** (covered in the syllabus for Paper F5 *Performance Management*) and investment in stabilising quality and brand loyalty may be required.

b) **Hold.** This involves preserving market share and ensuring that cash cows remain cash cows. Additional investment in customer retention through competitive pricing and marketing may be required.

c) **Harvest.** This involves using funds to promote products which have the potential to become future stars or to support existing stars.

d) **Divest.** This involves eliminating dogs and question marks which are under performing.

Using the BCG matrix: cautions

a) The model is probably **too simplistic** in the four classifications used. Some divisions or products could fall into more than one category.

b) The **market** is not always **easy to define** especially if a company operates in a specialist market.

c) The model requires the collection of a **large amount** of data and this can be costly and time consuming.

d) The model fails to consider the **relationship between divisions** or any links between products.

Product-market mix: Ansoff''s growth vector matrix

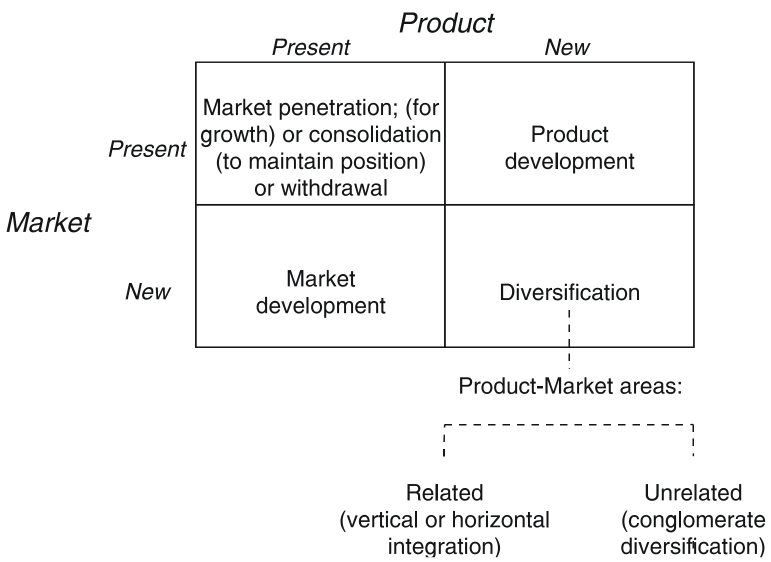
The Ansoff matrix identifies various options.

- **Market penetration**: current products, current markets
- **Market development**: current products, new markets
- **Product development**: new products, current markets
- **Diversification**: new products, new markets

All of these can secure growth.

We mentioned Ansoff's matrix briefly in Study Unit 20. There we looked at its role in **closing the gap** found by gap analysis.

Ansoff drew up a **growth vector matrix**, describing how a combination of a firm's activities in current and new markets, with existing and new products, can lead to **growth**. Ansoff's original model was a four cell matrix based on product and market, shown as the heart of the diagram below.



Present products and present markets: market penetration

Market penetration. The firm seeks to:

a) **Maintain or to increase its share** of current markets with current products, e.g. through competitive pricing, advertising, sales promotion

b) Secure dominance of growth markets

c) Restructure a mature market by driving out competitors

d) Increase usage by existing customers (e.g. 'airmiles', loyalty cards)

Present products and new markets: development

a) **New geographical areas** and export markets

b) **Different package sizes** for food and other domestic items

c) **New distribution channels** to attract new customers

d) **Differential pricing policies** to attract different types of customer and create **new market segments**.

New products and present markets: product development

Product development is the launch of new products to existing markets.

a) **Advantages**

   (i) Product development forces competitors to innovate

   (ii) Newcomers to the market might be discouraged

b) The **drawbacks** include the expense and the risk.

New products and new markets: diversification

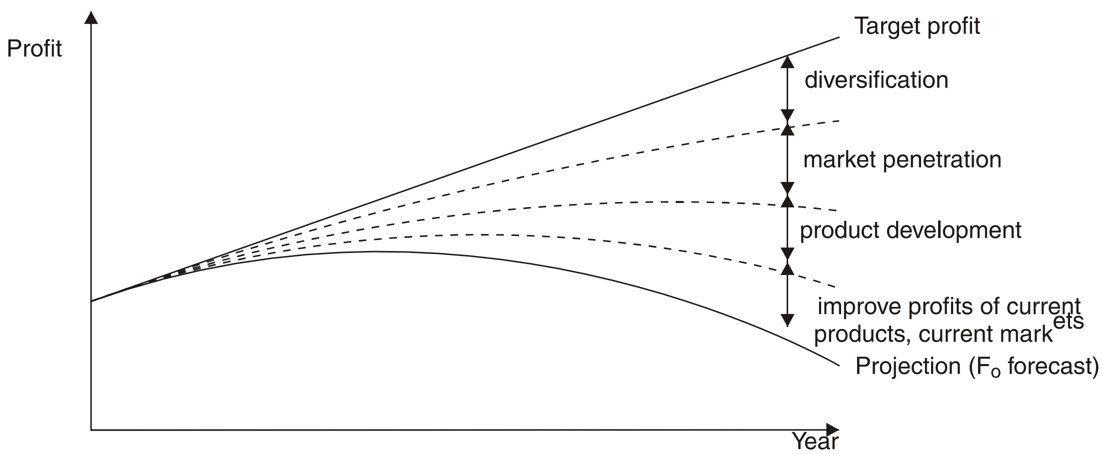
Diversification occurs when a company decides to make **new products for new markets**. It should have a clear idea about what it expects to gain from diversification.

a) **Growth.** New products and new markets should be selected which offer prospects for growth which the existing product-market mix does not.

b) **Investing surplus** funds not required for other expansion needs. (The funds could be returned to shareholders.)

Closing the profit gap and product-market strategy

The aim of product-market strategies is to **close the profit gap** that is found by gap analysis. A mixture of strategies may be needed to do this.



It is worth remembering that **divestment** is a product-market option to close the profit gap, if the business is creating losses.

A related question is what do you do with spare capacity – go for market penetration, or go into new markets. Many companies begin exporting into new overseas markets to use surplus capacity.

The strategies in the Ansoff matrix are not mutually exclusive. A firm can quite legitimately pursue a penetration strategy in some of its markets, while aiming to enter new markets.

BLANK

CRITICISMS OF PERFORMANCE INDICATORS

Performance measures are open to **misinterpretation** and **manipulation**. You need to be aware of this when you apply these measures.

Non-financial indicators versus financial measures

If performance measurement systems **focus entirely** on those items that can be **expressed in monetary terms**, managers will concentrate on only those variables and **ignore other important variables** that cannot be expressed in monetary terms.

For example, pressure from senior management to **cut costs** and **raise productivity** will produce **short-term benefits** in cost control but, in the **long term**, managerial **performance and motivation** are likely to be **affected**. Labour turnover will increase and **product quality** will **fall**.

Reductions in cost can easily be measured and recorded in performance reports. Employee morale cannot. **Performance reports** should therefore **include** not only financial measures but **other** important **variables** too, to give an indication of expected future results from current activity. The **wider implications** for the organisation of **achieving a particular indicator** should always be **considered**.

Pursuit of detailed operational goals

A danger of indicators measuring operational performance, especially non-financial indicators, is that managers might be led into pursuing detailed operational goals, becoming **blind to the overall objectives** that these goals were meant to attain.

Not measuring what is supposed to be measured

Sometimes performance indicators do not actually measure what they are supposed to be measuring.

For example, suppose that an organisation wished to measure the **efficiency of its production workforce** and used profit margin to do so.

Although **profit margin** is a key measure of efficiency (the efficiency with which sales have been used to generate profit), the **production workforce cannot directly affect the revenue earned**. Use of the indicator should therefore be **questioned**. Or maybe the organisation should **instead be measuring** the workforce's **productivity**.

Manipulating the way in which performance is measured

Suppose a poster in a doctor's surgery states that the doctor sees 98% of patients punctually. This sounds impressive. But you need to ask **how 'punctually' has been defined**. It could be that punctual means the patient was seen within ten minutes of the appointment time. You should also consider whether such a statement was based on the experience of all patients, or whether a **sample** was used. And if a sample was used, could it be **biased**? What if the doctor cut short the appointments of those patients he knew not to be in the sample in order to ensure those patients in the sample were seen on time.

CHAPTER ROUNDUP

- **Porter's Five Forces Model** suggests the importance of pressure from five competitive forces on profit.

- The **BCG portfolio matrix** provides a method of positioning products through their life cycles in terms of market growth and market share.

- The Ansoff matrix identifies various options.

  - **Market penetration**: current products, current markets
  - **Market development**: current products, new markets
  - **Product development**: new products, current markets
  - **Diversification**: new products, new markets

  All of these can secure growth.

- Performance measures are open to **misinterpretation** and **manipulation**. You need to be aware of this when you apply these measures.

STUDY UNIT 22

Performance Measurement Models

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EXAM GUIDE

One of the syllabus aims is to be able **to advise [...] on strategic business performance evaluation [...]**. So you must think about how you would use the models here in a report to advise management. Also you must think about the action words used in the study guide so you may need to **'evaluate'** in your exam answer.

Exam Focus Point

The examiner may ask you to **discuss** links between performance measures in an organisation. The question made clear which model to apply by using key words such as **vertical**, **horizontal**, **hierarchy, internal and external** aspects.

This represents an easy five marks as the words give a strong hint of the performance pyramid.

THE BALANCED SCORECARD

The **balanced scorecard** approach to performance measurement focuses on four different perspectives and uses financial and non-financial indicators.

Knowledge brought forward from earlier studies

The **balanced scorecard** approach emphasises the need to provide management with a set of information which covers all relevant areas of performance in an objective and unbiased fashion. The information provided may be both financial and non-financial and cover areas such as profitability, customer satisfaction, internal efficiency and innovation.

The balanced scorecard focuses on **four different perspectives**, as follows.

Perspective	Question	Explanation
Customer	What do existing and new customers value from us?	Gives rise to targets that matter to customers: cost, quality, delivery, inspection, handling and so on.
Internal	What processes must we excel at to achieve our financial and customer objectives?	Aims to improve internal processes and decision making.
Innovation and learning	Can we continue to improve and create future value?	Considers the business's capacity to maintain its competitive position through the acquisition of new skills and the development of new products.
Financial	How do we create value for our shareholders?	Covers traditional measures such as growth, profitability and shareholder value but set through talking to the shareholder or shareholders direct.

Performance targets are set once the key areas for improvement have been identified, and the balanced scorecard is the main monthly report.

The scorecard is **'balanced'** as managers are required to think in terms of **all four** perspectives, to prevent improvements being made in one area at the expense of another.

An example of how a balanced scorecard might appear is offered below.

Balanced Scorecard

Financial Perspective

GOALS	MEASURES
Survive	Cash flow
Succeed	Monthly sales growth and operating income by division
Prosper	Increase market share and ROI

Customer Perspective

GOALS	MEASURES
New products	Percentage of sales from new products
Responsive supply	On-time delivery (defined by customer)
Preferred supplier	Share of key accounts' purchases
	Ranking by key accounts
Customer partnership	Number of cooperative engineering efforts

Internal Business Perspective

GOALS	MEASURES
Technology capability	Manufacturing configuration vs competition
Manufacturing excellence	Cycle time
	Unit cost
	Yield
Design productivity	Silicon efficiency
	Engineering efficiency
New product introduction	Actual introduction schedule vs plan

Innovation and Learning Perspective

GOALS	MEASURES
Technology leadership	Time to develop next generation of products
Manufacturing learning	Process time to maturity
Product focus	Percentage of products that equal 80% sales
Time to market	New product introduction vs competition

Read the case study. You should be able to identify the perspectives as they appear here.

Case Study

The fall from grace of Digital Equipment Corporation, in the past second only to IBM in the world computer rankings, was examined in a *Financial Times* article. The downfall is blamed on Digital's failure to keep up with the development of the PC, but also on the company's **culture**.

The company was founded on **brilliant creativity**, but was **insufficiently focused** on the bottom line. Outside the finance department, monetary issues were considered vulgar and **organisational structure** was chaotic. Costs were not a core part of important decisions – 'if expenditure was higher than budget, the problem was simply a bad budget'. Ultimately the low-price world of lean competitors took its toll, leading to huge losses. It was acquired by Compaq which itself is now part of the HP (Hewlett Packard) group

Advantages and disadvantages of the balanced scorecard

Important features of this approach are as follows.

a) It looks at both **internal and external** matters concerning the organisation.

b) It is related to the key elements of a company's **strategy**.

c) **Financial and non-financial** measures are linked together.

As with all techniques, problems can arise when it is applied.

Problem	Explanation
Conflicting measures	Some measures in the scorecard such as research funding and cost reduction may naturally conflict. It is often difficult to determine the balance which will achieve the best results.
Selecting measures	Not only do appropriate measures have to be devised but the number of measures used must be agreed. Care must be taken that the impact of the results is not lost in a sea of information.
Expertise	Measurement is only useful if it initiates appropriate action. Non-financial managers may have difficulty with the usual profit measures. With more measures to consider this problem will be compounded.
Interpretation	Even a financially-trained manager may have difficulty in putting the figures into an overall perspective.

The scorecard should be used **flexibly.** The process of deciding **what to measure** forces a business to clarify its strategy. For example, a manufacturing company may find that 50% – 60% of costs are represented by bought-in components, so measurements relating to suppliers could usefully be added to the scorecard. These could include payment terms, lead times, or quality considerations.

Case Study

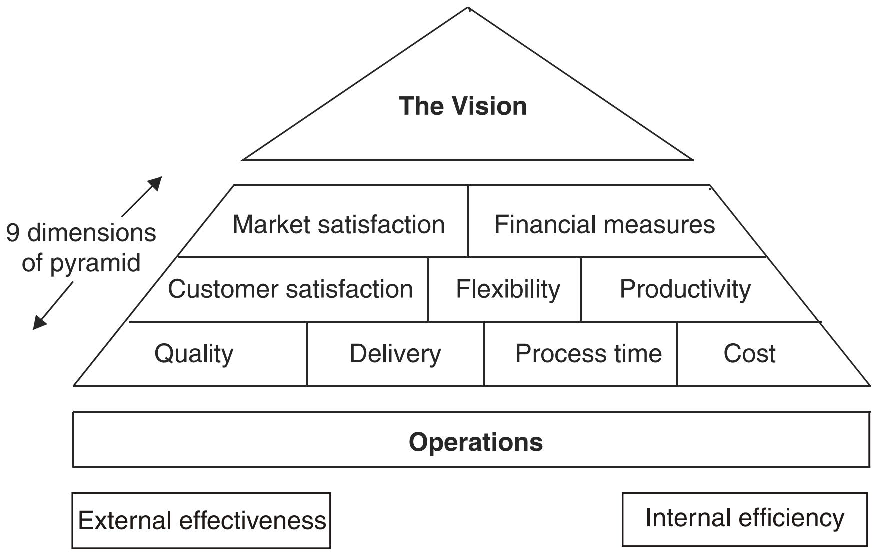
An oil company (quoted by Kaplan and Norton, *Harvard Business Review*) ties 60% of its executives' bonuses to their achievement of ambitious financial targets on ROI, profitability, cash flow and operating cost, and 40% on indicators of customer satisfaction, retailer satisfaction, employee satisfaction and environmental responsibility.

THE PERFORMANCE PYRAMID

The **performance pyramid** highlights the links running between an organisation's vision and its functional objectives.

The **performance pyramid** derives from the idea that an organisation operates at different levels, each of which has different concerns which should nevertheless support each other in achieving business objectives. The pyramid therefore links the overall strategic view of management with day to day operations.

It includes a range of **objectives** for both **external effectiveness** (such as related to customer satisfaction) and **internal efficiency** (such as related to productivity), which are achieved through measures at the various levels.



a) At **corporate level**, financial and market objectives are set.

b) At **strategic business unit** level, strategies are developed to achieve these financial and market objectives.

(i) **Customer satisfaction** is defined as meeting customer expectations.
(ii) **Flexibility** indicates responsiveness of the business operating system as a whole.
(iii) **Productivity** refers to the management of resources such as labour and time.

c) These in turn are supported by more specific **operational** criteria.

(i) **Quality** of the product or service, consistency of product and fit for the purpose for which it is intended

(ii) **Delivery** of the product or service (the method of distribution, its speed and ease of management)

(iii) **Process time** of all processes from cash collection to order processing to recruitment

(iv) **Cost**, meaning the elimination of all non-value added activities

The pyramid highlights the **links** running between the **vision for the company** and **functional objectives**. For example, a reduction in process time should lead to increased productivity and hence improved financial performance.

BUILDING BLOCKS

Fitzgerald and Moon's **building blocks** for **dimensions, standards** and **rewards** attempt to overcome the problems associated with performance measurement of service businesses.

Question

What are the five major characteristics of services that distinguish services from manufacturing. Can you relate them to the provision of a haircut?

Answer

a) **Intangibility**. A haircut is intangible in itself, and the performance of the service comprises many other intangible factors, like the music in the salon, the personality of the hairdresser.

b) **Simultaneity/inseparability**. The production and consumption of a haircut are simultaneous, and so cannot be inspected for quality in advance, nor returned if it is not what was required.

c) **Perishability**. Haircuts are perishable, so they cannot be stored. You cannot buy them in bulk, and the hairdresser cannot do them in advance and keep them in store in case of heavy demand.

d) **Heterogeneity/variability**. A haircut is heterogeneous and so the exact service received will vary each time: not only will A and B cut hair differently, but A will not consistently deliver the same standard of haircut.

e) **No transfer of ownership.** A haircut does not become the property of the customer.

Question

Consider how the factors intangibility, simultaneity, perishability, no transfer of ownership and heterogeneity apply to the various services that you use: public transport, your bank account, meals at stalls or in restaurants, the mobile ‘phone service, your annual holiday and so on.

Knowledge brought forward from earlier studies

Performance measurement in service businesses has sometimes been perceived as difficult because of the five factors listed above, but the modern view is that if something is difficult to measure this is because it has not been clearly enough defined. Fitzgerald *et al* and Fitzgerald & Moon provide **building blocks** for **dimensions, standards** and **rewards** for performance measurement systems in service businesses.

Standards

These are **ownership**, **achievability** and **equity**.

a) To ensure that employees take **ownership** of standards, they need to **participate** in the budget and standard-setting processes. They are then more likely to **accept** the standards, feel more **motivated** as they perceive the standards to be achievable and **morale** is improved. The disadvantage to participation is that it offers the opportunity for the introduction of **budgetary slack**.

b) Standards need to be set **high enough** to ensure that there is some **sense of achievement** in attaining them, but **not so high** that there is a **demotivating** effect because they are unachievable. It is management's task to find a **balance** between what the organisation perceives as achievable and what employees perceive as achievable.

c) **It is vital that equity is seen to occur when applying standards for performance measurement purposes. The performance of different business units should** not be measured against the same standards if some units have an inherent advantage unconnected with their own efforts. **For example, divisions operating in different countries should not be assessed against the same standards.**

Rewards

The reward structure of the performance measurement system should guide individuals to work towards standards. Three issues need to be considered if the performance measurement system is to operate successfully: **clarity**, **motivation** and **controllability**.

a) The organisation's objectives need to be **clearly understood** by those whose performance is being appraised i.e. they need to know what goals they are working towards.

b) Individuals should be **motivated** to work in pursuit of the organisation's strategic objectives. Goal clarity and participation have been shown to contribute to higher levels of motivation to achieve targets, providing managers accept those targets. Bonuses can be used to motivate.

c) Managers should have a certain level of **controllability** for their areas of responsibility. For example they should not be held responsible for costs over which they have no control.

Dimensions

a) **Competitive performance**, focusing on factors such as sales growth and market share.

b) **Financial performance**, concentrating on profitability, capital structure and so on.

c) **Quality of service** looks at matters like reliability, courtesy and competence.

d) **Flexibility** is an apt heading for assessing the organisation's ability to deliver at the right speed, to respond to precise customer specifications, and to cope with fluctuations in demand.

e) **Resource utilisation**, not unsurprisingly, considers how efficiently resources are being utilised. This can be problematic because of the complexity of the inputs to a service and the outputs from it and because some of the inputs are supplied by the customer (he or she brings their own hair, for example). Many measures are possible, however, for example 'number of customers per hairdresser per day/week'. Performance measures can be devised easily if it is known what activities are involved in the service.

f) **Innovation** is assessed in terms of both the innovation process and the success of individual innovations.

These dimensions can be divided into two sets.

1) The **results (**measured by financial performance and competitiveness)

2) The **determinants** (the remainder)

Focus on the examination and improvement of the determinants should lead to improvement in the results.

There is no need to elaborate on **competitive performance**, **financial performance** and **quality of service** issues, all of which have been covered already. The other three dimensions deserve more attention.

Flexibility

Flexibility has three aspects.

1) Speed of delivery

Punctuality is vital in some service industries like passenger transport: indeed punctuality is currently one of the most widely publicised performance measures - such as waiting time at hospitals out-patients, because organisations like health centres are making a point of it. **Measures** public transport might include waiting time in queues, as well as late buses. In other types of service it may be more a question of **timeliness**. Does the auditor turn up to do the annual audit during the appointed week? Is the audit done within the time anticipated by the partner or does it drag on for weeks? These aspects are all easily measurable in terms of **'days late'**. Depending upon the circumstances, 'days late' may also reflect on inability to cope with fluctuations in demand.

2) Response to customer specifications

The ability of a service organisation to respond to **customers' specifications** is one of the criteria by which Fitzgerald *et al* distinguish between the three different types of service. Clearly a professional service such as legal advice and assistance must be tailored exactly to the customer's needs. Performance is partly a matter of customer perception and so **customer attitude surveys** may be appropriate. However it is also a matter of the diversity of skills possessed by the service organisation and so it can be measured in terms of the **mix of staff skills** and the amount of time spent on **training**. In **mass service** business customisation is not possible by the very nature of the service.

3) Coping with demand

This is clearly measurable in quantitative terms in a mass service like a railway company which can ascertain the extent of **overcrowding**. It can also be very closely monitored in service shops: customer **queuing** time can be measured in banks and retailers, for example.

Professional services can measure levels of **overtime** worked: excessive amounts indicate that the current demand is too great for the organisation to cope with in the long term without obtaining extra human resources.

Resource utilisation measures

Resource utilisation is usually measured in terms of **productivity**. The ease with which this may be measured varies according to the service being delivered.

The main resource of a firm of accountants, for example, is the ”**time”** of various grades of staff. The main output of an accountancy firm is **chargeable hours**.

In a restaurant it is not nearly so straightforward. Inputs are highly **diverse**: the ingredients for the meal, the chef's time and expertise, the surroundings and the customers' own likes and dislikes. A **customer attitude survey** might show whether or not a customer enjoyed the food, but it could not ascribe the enjoyment or lack of it to the quality of the ingredients, say, rather than the skill of the chef.

Here are some of the resource utilisation ratios listed by Fitzgerald *et al*.

Business	Input	Output
Andersen Consulting	Man hours available	Chargeable hours
Commonwealth Hotels	Rooms available	Rooms occupied
Railway companies	Train miles available	Passenger miles
Barclays Bank	Number of staff	Number of accounts

Innovation

In a modern environment in which product quality, product differentiation and continuous improvement are the order of the day, a company that can find innovative ways of satisfying customers' needs has an important **competitive advantage**.

Fitzgerald *et al* suggest that **individual innovations** should be measured in terms of whether they bring about **improvements in the other five 'dimensions'**.

The innovating **process** can be measured in terms of how much it **costs** to develop a new service, how **effective** the process is (that is, how innovative is the organisation, if at all?), and how **quickly** it can develop new services. In more concrete terms this might translate into the following.

a) The amount of **R&D** spending and whether (and how quickly) these costs are recovered from new service sales

b) The proportion of **new** services to **total** services provided

c) The time between **identification** of the need for a new service and making it **available**

Now look at the Example below using your knowledge of the model.

Example

A service business has collected some figures relating to its year just ended.

		Budget	*Actual*
Customer enquiries:	New customers	6,000	9,000
	Existing customers	4,000	3,000
Business won:	New customers	2,000	4,000
	Existing customers	1,500	1,500
Types of services performed:	Service A	875	780
	Service B	1,575	1,850
	Service C	1,050	2,870
Employees:	Service A	5	4
	Service B	10	10
	Service C	5	8

Required

Calculate figures that illustrate competitiveness and resource utilisation.

Solution

Competitiveness can only be measured from these figures by looking at how successful the organisation is at converting enquiries into firm orders.

Percentage of enquiries converted into firm orders

	Budget	*Actual*
New customers (W1)	33%	44%
Existing customers (W1)	37.5%	50%

Resource utilisation can be measured by looking at average services performed per employee.

	Budget	*Actual*	*Rise*
Service A (W2)	175	195	+11.4%
Service B (W2)	157.5	185	+17.5%
Service C (W2)	210	358.75	+70.8%

Workings

1 For example 2,000/6,000 = 33%

2 For example 875/5 = 175

What comments would you make about these results? How well is the business doing?

Points to consider

There is some debate as to **how far the links between the financial results and the determinants** of those results **can be precisely identified.** Better quality will please customers, but there is a problem of **short-term versus long-term** benefits. Quality costs money now, while the benefits may take a long time to come through.

There is also the question of **how much quality** is enough: endless improvements that cost a lot of money, but are not necessarily sought by the customers (who may indeed be unwilling to pay for them) will harm long-term profitability.

Be prepared to think up performance measures for different areas of an organisation's business. Remember to make the measures relevant to the organisation in question. There is little point in suggesting measures such as waiting times in queues to assess the quality of the service provided by an educational establishment.

Question

Suggest two separate performance indicators that could be used to assess each of the following areas of a fast food chain's operations.

a) Food preparation department

b) Marketing department

Solution

Here are some suggestions.

a) Material usage per product
Wastage levels
Incidences of food poisoning

b) Market share
Sales revenue per employee
Growth in sales revenue

CHAPTER ROUNDUP

- The **balanced scorecard** approach to performance measurement focuses on four different perspectives and uses financial and non-financial indicators.

- The **performance pyramid** highlights the links running between an organisation's vision and its functional objectives.

- Fitzgerald and Moon's **building blocks** for **dimensions, standards** and **rewards** attempt to overcome the problems associated with performance measurement of service businesses.

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STUDY UNIT 23

Financial Performance Measurement

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EXAM GUIDE

This part of the syllabus lends itself to a range of possible question styles. Thus the examiner could ask for calculations as he has done in the pilot paper. He is likely to ask for commentary on these measures too, given the syllabus objectives. This part of the syllabus also covers public sector and non-profit organisations. So he may ask you to compare and contrast performance measurement in the different types of organisation.

THE PRIVATE SECTOR: SHAREHOLDER BENEFITS

The overriding **purpose** of a business is to **increase long-term owner wealth**.

Carefully read the case study below.

Case Study

The **statement of prospects** below is adapted from the published accounts of a UK printing company with revenue in 2000 of £110m, operating profits of £16m, and post-tax profit of £10m.

You may be interested in the order of priorities of the sections/paragraphs.

Note: Wyndeham Group is now owned by Walstead Investments,, a private company, and their strategy may be different. But Wyndeham Group remains a leading printer. .

Wyndeham Press plc

Group Strategy

1) Our strategy is to build on our position as one of the leading printers of magazines, brochures etc. offering a complete service for the customer from pre-press and printing to finishing and despatch. We remain focused on making acquisitions to assist in achieving our goal as well as developing our existing businesses.

Capital investment – investment criteria and budgeted expenditure

2) As referred to in the Chairman's and the Chief Executive's review, the last year has been a period of considerable investment for your company. We purchased new presses, finishing equipment and pre-press equipment, at a total cost of £14.1m. We plan to invest a further £14m this year on upgrading existing equipment and expanding capacity by installing additional machines.

Funding structure

3) Our closing level of debt is £26.7m of which £23.2m is at fixed rates ranging from 5.9% to 8.1%. The balance is at 1% over base rate and this averaged 6.4% during the period. Given the high level of **operating gearing** within a printing business, we believe our **optimal level of debt/ equity** is between 50% – 70%.

4) **Interest cover** has reduced from 14 times to 10.3 times, which is still a very healthy level, and **gearing increased to 56%.** Both ratios are well within our **targets** of a minimum of 8 times interest cover and a maximum of 70% gearing. The **covenants under our debt facilities** require a gearing of less than 85% and debt of less than twice **EBITDA** (earnings before interest, tax, depreciation and amortisation).

5) The Group has a progressive dividend policy. **Dividend growth** will follow **earnings growth** and we will maintain **dividend cover at our target of 3 times.** We believe this level of cover should generate sufficient **retained capital** to support the **equity component** of our investment programme.

Key performance indicators and benchmarking of performance

6) We benchmark our performance against a peer group of comparable businesses (A, B, C, D). We aim for **top quartile performance** compared to this group in the following categories: **operating profit** as a percentage of sales, **return on capital employed, profit per employee, proportion of repeat business.** We believe we currently rank in the top quartile of the printing sector on all these criteria.

7) The group achieved a **return on capital** employed of 29%. In the **long-term, our objective** is a steady rise in return on capital employed as a result of acquisitions, capital expenditure programmes and improvements in efficiency and machine utilisation.

Risks and sensitivities

8) The commercial risks we face in the coming year are:

   (i) If sterling continues to increase in value, overseas companies will become even more competitive on the non-magazine work.

   (ii) Whilst we expect a very modest growth in the economy, if economic activity contracts there will be a resultant decline in demand for our services.

Trading prospects

9) Our prospects for the current year are dependent on prices achieved and volume of work. We believe that volume of work will move ahead this year arising from the increased capacity generated by the installation of new plant.

10) We remain confident about the prospects for our business.

Why are shareholders important?

In the case example above, the 'statement of prospects' is expressed almost exclusively in financial terms, with the exception of the 1st paragraph. The 'prospects' are not the prospects of the business but the prospects for the **shareholders** who have invested in the company and to whom the report is aimed.

As we saw in the previous chapters, organisations are likely to have a number of goals, objectives and targets which, despite managerial effort to attain goal congruence, are at times likely to conflict. This is often due to the difficulty in satisfying the differing objectives of the organisation's various stakeholder groups.

But profit-making organisations tend to focus on financial performance in general and on the interests of shareholders in particular.

The traditional argument for this is that shareholders are the legal owners, the company belongs to them and so their interests are paramount.

Question

Go back to the case example above. Identify ways in which maximising long-term owner value was Wyndeham Press plc's objective.

Answer

a) Group strategy, to serve customers, is undertaken with profit in mind

b) Capital investment – generate future profits by raising productivity

c) Funding structure – there is generally an optimum mix of debt and equity capital. The firm monitors this to raise capital and funds at the cheapest cost – in the shareholders interests'

d) Benchmarking of performance. Although these are accounting measures, they do contribute to the long-term performance on the company. Raising return on capital employed means rewarding shareholders more each year for their investment

Significance of long-term owner focus

a) As maximising shareholder wealth is a **long-term** goal for a business, inevitably managers must decide between **what funds** they want to **disburse now** and **what funds** need to be **maintained** in the business to ensure the prospects of long-term profitability.

b) Shareholders **own the business**, and so the directors of the company have a **duty** to safeguard their interests.

c) What the shareholders require as a **return** is used to judge the **validity of investment projects**.

d) Shareholders assess the **quality of management** by how well the **business performs financially**.

e) Shareholders are the principal **source of capital investment** in a business. They provide funds on share issues or permit managers to retain profits for investment.

What are shareholders interested in?

a) Current earnings

b) Future earnings

c) Dividend policy

d) The relative risk of the investments compared to other investments and the return available

Difficulties of incorporating shareholder concerns in performance measurement for managers

a) **Accounting.** Shareholders are interested in **future returns** whereas accounts generally provide **historic information**. Accounting measures such as ROCE do not measure shareholder wealth.

b) **Shareholders** have an assessment of risk different from managers. Managers, typically, worry about their careers, which concern shareholders not at all. Shareholders are concerned about the security of their investment and the likelihood of making a return.

c) At **operating** level, it is not easy to identify exactly how well a business is doing in relation to other businesses.

d) Any other yardstick than shareholders' objectives effectively means that managers may run an organisation in their **own** interests.

Why should managers bother to know who their shareholders are?

A company's senior management should remain aware of who its major shareholders are, and it will often help to retain shareholders' support if the chairman or the managing director meets occasionally with the major shareholders, to exchange views.

a) The company's management might learn about **shareholders' preferences** for either high **dividends** or high **retained earnings** for profit growth and capital gain.

b) For public companies, changes in shareholdings might help to explain recent share price movements.

c) The company's management should be able to learn about **shareholders' attitudes to both risk and gearing**. If a company is planning a new investment, its management might have to consider the relative merits of seeking equity finance or debt finance, and shareholders' attitudes would be worth knowing about before the decision is taken.

d) Management might need to know its shareholders in the event of an unwelcome takeover bid from another company, to identify key shareholders whose views on the takeover bid might be crucial to the final outcome.

Aligning shareholder and managerial goals

One way of rewarding managers is **share options.**

a) This is regarded as a **good thing** as it means that managers have a direct financial interest in increasing owner wealth, ensuring goal congruence.

b) **Drawbacks** are more subtle.

   (i) Managers are rewarded for **past** performance, and the rewards are often **immediate.** They may be incentivised to take **short-term measures**, and ignore the long term.
   (ii) There may be a **general** rise in share prices which is not performance related.

Case Study

From *The Times, London,* Tues 13 November 2007

'Bonnie Brown was not in a position to haggle. She was recently divorced and living with her sister so when a small technology start-up offered her a job in 1999 as a part-time masseuse she took it. The post paid RWF450 a week, plus a pile of what were then worthless stock options.

Today, on the back of that package, Ms Brown, Google employee No 41, is a multimillionaire.'

This story gives a flavour of some of the rewards possible from owning options. However, no-one would suggest that Ms Brown, or indeed the other 1,000 or so Google employees who are multimillionaires put in as much as they have reaped in rewards. The dramatic rise in Google's share price is due to a range of factors from the hard work of its employees to market fever for Google shares.

Internet businesses

Between 1995 and 1999, **investors** in **Internet companies** offered **managers** share options, in return for a lower salary and long hours. The share options, potentially, could have made the managers into millionaires. For several years, managers worked long hours for reward that correlated neatly with the rewards offered to shareholders.

In 2000, the market lost confidence in Internet companies. Hired managers saw a potential RWF20m reward fall to $2m, and in many cases have left. Founders of the business have stayed on. (*Financial Times* 6/2/01).

It may therefore be unrealistic to expect managers to take the same risks with their rewards as investors, who are able to spread risks.

The growth in the internet has given shareholders an opportunity to organise and lobby the companies in which they hold shares..

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SURVIVAL AND GROWTH

Achieving objectives of **survival** and **growth** ultimately depends on making profits.

Successful businesses might report expanding sales volumes, manufacture prestigious brands, receive awards and recognition and be a good company to work for. These may be desirable achievements and objectives, but they are not enough to guarantee the survival and growth of an organisation.

The clearest **measure of success** for a business is **continued existence and expansion**. It is widely accepted that **growth requires profits** and that **growth can produce profits**; growth without profits can mean a company is taken over or goes into liquidation, that it does not survive. So whatever else it aims to do, a business must **make profits** and **make them in perpetuity.**

Despite the overriding importance of profits, growth can be measured in a number of ways.

Area of growth	Comment
Revenue	In the long term, growth in revenue is only really valuable to investors if it means growth in profits.
Profitability	There are many measures of this (see next section). Growing profitability is more useful if it is related to the level of investment.
Return of investment	A growing return on investment suggests that capital is being used more productively.
Market share	Growth in market share is generally regarded as a good thing, as it can generate economies of scale.
Number of employees	Shareholders are interested in productivity and profit per employee. An increasing head count is a measure of success if people are needed to deliver a service but people need to be employed productively.
Number of products	Growth in the number of products is only useful if the products are profitable.
Cash flow	This is one of the most important measures of growth as it ultimately determines how much a business has to invest.

Most of the time, **growth** is a sign of **success**, **provided it is profitable**. This is why it is crucial. At other times, growth can be achieved in many different ways. Look at the case example below, noting the strategies for growth and performance measures.

Case Study

From *Times Online,* 15 April 2008

Tesco, Britain's largest retailer, reported a 12 per cent jump in underlying pre-tax profit for the 12 months to February 23, and announced plans for 30,000 new jobs across the group.

The company gave no further details about the type or location of its new jobs.

The £30 billion supermarket chain made an underlying pre-tax profit of £2.8 billion, giving investors a 13 per cent increase in their annual dividend to 10.9p per share.

The underlying figures strip out costs such as pension payments and losses on financial instruments, as well as boosts such as rent-free periods. When these are added into the figures, Tesco's pre-tax profit was up 5.7 per cent.

Tesco reported a strong start to the year, with a like-for-like increase of 4 percent in UK sales, excluding petrol, in the first five weeks of 2008.

Sir Terry Leahy, the chief executive, said: "We began the new financial year confidently, with a good start in the UK, excellent progress in our established international markets and promising early performance from our investments in future growth, particularly in the US, China and Turkey."

Sir Terry's confidence is in contrast to the gloom on Britain's high streets. Last week the British Retail Consortium urged the Bank of England to cut interest rates by half a percentage point to avert a wave of job cuts as consumer spending slows down. Yesterday the BRC said that the like-for-like value of takings at the country's tills fell by 1.6 per cent in March.

At Tesco, UK sales were up 6.7 per cent like-for-like to £37.9 billion last year despite what the company described as "challenging market conditions". Without petrol sales, the percentage increase in sales was almost 4 per cent per cent, which Tesco said was slightly ahead of its planned performance.

The company said that attempts to lower prices had been hit by increased market prices for commodities and some seasonal fresh foods. Unseasonal summer weather slowed growth in the first half, Tesco said, while tougher competition from competitors and a downturn in customer demand for some of the company's non-food products cut sales in the second half.

The company said earlier this month that it would halt plans to sell its clothing lines online so that it could "improve the offer". Tesco Direct, the store's online grocery deliver service, racked up initial operating losses of £90 million.

Tesco's international division reported a 25 per cent increase in sales to £13.8 billion, with a £702 million contribution from China, which was consolidated in the accounts for the first time.

The company said last month that it would "pause for breath" in the US after opening 60 Fresh & Easy stores across Southern California and Arizona in five months. The stores are styled on the Tesco Express outlets in the UK but analysts have claimed that the shops are missing sales targets by as much as 70 per cent.

The company said today that it would separate out US sales and trading results in its interim results in September. Until then, they are included in the UK figures. Tesco said: "We are very encouraged by the start Fresh & Easy has made. ... Whilst it is still early days, the response of customers to our offer has surpassed our expectations." It insisted that US sales were ahead of budget and that plans to open about 150 new US stores this year were on track.

In its personal finance business, Tesco made a pre-tax profit of £64 million after a £11 million hit from household insurance claims from last summer's floods in Yorkshire and the Midlands.

The company's £5 billion programme to release value from its property portfolio delivered proceeds of £1.2 billion over the past year. The company admitted that yields had increased only modestly in recent months but said that demand for its property remained strong. The cash raised is used to fund a share buyback programme that has seen £1.1 billion worth of shares repurchased so far.

Tesco opened 17 new superstores and 103 express stores last year, taking its total number of outlets to 1,608 — which has raised concerns among campaigners who claim that the supermarket giants are killing Britain's high streets.

Tesco said that it was continuing to work with the Competition Commission on its inquiry into the grocery industry but issued a warning against red tape that would halt its expansion. "This is a very competitive industry from which consumers benefit hugely," the company said today. "We hope that the regulatory authorities will give due weight to this and to the need to avoid costly and burdensome new regulation."

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PROFITABILITY

Measures relating to profit include sales margin, EBITDA and EPS. More sophisticated measures (ROCE, ROI) take the size of investment into account. Later on in the chapter we consider how measures of profitability are used for **short-run** or **long-run performance measurement**. Bear this in mind particularly when you study the sections on RI, ROI and NPV and go through the examples covering these.

Case Study

Pearson, the education and publishing group, listed the following as 'financial highlights' in its 2007 annual accounts.

a) Sales
b) Operating profit (before goodwill, exceptional and non-operating items)
c) Adjusted earnings per share
d) EBITDA
e) Operating cash flow
f) Operating free cash flow
g) Return on invested capital
h) Net debt

Pearson actively targets sales growth, EBITDA and adjusted earnings per share.

You need to be able to discuss the **appropriateness** of the measures of 'profitability' covered in this section.

As a general principle, these measures of performance, which we will be looking at, are only meaningful if they are used for comparison.

a) Over time (equivalent time periods)
b) With other companies
c) With other measures of performance
d) With other industries

Profitability

A company ought of course to be profitable, and there are obvious checks on **profitability**.

a) Whether the company has made a profit or a loss on its ordinary activities

b) By how much this year's profit or loss is bigger or smaller than last year's profit or loss

It is probably better to consider separately the profits or losses on exceptional items if there are any. Such gains or losses should not be expected to occur again, unlike profits or losses on normal trading.

Question

A company has the following summarised income statements for two consecutive years.

	Year 1	*Year 2*
	RWF ‘000	RWF ‘000
Revenue	70,000	100,000
Less cost of sales	42,000	55,000
Gross profit	28,000	45,000
Less expenses	21,000	35,000
Net profit	7,000	10,000

Although the net profit margin is the same for both years at 10%, the gross profit margin is not.

Year 1 $\frac{28,000,000}{70,000,000} = 40\%$ Year 2 $\frac{45,000,000}{100,000,000} = 45\%$

Is this good or bad for the business?

Solution

An increased profit margin must be good because this indicates a wider gap between selling price and cost of sales. Given that the net profit ratio has stayed the same in the second year, however, expenses must be rising. In year 1 expenses were 30% of revenue, whereas in year 2 they were 35% of revenue. This indicates that administration, selling and distribution expenses or interest costs require tighter control.

Percentage analysis of profit between year 1 and year 2

	Year 1	*Year 2*
	%	%
Cost of sales as a % of sales	60	55
Gross profit as a % of sales	40	45
	100	100

Expenses as a % of sales	30	35
Net profit as a % of sales	10	10
Gross profit as a % of sales	40	45

Profit on ordinary activities before taxation is generally thought to be a **better** figure to use than profit after taxation, because there might be unusual variations in the tax charge from year to year which would not affect the underlying profitability of the company's operations.

Another profit figure that should be calculated is **PBIT**: **profit before interest and tax**.

a) This is the amount of profit which the company earned **before having to pay interest to the providers of loan capital**. By providers of loan capital, we usually mean longer-term loan capital, such as debentures and medium-term bank loans, which will be shown in the statement of financial position (balance sheet) as 'Suppliers: amounts falling due after more than one year.' This figure is of particular importance to bankers and lenders.

b) **How is profit before interest and tax calculated?**

The profit on ordinary activities before taxation

plus Interest charges on long-term loan capital

c) To calculate PBIT, in theory, all we have to do is to look at the interest payments in the relevant note to the accounts. Do not take the net interest figure in the income statement itself, because this represents interest payments less interest received, and PBIT is profit including interest received but before interest payments.

Sales margin

Sales margin is revenue less cost of sales.

Look at the following examples (both UK companies so stated in £ sterling).

a) **Wyndeham Press, a printer**

	2000
	£'000
Revenue	89,844
Cost of sales	(60,769)
Gross profit	29,075
Distribution expenses	(1,523)
Administrative expenses	(13,300)
Goodwill amortisation	(212)
Operating profit (15.6%)	14,040
(Interest etc)	

Cost of sales comprises **direct material** cost, such as paper, and **direct labour**. Distribution and administrative expenses include depreciation. **Sales margin = 32%**.

Sales margin at least shows the contribution that is being made, especially when direct variable costs are very significant.

b) **Arriva plc, a bus company**

	1999 £m
Revenue	1,534.3
Cost of sales	1,282.6
Gross profit	251.7
Net operating expenses	133.8
Operating profit (7.6%)	117.9
(Interest etc)	

Sales margin = 16%. Clearly a higher percentage of costs are operating costs.

c) **Lessons to be learnt**

(i) Sales margin as a measure is **not really any use in comparing different industries**.

(ii) Sales margin is **influenced** by the level of **fixed costs**.

(iii) **Trends** in sales margin are of interest. A falling sales margin suggests an organisation has not been able to pass on input price rises to customers.

(iv) **Comparisons** with similar companies are of interest. If an organisation has a lower sales margin than a similar business, this suggests problems in controlling input costs.

In short, the value of sales margin as a measure of performance depends on the cost structure of the industry and the uses to which it is put.

EBITDA

EBITDA is earnings before interest, tax, depreciation and amortisation.

Question

A multiple of EBITDA remains the most popular method for valuing media companies. Take Pearson plc as an example.

Why do you think EBITDA is 'increasingly used as a basis for valuing media companies such as Pearson'?

Solution

Pearson's 2007 sales were £4,162m.

Here is an extract from the company's 31 December 2007 statement of financial position (balance sheet) (stated in £m).

Non-current assets	£m
Intangible	3,814
Tangible	355
Investments in joint ventures and associates	20
Other assets*	594
	4,783

In other words, 80% of Pearson's **non-current assets are intangible** and are mainly **goodwill.**

* Various classes of asset itemised in the statement of financial position (balance sheet) but consolidated here for brevity.

To see what EBITDA actually does, it is worth identifying **what it omits**.

Item	Comment
Earnings	In practice this equals **profit after tax** for the financial year with some **adjustments**, as you should be aware from your financial accounting studies.
Interest	Essentially this is a **financing cost**. Pearson's statement of financial position (balance sheet) at 31/12/05 showed net assets of £3,733m. Suppliers due over one year were £2,500m, most of which were bonds and commercial paper.
Tax	The government's take is not relevant to the operating performance of the business.
Depreciation and amortisation	This is the income statement charge for **tangible** and **intangible** assets. Depreciation generally represents the writing off of expenditure incurred several years ago, not in itself relevant to performance in any particular financial year.

Advantages of EBITDA

a) It is a good proxy for **cash flow from operations**, and therefore is a measure of underlying performance. It can be seen as the proportion of operating profits converted to cash.

b) Tax and interest – while important – are effectively distributions to the government (tax) and a finance charge (interest). They are not relevant to the underlying success of this particular business.

c) EBITDA is easy to calculate and understand.

d) EBITDA can be used to assess the performance of a manager who has no control over acquisition and financing policy as it excludes costs associated with assets (depreciation) and debt (interest).

Question

When might interest be relevant in a significant way to the **operating** performance of the business?

Solution

- It depends. Short term bank interest can be a significant operating expense.
- Also, a bank itself earns money from an interest margin so interest is at the heart of what it does.

Earnings per share (EPS)

EPS is a convenient measure as it shows how well the shareholder is doing.

EPS is widely used as a **measure of a company's performance**, especially in **comparing** results over a period **of several years**. A company must be able to sustain its earnings in order to pay dividends and re-invest in the business so as to achieve future growth. Investors also look for **growth in the EPS** from one year to the next.

Earnings per share (EPS) is defined (in Financial Reporting Standard 3) as the profit in cents attributable to each equity (ordinary) share. EPS is calculated as follows.

$$\frac{\text{Profit of the period after tax, minority interests and extraordinary items, and after deducting preference dividends}}{\text{Number of equity shares in issue and ranking for dividend}}$$

Extraordinary items are unusual, non-repeating items that affect profit but have effectively been outlawed by FRS 3.

EPS on its own does not really tell us anything. It must be seen **in context**.

a) EPS is used for comparing the results of a company **over time**. Is its EPS growing? What is the rate of growth? Is the rate of growth increasing or decreasing?

b) Is there likely to be a significant **dilution of EPS** in the future, perhaps due to the exercise of share options or warrants, or the conversion of convertible loan stock into equity?

c) EPS should not be used blindly to compare the earnings of one company with another. For example, if A Co has an EPS of RWF120 for its 10,000,000 RWF100 shares and B Co has an EPS of RWF240 for its 50,000,000 RWF250 shares, we must take account of the numbers of shares. When **earnings are used to compare one company's shares with another**, this is done **using** the **P/E ratio or perhaps the earnings yield**.

d) If EPS is to be a reliable basis for comparing results, it **must be calculated consistently**. The EPS of one company must be directly comparable with the EPS of others, and the EPS of a company in one year must be directly comparable with its published EPS figures for previous years. Changes in the share capital of a company during the course of a year cause problems of comparability.

Note that EPS is a figure based on past data, and it is easily manipulated by changes in accounting policies and by mergers or acquisitions. **The use of the measure in calculating management bonuses makes it particularly liable to manipulation.** The attention given to EPS as a performance measure by City analysts is arguably disproportionate to its true worth. Investors should be more concerned with **future earnings**, but of course estimates of these are more difficult to reach than the readily available figure.

A **fully diluted EPS** (FDEPS) can be measured where the company has issued securities that might be converted into ordinary shares at some future date, such as convertible loan stock, share warrants or share options. The FDEPS gives investors an appreciation of by how much EPS might be affected if and when the options, warrants or conversion rights are exercised.

Profitability and return: the return on capital employed (ROCE)

It is impossible to assess profits or profit growth properly without relating them to the amount of funds (the capital) employed in making the profits. An important profitability ratio is therefore **return on capital employed (ROCE)**, which states the profit as a **percentage of the amount of capital employed**.

Profit is usually taken as PBIT, and capital employed is shareholders' capital plus 'suppliers: amount falling due after more than one year' plus long-term provisions for liabilities and charges. This is the same as total assets less current liabilities. The underlying principle is that we must compare like with like, and so if capital means share capital and reserves plus long-term liabilities and debt capital, profit must mean the profit earned by all this capital together. This is PBIT, since interest is the return for loan capital.

Return on capital employed (ROCE) indicates the productivity of capital employed. It is calculated as:

$$\frac{\text{Profit before interest and tax x 100}}{\text{Average capital employed}}$$

The denominator is normally calculated as the average of the capital employed at the beginning and end of the year. Problems of seasonality, new capital introduced or other factors may necessitate taking the average of a number of periods within the year.

Evaluating the ROCE

What does a company's ROCE tell us? What should we be looking for? There are three **comparisons** that can be made.

a) The change in ROCE from **one year to the next**

b) The ROCE being earned by **other companies**, if this information is available

c) A comparison of the ROCE with **current market borrowing rates**

   (i) What would be the cost of extra borrowing to the company if it needed more loans, and is it earning an ROCE that suggests it could make high enough profits to make such borrowing worthwhile?

   (ii) Is the company making an ROCE which suggests that it is making profitable use of its current borrowing?

Analysing profitability and return in more detail: the secondary ratios

We may analyse the ROCE, to find out why it is high or low, or better or worse than last year. There are two factors that contribute towards a return on capital employed, both related to revenue.

a) **Profit margin**. A company might make a high or a low profit margin on its sales. For example, a company that makes a profit of RWF250 per RWF1,000 of sales is making a bigger return on its revenue than another company making a profit of only RWF100 per RWF1,000 of sales.

b) **Asset turnover**. Asset turnover is a measure of how well the assets of a business are being used to generate sales. For example, if two companies each have capital employed of RWF100,000, and company A makes sales of RWF400,000 a year whereas company B makes sales of only RWF200,000 a year, company A is making a higher revenue from the same amount of assets and this will help company A to make a higher return on capital employed than company B. Asset turnover is expressed as 'x times' so that assets generate x times their value in annual revenue. Here, company A's asset turnover is 4 times and company B's is 2 times.

Profit margin and asset turnover together explain the ROCE, and if the ROCE is the primary profitability ratio, these other two are the **secondary ratios**. The relationship between the three ratios is as follows.

Profit margin × asset turnover = ROCE

$$\frac{\text{PBIT}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Capital employed}} = \frac{\text{PBIT}}{\text{Capital employed}}$$

It is also worth commenting on the **change in revenue** from one year to the next. Strong sales growth will usually indicate volume growth as well as revenue increases due to price rises, and volume growth is one sign of a prosperous company.

Return on investment (ROI)

Return on investment (ROI) is a form of ROCE and is calculated as:

$$\frac{\text{Profit before interest and tax x 100}}{\text{Operations management capital employed}}$$

The ROI compares income with the operational assets used to generate that income. Profit is taken before tax and interest because tax is an appropriation of profit made from the use of the investment, and the introduction of interest charges introduces the effect of financing decisions into an appraisal of operating performance.

ROI is normally used to apply to investment centres or profit centres. These normally reflect the existing organisation structure of the business.

Main reasons for the widespread use of ROI

a) **Financial reporting**. It ties in directly with the accounting process, and is identifiable from the income statement and statement of financial position (balance sheet), the firm's most important communications media with investors.

b) **Aggregation**. ROI is a very convenient method of measuring the performance for a division or company as an entire unit.

Other advantages include its ability to permit comparisons to be drawn between investment centres that differ in their absolute size.

Measurement problems: non-current assets

a) It is probably most common to use **return on net assets**.

   (i) If an investment centre maintains the **same annual profit**, and keeps the **same assets** without a policy of regular non-current asset replacement, its **ROI** will **increase year by year as the assets get older**. This can give a false impression of improving 'real' performance over time.

   (ii) It is **not easy** to **compare fairly** the performance of one investment centre with another. Non-current assets may be of different ages or may be depreciated in different ways.

   (iii) **Inflation and technological change** alter the cost of non-current assets. If one investment centre has non-current assets bought ten years ago with a gross cost of RWF1,000 million, and another investment centre, in the same area of business operations, has non-current assets bought very recently for RWF1,000 million, the quantity and technological character of the non-current assets of the two investment centres are likely to be very different.

(iv) Measuring ROI as return on **gross assets ignores the age factor**. Older non-current assets usually cost more to repair and maintain. An investment centre with old assets may therefore have its profitability reduced by repair costs.

b) **Measurement problems: what are 'assets' anyway?**

Prudence and other accounting principles require that items such as research and development should only be carried forward as an investment in special circumstances. Many 'costs' do have the effect of enhancing the long-term revenue-earning capacity of the business. A good example is **brands**: many firms have capitalised brands for this reason. For **decision-making** and **control** purposes, the expenditure on brands might be better treated as an investment.

The target return for a group of companies

If a group of companies sets a **target return** for the group as a whole, or if a company sets a target return for each SBU, it might be company policy that no investment project should go ahead in any subsidiary or investment centre unless the project promises to earn at least the target return. Here is an example.

a) There should be no new investment by any subsidiary in the group unless it is expected to earn at least a 15% return.

b) Similarly, no non-current asset should be disposed of if the asset is currently earning a return in excess of 15% of its disposal value.

c) Investments which promise a return of 15% or more ought to be undertaken.

Problems with such a policy include:

a) **Investments** are **appraised by DCF** whereas **actual performance** will probably be **measured on the basis of ROI**.

b) The **target return** makes **no allowance** for the different **risk** of each investment centre.

c) In a **conglomerate**, an **identical target return** may be **unsuitable** to many businesses in a group.

Since **managers** will be judged on the basis of the ROI that their centre earns each year, they are likely to be **motivated** into taking those decisions which **increase** their centre's **short-term ROI**.

a) An investment might be desirable from the group's point of view, but would not be in the individual investment centre's 'best interest' to undertake. Thus there is a lack of **goal congruence**.

b) In the short term, a desire to increase ROI might lead to projects being taken on without **due regard to their risk**.

c) Any decisions which **benefit** the company in the **long term** but which **reduce** the ROI in the immediate **short term** would **reflect badly** on the manager's reported performance.

Divisional performance: residual income (RI)

An alternative way of measuring the performance of an investment centre, instead of using ROI, is residual income (RI).

Residual income is a measure of the centre's profits after deducting a notional or imputed interest cost.

Its use highlights the finance charge associated with funding.

The **imputed cost of capital** might be the organisation's **cost of borrowing** or its **weighted average cost of capital**. Alternatively, the cost of capital can be adjusted to allow for the risk characteristics of each investment centre, with a higher imputed interest rate being applied to higher **risk** centres.

Example: calculation of ROI and RI

Division M is a division of MR Co. The following data relate to Division M.

Capital employed (net assets)	RWF20m
Annual profit	RWF5m
Cost of capital	15% per annum

MR Co is considering two proposals.

Proposal 1

Invest a further RWF2m in fixed assets to earn an annual profit of RWF0.30m.

Proposal 2

Dispose of fixed assets at their net book value of RWF5.5m. This would lead to profits falling by RWF0.8m per annum. Proceeds from the disposal of these fixed assets would not be credited to Division M (but to the Holding Company of MR Co instead).

Required

a) Calculate the current Return on Investment and Residual Income for Division M.

b) Consider each of the two proposals and show how the Return on Investment and Residual Income would change if these proposals were adopted.

Solution

a) **Current Return on Investment**

Return on Investment $= \dfrac{\text{Profit before interest and tax}}{\text{Operations management capital employed}} \times 100\%$

$= \dfrac{\text{Rwf 5m}}{\text{Rwf20m}} \times 100\%$

$= 25\%$

Residual Income = Annual profit – imputed interest charge on net assets

= RWF5m – (15% × RWF20m)

$= \quad$ RWF5m – RWF3m

$= \quad$ RWF2m

The Return on Investment (25%) exceeds the cost of capital (15%) and the residual income is positive (+RWF2m) and therefore Division M is performing well.

b) Let us now look at the situations that would arise if proposals 1 and 2 were to be adopted.

Proposal 1

New profit = RWF5m + RWF0.3m

= RWF5.3m

$\therefore$ New capital employed = RWF20m + RWF2m

= RWF22m

$\therefore$ **New Return on Investment** $= \dfrac{\text{Rwf5.3m}}{\text{Rwf22m}} \times 100\%$

= 24.1%

$\therefore$ **New Residual Income** = RWF5.3m – (15% × RWF22m)

= RWF5.3m – RWF3.3m

= RWF2m

Proposal 2

New profit = RWF5m – RWF0.8m

= RWF4.2m

New capital employed = RWF20m – RWF5.5m

= RWF14.5m

$\therefore$ **New Return on Investment** $= \dfrac{\text{Rwf4.2m}}{\text{Rwf14.5m}} \times 100\%$

= 29%

$\therefore$ **New Residual Income** = RWF4.2m – (15% × RWF14.5m)

= RWF4.2m – RWF2.18m

= RWF2.02m

Summary

	Current	*Proposal 1*	*Proposal 2*
Return on Investment (%)	25	24.1	29
Residual Income (RWFm)	2	2	2.02

On first inspection it appears that proposal 2 should be adopted as the ROI increases from 25% to 29% and the RI also increases slightly from RWF2m to RWF2.02m. However, divisional managers should also consider the asset rate of return relevant to Proposal 2.

Asset rate of return = $\dfrac{\text{Change in profit}}{\text{Change in investment}}$

$= \dfrac{\text{Rwf0.8m}}{\text{Rwf5.5m}} \times 100\%$

= 14.5%

Since MR Co's current rate of return is 25%, any asset which has a rate of return less than this should be disposed of. It is important to remember, therefore, that whichever proposal is accepted, it should lead to **goal congruence**.

The advantages and weaknesses of RI compared with ROI

Advantages of RI

a) Residual income **increases in the following circumstances.**

   (i) Investments earning above the cost of capital are undertaken
   (ii) Investments earning below the cost of capital are eliminated

b) Residual income is more **flexible** since a different cost of capital can be applied to investments with different risk characteristics.

Weaknesses of RI

The first is that it **does not facilitate comparisons** between investment centres nor does it relate the size of a centre's income to the size of the investment, other than indirectly through the interest charge. The second is that it can be **difficult to decide on an appropriate and accurate measure of the capital employed** upon which to base the imputed interest charge (see comments on ROI).

Cash flows: NPV and IRR

The Study Guide mentions NPV and IRR as measures of 'profitability' to be considered in this context.

The advantages and weaknesses of NPV compared with ROI and RI

Advantages include:

a) Cash flows are less subject to manipulation and subjective decisions than accounting profits.

b) It considers the opportunity cost of not holding money.

c) Risk can be allowed for by adjusting the cost of capital.

d) Shareholders are interested in cash flows (both in the short term and long term).

The **disadvantages** of the NPV approach are centred on the assumptions underlying the values of critical variables within the model. For example:

a) The duration of the cash flows

b) The timing of the cash flows

c) The appropriate cost of capital

NPV and IRR are typically used to evaluate capital investment or other discrete items of expenditure, or to compare investment projects.

Cash flows and NPVs for strategic control: shareholder wealth

Control and performance measures at a strategic level do need to pay some attention to wealth. Shareholders are interested in cash flow as the safest indicator of business success. According to one model of share valuations, the market value of the shares is based on the expected future dividend.

Control at a **strategic level** should be **based** on measurements of **cash flows** (actual cash flows for the period just ended and revised forecasts of future cash flows). Since the objective of a company might be to maximise the wealth of its shareholders, a control technique based on the measurement of cash flows and their NPV could be a very useful technique to apply. A numerical example might help to illustrate this point.

Suppose that ABC Co agrees to a **strategic plan from 1 January 20X1** as follows.

Year	*20X1*	*20X2*	*20X3*	*20X4*	*20X5*	*Total*
Planned net cash inflow (RWFm)	200	300	300	400	500	1,700
NPV at cost of capital 15%	174	227	197	229	249	1,076

Now suppose that ABC Co **reviews** its position **one year later**.

a) It can measure its actual total cash flow in 20X1 – roughly speaking, this will be the funds generated from operations minus tax paid and minus expenditure on non-current assets and plus/minus changes in working capital.

b) It can revise its forecast for the next few years.

We will assume that there has been **no change in the cost of capital**. Control information at the end of 20X1 might be as follows.

Year	*20X1* (*actual*)	*20X2* (*forecast*)	*20X3*	*20X4*	*20X5*	*Total*
Net cash inflow (RWF m)	180	260	280	400	540	1,660
NPV at cost of capital 15%	180	226	212	263	309	1,190

A **control summary** comparing the situation at the start of 20X1 and the situation one year later would now be as follows.

	RWF m
Expected NPV as at 1.1.20X1	1,076
Uplift by cost of capital 15% *	161
What NPV should have been at 31.12.20X1 **	1,237
Expected NPV as at 31.12.20X1	1,190
Variance	47 (A)

* You might wonder why we are doing this. Each cash flow in the original calculation was × by discount factor of $1/(1.15)^N$, where N = number of years between 20X1 and the cash flow. If we were to calculate the NPV starting at a point a year later the discount factor for each of the cash flows would be $1/(1.15)^{N-1}$ (i.e. a cash flow at year 2 (31 December 20X2) from 1 January 20X1 would have a discount factor of $1/1.15^2$, but when NPV is recalculated at 31 December 20X1 discount factor for 31 December 20X2 cash flow = 1/1.15. So each discount factor for recalculating is multiplied by 1.15 (changing $1/1.15^N$ to $1/1.15^{N-1}$). We can therefore × total NPV at 1 January 20X1 by 1.15 to get what NPV should have been at 31 December 20X1.

** The uplifting shows by how much the expected NPV would change if we were doing the calculation 12 months later.

The control information shows that by the end of 20X1, ABC Co **shows signs of not achieving the strategic targets** it set itself at the start of 20X1. This is partly because actual cash flows in 20X1 fell short of target by (200-180) RWF2 m, but also because the revised forecast for the future is not as good now either. In total, the company has a lower NPV by RWF47,000,000.

The **reasons for the failure** to achieve target should be investigated. Here are some possibilities.

a) A higher-than-expected pay award to employees, which will have repercussions for the future as well as in 20X1

b) An increase in the rate of tax on profit.

c) A serious delay in the implementation of some major new projects

d) The slower-than-expected growth of an important new market

Strategic progress can therefore be **measured** by **reconciling successive net present values and the intervening cash flows**. The arithmetic is straightforward and can be summed up as follows.

Step 1 The previous NPV is uplifted by the cost of capital applicable to the current period.

Step 2 The result is the 'benchmark NPV' indicating what the new NPV needs to be if long-term health has been maintained.

Step 3 Comparison of the new NPV with the benchmark produces a variance which can be analysed by cause and by time frame.

Attempt your own solution to the following question.

Internal rate of return

IRR is another way of reviewing investments. The IRR of a project can be compared to the cost of capital. It should be possible in theory to assess an IRR for a company, but other models or measures may be simpler.

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GEARING

As well as profitability, **liquidity** and **gearing** are key measures of performance.

Capital structure

The assets of a business must be financed somehow, and when a business is growing, the additional assets must be financed by additional capital. **Capital structure** refers to the **way in which an organisation** is **financed**, by a combination of long-term capital (ordinary shares and reserves, preference shares, debentures, bank loans, convertible loan stock and so on) and short-term liabilities, such as a bank overdraft and trade suppliers.

Debts and financial risk

There are two main **reasons why companies should keep their debt burden under control**.

a) When a company is heavily in debt, and seems to be getting even more heavily into debt, banks and other would-be lenders are very soon likely to refuse further borrowing and the company might well find itself in trouble.

b) When a company is earning only a modest profit before interest and tax, and has a heavy debt burden, there will be very little profit left over for shareholders after the interest charges have been paid. And so if interest rates were to go up or the company were to borrow even more, it might soon be incurring interest charges in excess of PBIT. This might eventually lead to the liquidation of the company.

A high level of debt creates financial risk. **Financial risk** can be seen from different points of view.

a) **The company** as a whole. If a company builds up debts that it cannot repay when they fall due, it will be forced into liquidation.

b) **Suppliers**. If a company cannot pay its debts, the company will go into liquidation owing suppliers money that they are unlikely to recover in full.

c) **Ordinary shareholders**. A company will not make any distributable profits unless it is able to earn enough profit before interest and tax to pay all its interest charges, and then tax. The lower the profits or the higher the interest-bearing debts, the less there will be, if there is anything at all, for shareholders.

When a company has preference shares in its capital structure, ordinary shareholders will not get anything until the preference dividend has been paid.

The appraisal of capital structures

One way in which the financial risk of a company's capital structure can be measured is by a **gearing ratio**. A gearing ratio should not be given without stating how it has been defined.

Gearing ratios

Gearing ratios measure the financial risk of a company's capital structure. Business risk can be measured by calculating a company's **operational gearing.**

Financial gearing/leverage is the use of debt finance to increase the return on equity by using borrowed funds in such a way that the return generated is greater than the cost of servicing the debt. If the return on borrowed funds is less than the cost of servicing the debt, the effect of gearing is to reduce the return on equity.

Gearing measures the **relationships between shareholders' capital plus reserves, and either prior charge capital or borrowings or both**.

Prior charge capital is capital which has a right to the receipt of interest or preference dividends before any claim is made by ordinary shareholders on distributable earnings. On winding up, the claims of holders of prior charge capital rank before those of ordinary shareholders.

Prior charge capital is:

a) Any preference share capital

b) Interest-bearing long-term capital

c) Interest-bearing short-term debt capital with less than 12 months to maturity, including any bank overdraft

However, (c) might be excluded.

Here are some commonly used measures of financial gearing, which are **based** on the **statement of financial position (balance sheet) values (book values)** of the **fixed interest and equity capital**.

$$\frac{\text{Prior charge capital}}{\text{Equity capital (including reser}} \qquad \frac{\text{Prior charge capital}}{\text{Total capital employ}}$$

With the **first definition** above, a company is **low geared** if the **gearing ratio** is **less than 100%**, highly geared if the ratio is over 100% and neutrally geared if it is exactly 100%.

Example

From the following statement of financial position (balance sheet), compute the company's financial gearing ratio.

	RWF m	RWF m	RWF m
ASSETS			
Non-current assets			12,400
Current assets			1,000
			13,400

	RWF m	RWF m	RWF m
EQUITY AND LIABILITIES			
Equity			
Called up share capital			
Ordinary shares			1,500
Preference shares			500
Share premium account			760
Revaluation reserve			1,200
Retained earnings			2,810
Non-current liabilities			
Debentures		4,700	
Bank loans		500	
			5,200
Deferred tax			300
Deferred income			250
Current liabilities			
Loans		120	
Bank overdraft		260	
Trade suppliers		430	
Bills of exchange		70	
			880
			13,400

Solution

Prior charge capital	RWF m
Preference shares	500
Debentures	4,700
Long-term bank loans	500
Prior charge capital, ignoring short-term debt	5,700
Short-term loans	120
Overdraft	260
Prior charge capital, including short-term interest bearing debt	6,080

Either figure, RWF6,080 m or RWF 5,700 m, could be used. If gearing is calculated with capital employed in the denominator, and capital employed is net non-current assets plus **net** current assets, it would seem more reasonable to exclude short-term interest bearing debt from prior charge capital. This is because short-term debt is set off against current assets in arriving at the figure for net current assets.

Equity = 1,500 + 760 + 1,200 + 2,810 = RWF6,270,000,000

The gearing ratio can be calculated in one of the following ways.

a) $\frac{\text{Prior charge capital}}{\text{Equity}}$ x 100% = $\frac{6{,}080}{6{,}270}$ x 100% = 97%

b) $\frac{\text{Prior charge capital}}{\text{Total capital employed}}$ x 100% = $\frac{5{,}700}{12{,}520}$ x 100% = 45.5%

There is **no absolute limit** to what a **gearing ratio** ought to be. Many companies are highly geared, but if a highly geared company is increasing its gearing, it is likely to have difficulty in the future when it wants to borrow even more, unless it can also boost its shareholders' capital, either with retained profits or with a new share issue.

The effect of gearing on earnings

The level of gearing has a considerable effect on the earnings attributable to the ordinary shareholders. A **highly geared** company must **earn enough profits to cover its interest charges before anything is available for equity**. On the other hand, if borrowed funds are invested in projects which provide returns in excess of the cost of debt capital, then shareholders will enjoy increased returns on their equity.

Gearing, however, also **increases the probability of financial failure** occurring through a company's inability to meet interest payments in poor trading circumstances.

Example: gearing

Suppose that two companies are identical in every respect except for their gearing. Both have assets of RWF20 m and both make the same operating profits (profit before interest and tax: PBIT). The only difference between the two companies is that Nonlever Co is all-equity financed and Lever Co is partly financed by debt capital, as follows.

	Nonlever Co	*Lever Co*
	RWF ‘000	RWF ‘000
Assets	20,000	20,000
10% Loan stock	0	(10,000)
	20,000	10,000
Ordinary shares of RWF 1,000	20,000	10,000

Because Lever Co has RWF10,000,000 of 10% loan stock it must make a profit before interest of at least RWF1,000,000 in order to pay the interest charges. Nonlever Co, on the other hand, does not have any minimum PBIT requirement because it has no debt capital. A company, which is lower geared, is considered less risky than a higher geared company because of the greater likelihood that its PBIT will be high enough to cover interest charges and make a profit for equity shareholders.

Operating gearing

Financial risk, as we have seen, can be measured by financial gearing. **Business risk** refers to the **risk of making only low profits**, or even losses, **due to the nature of the business** that the company is involved in. One way of measuring business risk is by calculating a company's **operating gearing** or **'operational gearing'**.

Operating gearing or leverage = $\frac{\text{Contribution}}{\text{Profit before interest and tax (PE}}$

If contribution is high but PBIT is low, fixed costs will be high, and only just covered by contribution. **Business risk**, as measured by operating gearing, will be **high**. If contribution is not much bigger than PBIT, fixed costs will be low, and fairly easily covered. Business risk, as measured by operating gearing, will be low.

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LIQUIDITY

A company can be profitable but at the same time get into cash flow problems. Liquidity ratios (**current** and **quick**) and **working capital turnover ratios** give some idea of a company's liquidity.

Profitability is of course an important aspect of a company's performance, and debt or gearing is another. Neither, however, addresses directly the key issue of liquidity. A company needs liquid assets so that it can meet its debts when they fall due.

Liquidity is the amount of cash a company can obtain quickly to settle its debts (and possibly to meet other unforeseen demands for cash payments too).

Liquid assets

Liquid funds include:

a) Cash

b) Short-term investments for which there is a ready market, such as investments in shares of other companies (NB **not** subsidiaries or associates)

c) Fixed-term deposits with a bank or building society, for example six month deposits with a bank

d) Trade customers

e) Bills of exchange receivable

Some assets are more liquid than others. Inventories of goods are fairly liquid in some businesses. Inventories of finished production goods might be sold quickly, and a supermarket will hold consumer goods for resale that could well be sold for cash very soon. Raw materials and components in a manufacturing company have to be used to make a finished product before they can be sold to realise cash, and so they are less liquid than finished goods. Just how liquid they are depends on the speed of inventory **turnover** and the length of the production cycle.

Non-current assets are not liquid assets. A company can sell off non-current assets, but unless they are no longer needed, or are worn out and about to be replaced, they are necessary to continue the company's operations. Selling non-current assets is certainly not a solution to a company's cash needs, and so although there may be an occasional non-current asset item which is about to be sold off, probably because it is going to be replaced, it is safe to disregard non-current assets when measuring a company's liquidity.

In summary, **liquid assets are current asset items that will or could soon be converted into cash, and cash** itself. Two common definitions of liquid assets are **all current assets** or **all current assets with the exception of inventories.**

The main source of liquid assets for a trading company is sales. A company can obtain cash from sources other than sales, such as the issue of shares for cash, a new loan or the sale of non-current assets. But a company cannot rely on these at all times, and in general, obtaining liquid funds depends on making sales and profits.

Why does profit not provide an indication of liquidity?

If a company makes profits, it should earn money, and if it earns money, it might seem that it should receive more cash than it pays out. In fact, **profits are not always a good guide to liquidity**. Two examples will show why this is so.

a) Suppose that company X makes all its sales for cash, and pays all its running costs in cash without taking any credit. Its profit for the year just ended was as follows.

b)

		RWF	RWF
Revenue			400,000
Less costs:	running costs	200,000	
	Depreciation	50,000	
			250,000
Profit			150,000
Less dividends (all paid)			80,000
Retained profits			70,000

During the year, the company purchased a non-current asset for RWF180,000 and paid for it in full.

Depreciation is not a cash outlay, and so the company's 'cash profits' less dividends were sales less running costs less dividends = RWF120,000. However, the non-current asset purchase required RWF180,000, and so the company's cash position worsened in the year by RWF60,000, in spite of the profit.

a) Suppose that company Y buys three items for cash, each costing RWF5,000, and resells them for RWF7,000 each. The buyers of the units take credit, and by the end of the company's accounting year, they were all still customers.

   (i) The profit on the transactions is RWF2,000 per unit and RWF6,000 in total.

   (ii) The company has paid RWF15,000 to buy the goods, but so far it has received no cash back from selling them, and so its cash position is so far RWF15,000 worse off from the transactions.

   (iii) The effect so far of the transactions is:

Reduction in cash	RWF15,000
Increase in customers	RWF21,000
Increase in profit	RWF6,000

   The increase in assets is RWF6,000 in total, to match the RWF6,000 increase in profit, but the increase in assets is the net change in cash (reduced balance) and customers (increased balance).

Both of these examples show ways in which a **company can be profitable but** at the same time **get into cash flow problems**. If an analysis of a company's published accounts is to give us some idea of the company's liquidity, profitability ratios are not going to be appropriate for doing this. Instead, we look at liquidity ratios and working capital **turnover** ratios.

Liquidity ratios

Current ratio

The standard test of liquidity is the current ratio. It can be obtained from the statement of financial position (balance sheet), and is **current assets/current liabilities.**

A company should have enough current assets that give a promise of 'cash to come' to meet its commitments to pay its current liabilities. Obviously, a **ratio in excess of 1 should be expected**. Otherwise, there would be the prospect that the company might be unable to pay its debts on time. In practice, a ratio comfortably in excess of 1 should be expected, but what is 'comfortable' varies between different types of businesses.

Companies are not able to convert all their current assets into cash very quickly. In particular, some manufacturing companies might hold large quantities of raw material inventories, which must be used in production to create finished goods. Finished goods might be warehoused for a long time, or sold on lengthy credit. In such businesses, where inventory **turnover** is slow, most inventories are not very liquid assets, because the cash cycle is so long. For these reasons, we calculate an additional liquidity ratio, known as the quick ratio or acid test ratio.

Quick ratio

The quick ratio, or **acid test ratio**, is **(current assets less inventories)/current liabilities.**

This ratio should ideally be **at least 1** for companies with a **slow inventory turnover**. For companies with a **fast inventory turnover**, a quick ratio can be **less than 1** without suggesting that the company is in cash flow difficulties.

Do not forget the other side of the coin. The current ratio and the quick ratio can be bigger than they should be. A company that has large volumes of inventories and customers might be over-investing in working capital, and so tying up more funds in the business than it needs to. This would suggest poor management of customers or inventories by the company.

Turnover periods

We can calculate **turnover periods** for inventory, customers and suppliers (the question below revises these calculations). The time taken to collect amounts due from customers is known as the **accounts receivable collection period**. Credit from suppliers is known as the **accounts payable payment period**. If we add together the inventory days and the days taken to collect accounts owed from customers, this should give us an indication of how soon inventory is convertible into cash. This gives us a further indication of the company's liquidity.

Example

What are the liquidity and working capital ratios from the accounts of a manufacturer of products for the construction industry, and comment on the ratios.

	20X8	*20X7*
	RWFm	RWFm
Revenue	2,065.0	1,788.7
Cost of sales	1,478.6	1,304.0
Gross profit	586.4	484.7
ASSETS		
Current assets		
Inventories	119.0	109.0
Customers (note 1)	400.9	347.4
Short-term investments	4.2	18.8
Cash at bank and in hand	48.2	48.0
	572.3	523.2
EQUITY AND LIABILITIES		
Non-current liabilities		
Loans and overdrafts	49.1	35.3
Taxes	62.0	46.7
Dividend	19.2	14.3
Suppliers (note 2)	370.7	324.0
	501.0	420.3
	RWFm	RWFm
Net current assets	71.3	102.9

		20X8	20X7
Notes			
1	Trade customers	329.8	285.4
2	Trade suppliers	236.2	210.8

Solution

	20X8	*20X7*
Current ratio	572.3/501.0 = 1.14	523.2/420.3 = 1.24
Quick ratio	453.3/501.0 = 0.90	414.2/420.3 = 0.99
Accounts receivable collection period	329.8/2,065.0 × 365 = 58 days	285.4/1,788.7 × 365 = 58 days
Inventory turnover period	119.0/1,478.6 × 365 = 29 days	109.0/1,304.0 × 365 = 31 days
Accounts payable payment period	236.2/1,478.6 × 365 = 58 days	210.8/1,304.0 × 365 = 59 days

As a manufacturing group serving the construction industry, the company would be expected to have a comparatively lengthy accounts receivable collection period, because of the relatively poor cash flow in the construction industry. It is clear that the company compensates for this by ensuring that they do not pay for raw materials and other costs before they have sold their inventories of finished goods (hence the similarity of accounts receivable and accounts payable turnover periods).

The company's current ratio is a little lower than average but its quick ratio is better than average and very little less than the current ratio. This suggests that inventory levels are strictly controlled, which is reinforced by the low inventory turnover period. It would seem that working capital is tightly managed, to avoid the poor liquidity which could be caused by a high accounts receivable collection period and comparatively high suppliers.

The accounts payable payment period is ideally calculated by the formula (trade accounts payable/purchases) × 365.

However, it is rare to find purchases disclosed in published accounts and so cost of sales serves as an approximation. The ratio often helps to assess a company's liquidity; an increase is often a sign of lack of long-term finance or poor management of current assets, resulting in the use of extended credit from suppliers, increased bank overdraft and so on

SHORT-RUN AND LONG-RUN FINANCIAL PERFORMANCE

Short-termism is often due to the fact that managers' performance is measured on short-term results.

In the previous chapter we saw how organisations often have to make a trade-off between short-term and long-term objectives which can, of course, be focused on financial performance. Advertising expenditure may be cut to increase short-term profit, but this is likely to be at the expense of long-term financial results.

Earlier on in this chapter we looked at how RI, ROI and NPV are used to measure profitability. Exam questions may test how useful these measures are for **long-run** and **short-run performance measurement.**

Case Study

In April 2001, the *Financial Times* reported on how efforts to cut costs to boost short-term profits at Marks & Spencer had long-term implications.

To fulfil expectations during the 1990s, staff numbers were limited or reduced, store enhancements were restricted, and relationships with suppliers squeezed. As a result, earnings matched market expectations for a while but eventually 'customers started to notice that value for money was not quite as good as it could have been. That you had to wait to get the attention of a sales assistant. That the shops were dowdy and so was some of the merchandise. These impressions accumulated. Gradually the positive Marks & Spencer anecdotes were replaced by negative ones. Suddenly the company's reputation fell off a cliff. And so did its profits.'

Using ROI

Suppose that an investment in a non-current asset would cost RWF100,000,000 and make a profit of RWF11,000,000 p.a. after depreciation. The asset would be depreciated by RWF25,000,000 pa for four years. It is group policy that investments must show a minimum return of 15%. The DCF net present value of this investment would just about be positive, and so the investment ought to be approved if group policy is adhered to.

Year	*Cash flow (profit before dep'n)*	*Discount factor*	*Present value*
	RWF '000	15%	RWF '000
0	(100,000)	1.000	(100,000)
1	36,000	0.870	31,320
2	36,000	0.756	27,216
3	36,000	0.658	23,688
4	36,000	0.572	20,592
		NPV	2,816

If the investment is measured year by year according to the accounting ROI it has earned, its return is less than 15% in year 1, but more than 15% in years 2, 3 and 4.

Year	*Profit*	*Net book value of equipment (mid-year value)*	*ROI*
	RWF '000	RWF '000	
1	11,000	87,500	12.6%
2	11,000	62,500	17.6%
3	11,000	37,500	29.3%
4	11,000	12,500	88.0%

In view of the low accounting ROI in year 1, should the investment be undertaken or not?

a) Strictly speaking, **investment decisions should be based on DCF yield**, and should not be guided by short-term accounting ROI.

b) Even if accounting ROI is used as a guideline for investment decisions, ROI should be looked at **over the full life** of the investment, not just in the short term. In the short term (in the first year or so of a project's life) the accounting ROI is likely to be low because the net book value of the asset will still be high.

DCF v ROI

In spite of the superiority of DCF yield over accounting ROI as a means of evaluating investments, and in spite of the wisdom of taking a longer-term view rather than a short-term view with investments, it is nevertheless an uncomfortable fact that the consideration of short-run accounting **ROI does often influence investment decisions.**

In our example, it is conceivable that the group's management might disapprove of the project because of its low accounting ROI in year 1. This approach is short-sighted, but it nevertheless can make some sense to a company or group of companies which has to show a satisfactory profit and ROI in its **published accounts** each year, to keep its **shareholders** satisfied with performance.

A similar misguided decision would occur where a divisional manager is worried about the low ROI of his division, and decides to reduce his investment by **scrapping some machinery** which is not currently in use. The reduction in both depreciation charges and assets would immediately improve the ROI. When the machinery is eventually required the manager would then be obliged to buy new equipment. Such a situation may seem bizarre, but it does occur in real life.

Short-term ROI should not be used to guide management decisions but there is a difficult motivational problem. If **management performance** is measured in terms of ROI, any decisions which benefit the company in the long term but which reduce the ROI in the immediate short term would reflect badly on the manager's reported performance. In other words, good investment decisions would make a manager's performance seem worse than if the wrong investment decision were taken instead.

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PROFITS AND SHARE VALUE

The value of the **P/E ratio** reflects the market's appraisal of the shares' future prospects.

Shareholders value shares on the **basis not of past performance** but of expectations of **future performance.**

Note that **past performance** is useful, however, in that it gives **information** about the quality of the management team, and the business' **success** at devising and executing strategies to maximise shareholders’ wealth, to date.

Shareholders may have a **view** towards a **particular industry** sector as well as an **individual business**. No matter how well a business is run, it may operate in an unattractive or mature industry sector.

Investors may have a genuinely different view of the prospects of a sector from managers, so even well-run companies in an industry may feel starved of capital at an appropriate rate. This is because they are always compared with other companies.

The **management issues** are contradictory.

a) Managers have a **personal interest** in the long-term survival of the business.

b) Shareholders want a long-term increase in their wealth from investment in a business or other companies in the sector.

Short-termism often occurs, however.

a) Managers' performance is measured on short-term results (for example quarterly reporting in the US).
b) Even investors are under pressure to maximise the growth in value of their portfolios in a particular period.

The price/earnings (P/E) ratio: profits and share value

The P/E ratio is the most important yardstick for assessing the relative worth of a share. It is:

$$\frac{\textbf{Market price in ce}}{\textbf{EPS in cents}} \text{ which is the same as } \frac{\textbf{Total market value of eq}}{\textbf{Total earnings}}$$

The **value** of the P/E ratio reflects the **market's appraisal** of the **shares' future prospects**. In other words, if one company has a higher P/E ratio than another it is because investors either expect its earnings to increase faster than the other's or consider that it is a less risky company or in a more 'secure' industry. The P/E ratio is, simply, a **measure of** the **relationship between the market value of a company's shares and the earnings from those shares**.

Example: price earnings ratio

A US company has recently declared a dividend of 12c per share. The share price is $3.72 cum div and earnings for the most recent year were 30c per share. Calculate the P/E ratio.

Solution

$$\text{P/E ratio} = \frac{\text{MV ex div}}{\text{EPS}} = \frac{\$3.60}{30c} = 12$$

Changes in EPS: the P/E ratio and the share price

The **dividend valuation model** or fundamental theory of share values is the theory that share prices are related to expected future dividends on the shares.

A common sense approach to assessing what share prices ought to be, which is often used in practice, is a P/E ratio approach.

a) The relationship between the EPS and the share price is measured by the P/E ratio

b) There is no reason to suppose, in normal circumstances, that the P/E ratio will vary much over time

c) So, if the EPS goes up or down, the share price should be expected to move up or down too, and the new share price will be the new EPS multiplied by the constant P/E ratio

For example, if a company had an EPS last year of 300 francs and a share price of RWF3.600, its P/E ratio would have been 12. If the current year's EPS is 330 francs, we might expect that the P/E ratio would remain the same, 12, and so the share price ought to go up to 12 × 33c0= RWF3,960.

Internet companies

In 1999/2000 share prices in the US and Europe rose to unprecedented heights. The drivers for this were the rise of **technology stocks**, particularly those relating to **internet companies**.

There were a number of **causes** of this.

a) The internet appeared to offer unrivalled opportunities for growth. Everybody wanted to jump on the bandwagon.

b) There were influential proponents of the 'new economy' who felt that some economic laws had been re-written.

c) Internet firms offered **increasing returns to scale** thanks to **network effects**. In other words, the more people using the Internet, the more useful it becomes for others to use.

d) However, despite exciting websites and huge marketing expenditure, internet companies (such as Boo.com) were made or broken on issues of logistics and distribution.

Many internet firms used up large amounts of cash before attaining any profits, and so have collapsed.

a) B2C (**business-to-consumer companies**) such as Boo.com lost money. Other retailing sites kept going, however. Even so, amazon.com laid off staff. One of the most successful Internet retailers in the UK is 'old economy' Tesco.

b) B2B (**business-to-business internet companies**) have had more success, if they offer something of value.

In fact, a recent study of 'tech' companies by Merrill Lynch reported that their earnings were overstated by an average of 25% compared with what they would be if determined on the basis of generally accepted accounting principles.

Despite the heady days of 2000, it is a fallacy that Internet companies can avoid the need for profit and positive cash inflows.

> 'From peak to trough, Amazon.com's market value sank by $35 billion as Jeff Bezos (*Time* magazine's 'person of the year' in 1999) claimed that his company was profitable on a 'proforma basis'. But let's get real: its proforma profits were found by ignoring interest payments on nearly $2 billion of debt. That's like saying my holiday home doesn't cost me anything – as long as I ignore the mortgage payments.'(Ted Stone, 'Trade Secrets', CIMA *Insider,* June 2002)

The Internet share market has learnt its lesson. Here's a recent example of how Google can generate accounting profits and still excite the stock market into huge valuations.

Case Study

'In the interests of decorum, professionalism, etc., analysts will no doubt offer careful assessments of Google's Q3 results. And the wires will bustle with stories about how ridiculous it is that a stock that went public at US$85 Aug 2004 is now trading at $350ish, etc.

The real story? These results are absolutely staggering.

Google's stock price – shocking though it is – is much less amazing than Google's fundamental performance, which is simply not to be believed. A 7 year old company with a revenue run-rate of $6 billion, an annual growth rate near 100%, 43% EBITDA margins, 100% plus return-on-invested-capital, a dominant global franchise, and already about half the cash flow of Time Warner (a 100 year-old company with 85,000 employees). '

Source: *Internet Outsider,* October 2005

[In Jan 2102 Google is trading between $500- $600s - editor's note]

COMPARISONS OF ACCOUNTING FIGURES

Comparisons might be made between a company's results and the results of the most recent year/previous years, other companies in the same industry and other companies in other industries.

Results of the same company over successive accounting periods

Although a company might present useful information in its five-year or ten-year summary, it is quite likely that the only detailed comparison you will be able to make is between the current year's and the previous year's results. The comparison should give you some idea of whether the company's situation has improved, worsened or stayed much the same between one year and the next.

Useful comparisons over time include:

a) Percentage growth in profit (before and after tax) and percentage growth in revenue

b) Increases or decreases in the debt ratio and the gearing ratio

c) Changes in the current ratio, the inventory turnover period and the accounts receivable collection period

d) Increases in the EPS, the dividend per share, and the market price

The principal advantage of making comparisons over time is that they give some indication of progress: are things getting better or worse? However, there are some weaknesses in such comparisons.

a) The effect of **inflation** should not be forgotten.

b) The progress a company has made, needs to be set in the context of what other companies have done, and whether there have been any special environmental or economic influences on the company's performance.

Putting a company's results into context

The financial and accounting ratios of one company should be looked at in the context of what other companies have been achieving, and also any **special influences** on the industry or the economy as a whole. Here are two examples.

a) If a company achieves a 10% increase in profits, this performance taken in isolation might seem commendable, but if it is then compared with the results of rival companies, which might have been achieving profit growth of 30% the performance might in comparison seem very disappointing.

b) An improvement in ROCE and profits might be attributable to a temporary economic boom, and an increase in profits after tax might be attributable to a cut in the rate of corporation tax. When improved results are attributable to factors outside the control of the company's management, such as changes in the economic climate and tax rates other companies might be expected to benefit in the same way.

Comparisons between different companies in the same industry

Making comparisons between the results of different companies in the same industry is a way of assessing which companies are outperforming others.

a) Even if **two companies are in the same broad industry (for example retailing) they might not be direct competitors**. For example, in the UK, the Kingfisher group (hardware and garden supplies) does not compete directly with the Arcadia group (clothes). Even so, they might still be expected to show broadly **similar performance**, in terms of growth, because a boom or a depression in retail markets will affect all retailers. The results of two such companies can be compared, and the company with the better growth and accounting ratios might be considered more successful than the other.

b) If two companies **are direct competitors**, a comparison between them would be **particularly interesting**. Which has achieved the better ROCE, sales growth, or profit growth? Does one have a better debt or gearing position, a better liquidity position or better working capital ratios? How do their P/E ratios, dividend cover and dividend yields compare? And so on.

Comparisons between companies in the same industry can help investors to rank them in order of desirability as investments, and to judge relative share prices or future prospects. It is important, however, to make comparisons with caution: a large company and a small company in the same industry might be expected to show different results, not just in terms of size, but in terms of:

a) Percentage rates of growth in sales and profits

b) Percentages of profits re-invested (Dividend cover will be higher in a company that needs to retain profits to finance investment and growth.)

c) Non-current assets (Large companies are more likely to have freehold property in their statement of financial position (balance sheet) than small companies.)

Comparisons between companies in different industries

Useful information can also be obtained by comparing the financial and accounting ratios of companies in different industries. An investor ought to be aware of how companies in one industrial sector are performing in comparison with companies in other sectors. For example, it is important to know:

a) Whether sales growth and profit growth is higher in some industries than in others (For example, how does growth in the financial services industry compare with growth in heavy engineering, electronics or leisure?)

b) How the return on capital employed and return on shareholder capital compare between different industries

c) How the P/E ratios and dividend yields vary between industries (For example, if a publishing company has a P/E ratio of, say, 20, which is average for its industry, whereas an electronics company has a P/E ratio of, say, 14, do the better growth performance and prospects of the publishing company justify its higher P/E ratio?)

CHAPTER ROUNDUP

- The overriding **purpose** of a business is to **increase owner wealth in the long-term**.
- Achieving objectives of **survival** and **growth** ultimately depends on making profits.
- **Measures relating to profit** include sales margin, EBITDA and EPS. More sophisticated measures (ROCE, ROI) take the size of investment into account. Later on in the chapter we considered how measures of profitability are used for **short-run** or **long-run performance measurement**. Bear this in mind particularly when you study the sections on RI, ROI and NPV and go through the example covering these.
- As well as profitability, **liquidity** and **gearing** are key measures of performance.
- **Gearing ratios** measure the financial risk of a company's capital structure. Business risk can be measured by calculating a company's **operational gearing.**
- A company can be profitable but at the same time get into cash flow problems. Liquidity ratios (**current** and **quick**) and **working capital turnover ratios** give some idea of a company's liquidity.
- **Short-termism** is often due to the fact that managers' performance is measured on short-term results.
- The value of the **P/E ratio** reflects the market's appraisal of the shares' future prospects.
- **Comparisons** might be made between a company's results and the results of the most recent year/previous years, other companies in the same industry and other companies in other industries.

STUDY UNIT 24

Non-Financial Performance Indicators

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EXAM GUIDE

You need to think about how you would use the information here on NFPIs in a report to advise management. Also you must think about the action words used in the study guide so you need to **'discuss'** and **'identify'** in your exam answer.

DISADVANTAGES OF FINANCIAL PERFORMANCE INDICATORS

Concentration on financial indicators means that important goals and factors may be ignored.

Concentration on too few variables

If performance measurement systems focus entirely on those items which can be expressed in monetary terms, managers will **concentrate on only those variables** and **ignore** other important variables that cannot be expressed in monetary terms.

For example, pressure from senior management to **cut costs and raise productivity** will produce **short-term benefits** in cost control but, in the **long term,** managerial performance and motivation is likely to be affected, labour turnover will increase and product quality will fall.

Reductions in cost can easily be measured and recorded in performance reports, employee morale cannot. **Performance reports** should therefore **include** not only costs and revenues but **other important variables**, to give an indication of expected future results from present activity.

Lack of information on quality

Traditional ‘responsibility’ accounting systems also fail to provide **information on the quality or importance of operations**. Drury provides the following example.

'Consider a situation where a purchasing department regularly achieved the budget for all expense items. The responsibility performance reporting system therefore suggests that the department was well managed. However, the department provided a poor service to the production departments. Low-cost suppliers were selected who provided poor quality materials and frequently failed to meet delivery dates. This caused much wasted effort in chasing up orders and prejudiced the company's ability to deliver to its customers on time.'

Measuring success, not ensuring success

Financial performance indicators have been said simply to **measure success**. What organisations also require, however, are performance **indicators that ensure success**. Such indicators, **linked** to an organisation's **critical success factors** such as quality and flexibility, will be **non financial** in nature.

GROWING EMPHASIS ON NFPIs

Changes in cost structures, the competitive environment and the manufacturing environment have lead to an **increased use of NFPIs.**

Impact of changes in cost structures and the manufacturing and competitive environments

These have led to a shift from treating financial figures as the foundation of performance measurement to treating them as one of a range of measures.

Changes in cost structures

Modern technology requires massive investment and product life cycles have got shorter. A greater proportion of costs are sunk and a large proportion of costs are planned, engineered or designed into a product/service before production/delivery. **At the time the product/service is produced/delivered, it is therefore too late to control costs.**

Changes in competitive environment

Financial measures do not convey the full picture of a company's performance, especially in a **modern business environment**.

> 'In today's worldwide competitive environment companies are competing in terms of product quality, delivery, reliability, after-sales service and customer satisfaction. None of these variables is directly measured by the traditional responsibility accounting system, despite the fact that they represent the major goals of world-class manufacturing companies.'

Changes in manufacturing environment

New manufacturing techniques and technologies focus on minimising throughput times, inventory levels and set-up times. But managers can reduce the costs for which they are responsible by increasing inventory levels through maximising output. If a performance measurement system **focuses principally on costs**, managers may **concentrate on cost reduction and ignore other important strategic manufacturing goals**.

Introducing NFPIs

Many companies are therefore discovering the usefulness of quantitative and qualitative **non-financial performance indicators (NFPIs)**. The following definition from CIMA's *Official Terminology* is useful because of the examples it provides.

Non-financial performance measures are 'measures of performance based on non-financial information which may originate in and be used by operating departments to monitor and control their activities without any accounting input.

Non-financial performance measures may give a more timely indication of the levels of performance achieved than do financial ratios, and may be less susceptible to distortion by factors such as uncontrollable variations in the effect of market forces on operations.

Examples of non-financial performance measures:

Area assessed	*Performance measure*
Service quality	Number of complaints Proportions of repeat bookings Customer waiting time On-time deliverie
Production performance	Set-up times Number of suppliers Days' inventory in hand Output per employee Material yield percentage Schedule adherence Proportion of output requiring rework Manufacturing lead time

Marketing effectiveness	Trend in market share Sales volume growth Customer visits per salesperson Client contact hours per salesperson Sales volume forecast v actual Number of customers Customer survey response information
Personnel	Number of complaints received Staff turnover Days lost through absenteeism Days lost through accidents/sickness Training time per employee.

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THE VALUE OF NFPIs

Ease of use

NFPIs do have advantages over financial indicators but a **combination** of both types of indicator is likely to be most successful.

Unlike traditional variance reports, NFPIs can be provided quickly for managers, per shift, **daily** or even **hourly** as required. They are likely to be easy to calculate, and easier for non-financial managers to understand and therefore to use effectively.

The beauty of non-financial indicators is that **anything can be compared** if it is **meaningful** to do so. The measures should be **tailored** to the circumstances so that, for example, number of coffee breaks per 20 pages of Study Text might indicate to you how hard you are studying!

Many suitable measures combine elements from the chart shown below. Use it to answer the question below.

Errors/failure	**Time**	**Quantity**	**People**
Defects	Second	Range of products	Employees
Equipment failures	Minute	Parts/components	Employee skills
Warranty claims	Hour	Units produced	Customers
Complaints	Shift	Units sold	Competitors
Returns	Cycle	Services performed	Suppliers
Stockouts	Day	kg/litres/metres	
Lateness/waiting	Month	m^2/m^3	
Misinformation	Year	Documents	
Miscalculation		Deliveries	
Absenteeism		Enquiries	

Here are five indicators, showing you how to use the chart, but there are many other possibilities.

a) Services performed late v total services performed

b) Total units sold v total units sold by competitors (indicating market share)

c) Warranty claims per month

d) Documents processed per employee

e) Equipment failures per 1,000 units produced

Now think some for yourself but don't forget to explain how the ones that you chose might be useful.

NFPIs and financial measures

Arguably, NFPIs are less likely to be **manipulated** than traditional profit-related measures and they should, therefore, offer a means of counteracting short-termism, since short-term profit at any (non-monetary) expense is rarely an advisable goal. The ultimate goal of commercial organisations in the long run is likely to remain the maximisation of **profit**, however, and so the financial aspect cannot be ignored.

There is a danger that too many such measures could be reported, leading to **information overload** for managers, providing information that is not truly useful, or that sends conflicting signals. A further danger of NFPIs is that they might lead managers to pursue detailed **operational goals** and become blind to the **overall strategy** in which those goals are set.

A **combination** of financial and non-financial indicators is therefore likely to be most successful.

The balanced scorecard

The need to **link financial and non-financial measures** of performance and to identify the **key performance measures** provided the impetus for the development of the balanced scorecard, which we looked at in Study Unit 22.

NFPIs IN RELATION TO EMPLOYEES

NFPIs can usefully be applied to **employees**.

One of the many criticisms of **traditional accounting performance measurement systems** is that they **do not measure the skills, morale and training of the workforce**, which can be as **valuable to an organisation as its tangible assets**. For example if employees have not been trained in the manufacturing practices required to achieve the objectives of the new manufacturing environment, an organisation is unlikely to be successful. Indeed, in a service industry such an accountant's business, the people are the key assets

Employee attitudes and morale can be measured by **surveying** employees. Education and skills levels, promotion and training, absenteeism and labour turnover for the employees for which each manager is responsible can also be monitored.

The **weighting** attached to employee-oriented NFPIs when assessing managerial performance should be high. High profitability or tight cost control should not be accompanied by 100% labour revenue.

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NFPIs IN RELATION TO PRODUCT / SERVICE QUALITY

NFPIs are extremely useful when assessing **product/service quality.**

Performance measurement in a TQM environment

TQM is a highly significant trend in modern business thinking. We look at it in more detail in Study Unit 17 when we look at Japanese businesses practices and when considering the **costs of quality**.

Because **TQM embraces every activity** of a business, performance measures cannot be confined to the production process but must also cover the work of sales and distribution departments and administration departments, the efforts of external suppliers, and the reaction of external customers.

In many cases the measures used will be non-financial ones. They may be divided into three types.

Measuring the quality of incoming supplies

The quality of output depends on the quality of input materials, and so **quality control** should include procedures for acceptance and inspection of goods inwards and measurement of rejects.

a) **Inspection** will normally be based on statistical sampling techniques and the concept of an acceptance quality level (AQL).

b) Another approach that can be used is to give each **supplier a 'rating'** for the quality of the goods they tend to supply, and give preference with purchase orders to well-rated suppliers.

c) Where a **quality assurance scheme** is in place, the supplier guarantees the quality of goods supplied. This places the onus on the supplier to carry out the necessary quality checks, or face cancellation of the contract.

Monitoring work done as it proceeds

This will take place at various key stages in the production process. Inspection, based on random sampling and other statistical techniques, will provide a continual check that the production process is under control. The aim of inspection is not really to sort out the bad products from the good ones after the work has been done. The aim is to **satisfy management that quality control in production is being maintained.**

'In-process' controls include statistical process controls and random sampling, and measures such as the amount of scrap and reworking in relation to good production. Measurements can be made by product, by worker or work team, by machine or machine type, by department, or whatever is appropriate.

Measuring customer satisfaction

Some sub-standard items will inevitably be produced. In-process checks will identify some bad output, but other items will reach the customer who is the ultimate judge of quality. **'Complaints'** may be monitored in the form of letters of complaint, returned goods, penalty discounts, claims under guarantee, or requests for visits by service engineers.

Some companies adopt a more pro-active approach to monitoring customer satisfaction by surveying their customers on a regular basis. They use the feedback to obtain an index of customer satisfaction which is used to identify quality problems before they affect profits.

Quality of service

Service quality is measured principally by **qualitative measures**, as you might expect, although some quantitative measures are used by some businesses.

a) If it were able to obtain the information, a retailer might use number of lost customers in a period as an indicator of service quality.

b) Lawyers use the proportion of time spent with clients.

Fitzgerald *et al* identify 12 factors pertaining to service quality and the following table shows the measures used and the means of obtaining the information by British Airports Authority, a mass transport service:

Service quality factors	Measures	Mechanisms
Access	Walking distances Ease of finding way around	Customer survey and internal operational data Customer survey
Aesthetics/appearance	Staff appearance Airport's appearance Quantity, quality, appearance of food	Customer survey Customer survey Management inspection
Availability	Equipment availability	Internal fault monitoring system and customer survey Customer survey and internal operational data
Cleanliness/tidiness	Cleanliness of environment and equipment	Customer survey and management inspection
Comfort	Crowdedness of airport	Customer survey and management inspection
Communication	Information clarity Clarity of labelling and pricing	Customer survey Management inspection
Courtesy	Courtesy of staff	Customer survey and management inspection
Friendliness	Staff attitude and helpfulness	Customer survey and management inspection
Reliability	Number of equipment faults	Internal fault monitoring systems
Responsiveness	Staff responsiveness	Customer survey
Security	Efficiency of security checks Number of urgent safety reports	Customer survey Internal operational data

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QUALITATIVE ISSUES

Qualitative factors are not easily measured and so, in management accountancy, they can be 'those factors which can be expressed in monetary terms only with much difficulty or imprecision'.

There will often be no conclusion that you as the management accountant can draw from qualitative information. Your job is to **be aware of its existence** and report it under the heading of **'other matters to be considered'**. In practice of course, many decisions are finally swayed by the strength of the qualitative arguments rather than the cold facts presented in the quantitative analysis, and rightly so.

Exam Focus Point

As a general guideline, if you are asked to comment on qualitative issues, you should consider matters such as the following.

a) The impact on or of human behaviour. What will be the reaction on the factory floor? How will managers feel? Will customers be attracted or deterred? Can suppliers be trusted?

b) The impact on or of the environment ('surroundings'). Is the country in a recession? Is government or legislation influential? Are there 'green' issues to be considered? What is the social impact? What action will competing companies take? Is changing technology a help or a hindrance?

c) The impact on or of ethics. Is the action in the public interest? Are we acting professionally? Are there conflicts of interest to be considered? Will fair dealing help to win business? Are we treating staff properly?

Branding

Brand identity conveys a lot of information very quickly and concisely. This helps customers to identify the goods or services and thus helps to **create customer loyalty** to the brand. It is therefore a means of increasing or maintaining sales.

Where a brand image promotes an idea of **quality**, a customer will be disappointed if his experience of a product fails to live up to his expectations. Quality control is therefore of utmost importance. It is essentially a problem for **service industries** such as hotels, airlines and retail stores, where there is **less possibility** than in the manufacturing sector of **detecting and rejecting the work of an operator before it reaches the customer**. Bad behaviour by an employee in a face-to-face encounter with a customer will **reflect on** the **entire company** and possibly deter the customer from using any of the company's services again.

Brand awareness is an **indicator of a product's/organisation's place in the market**. **Recall tests** can be used to assess the public's brand awareness.

Company profile

Company profile is **how an organisation is perceived by a range of stakeholders.** For example, stakeholders may have a negative attitude towards an organisation, perhaps as a result of an ethical issue or a crisis that has struck the organisation and perhaps of the associated media comment. **Market research** can determine company profile and **marketing campaigns** can improve it if necessary.

CHAPTER ROUNDUP

- **Concentration on financial indicators** means that important goals and factors may be ignored.
- Changes in cost structures, the competitive environment and the manufacturing environment have led to an **increased use of NFPIs.**
- NFPIs do have advantages over financial indicators but a **combination** of both types of indicator is likely to be most successful.
- NFPIs can usefully be applied to **employees**.
- NFPIs are extremely useful when assessing **product/service quality.**
- **Qualitative factors** are 'those that can be expressed in monetary terms only with much difficulty or imprecision'.

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STUDY UNIT 25

Impact Of Developments In Information Technology & E-Commerce

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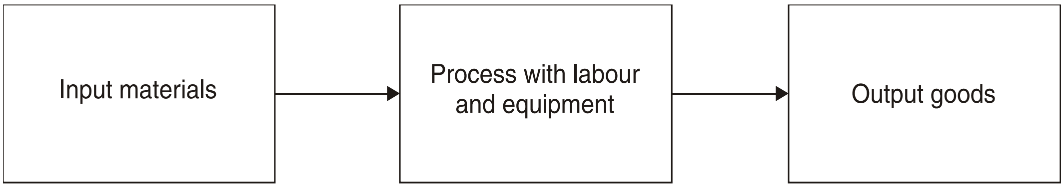
EXAM GUIDE

This chapter covers material that is integral to your understanding of management accounting. You should understand from your workplace how information technology is used to communicate information around the organisation. You should expect a **written** question or part-question covering this material.

INFORMATION NEEDS OF MANUFACTURING AND SERVICE BUSINESSES

Information needs of manufacturing businesses

All manufacturing businesses follow a simple model.



The information required by even modern manufacturing organisations is still based on the demands of this model.

A variety of performance indicators are used by manufacturing businesses, but there are some over-riding considerations.

Consideration	Detail
Cost behaviour	Labour is generally considered a variable cost. Machinery is a fixed cost. Modern technology requires more overheads. (With advanced manufacturing technology, there is a higher proportion of fixed equipment costs compared with variable labour costs.)
Quality	Important in terms of output adherence to production specification.
Time	Production bottlenecks; delivery times; deadlines; machine speed
Innovation	Required in products and processes
Valuation	Despite the tendency towards low inventory and just in time delivery, many businesses still have to give a value to inventories of raw materials or finished goods, as a major element in their profit calculations. Whether complicated tracking systems are needed is a different question.

We look at the first four of these considerations in more detail in the following paragraphs.

Cost behaviour, quality, time and innovation

a) **Cost behaviour**

Uses	Comment
Planning	Standard costs can be outlined, and actual costs compared with them.
Decision making	Estimates of future costs may be needed to assess the likely profitability of a product.
Control	Total cost information can be monitored, to ensure the best rates for supplies.

b) **Quality** information is used to ensure that 'customer satisfaction' is built into the manufacturing system and its outputs.

Uses	Comment
Planning	Ensure that products are well designed and manufactured according to specification.
Decision making	Businesses have a choice as to what level of quality they 'build' into a product. Quality need not be perfection, it is 'fitness for the purpose for which intended'.
Control	Falling levels of quality are an alarm bell – if products are not manufactured according to their design specification, there will be more rejects, more waste and more dissatisfied customers. This means higher costs and lower profits.

c) **Time**

Uses	Comment
Planning	Manufacturing time has to be scheduled to ensure the most efficient use of the system; if production can be smoothed over a period, this ensures effective capacity utilisation. Throughput time is thus important.
Decision making	Time is relevant to decision making, as it indicates a firm's ability to keep its promises to its customers for delivery and so on.
Control	• New product development (from conception to implementation) • Speed of delivery • Bottlenecks • In just-in-time systems, where firms hold little material inventories, time is a measure of a factory's ability to function at all. Inventory levels will be measured not in units but in day's supplies • As a measure of efficiency (e.g. inventory revenue, asset turnover)

d) **Innovation**

Uses	Comment
Planning	• New product development • Speed to market • New process
Control	This generally refers to the launch and design of new products.

The **experience curve** can be used in strategic control of costs and is relevant to 'time' and 'innovation'. It suggests that as output increases, the cost per unit of output falls, for these reasons.

a) **Economies of scale –** in other words an increased volume of production leads to lower unit costs, as the firm approaches full capacity.

b) A genuine **'learning effect'** as the workforce becomes familiar with the job and learns to carry out the task more efficiently. As a process is repeated, it is likely that costs will reduce due to **efficiency, discounts** and **reduced waste**.

c) **Technological improvements**.

This brings us on to **target costing**, covered in your study of Paper *F5 Performance Management* or the previous syllabus Paper 2.4

a) In the short run, because of development costs and the learning time needed, costs are likely to exceed price.

b) In the longer term, costs should come down (for example, because of the experience curve) to their target level.

Strategic, tactical and operational information

The information requirements of manufacturing businesses can also be considered in terms of three levels.

Information type	Examples
Strategic	Future demand estimates New product development plans Competitor analysis
Tactical	Variance analysis Departmental accounts Inventory turnover
Operational	Production reject rates Materials and labour used Inventory levels

The information requirements of commercial organisations are influenced by the need to make and monitor profit. Information that contributes to the following measures is important.

a) Changeover times
b) Number of common parts
c) Level of product diversity
d) Product and process quality

Service businesses

Unlike manufacturing companies, services are characterised by **intangibility, inseparability, variability, perishability** and no **transfer of ownership.**

Before we delve into the detail, here's the big picture. According to a 2006 Office for National Statistics ONS report, the service sector made up 73% of the UK economy. 32 of the top UK companies were in the service sector and one third of those employed over one million people in total.

Despite the apparent domination in the service sector as a whole by a few large companies, in reality **most service organisations are very small** (as normal experience would suggest): for instance: hair-dresser, restaurants, cafés, CPA businesses.. So we are talking of a very **large number** of organisations, many of them quite small, but collectively accounting for a powerful proportion of the workforce.

Types of service business

Mass services are standard services provided to large numbers of people, and are often automated. **Personal services** vary on the circumstances of the service delivery, and are generally one-to-one.

With this in mind, we can identify different types of service.

Type	Comment
Mass service	The delivery of the same, very standardised service to many people, as a transaction, for example cheque processing.
Personalised service	This service is unique to the recipient, such as dentistry: every mouth is different, even though standard procedures are adopted to ensure best practice.

Examples of service businesses include:

a) **Mass service** e.g. the banking sector, transportation (bus, air), mass entertainment

b) **Either/or** e.g. fast food, teaching, hotels and holidays, psychotherapy

c) **Personal service** e.g. pensions and financial advice, car maintenance

Service activities therefore cut across all sectors of the economy. In the UK, **healthcare** is provided by the **public sector** but also by the **private sector** (for-profit). The objectives may differ even though the activities remain the same.

'**Services** are any activity of benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Its production may or may not be tied to a physical product.' (P Kotler, *Social Marketing)*

There are **five major characteristics that distinguish services from manufacturing**.

a) **Intangibility** refers to the lack of substance, which is involved with service delivery. Unlike goods (physical products such as confectionery), there is no substantial material or physical aspects to a service: no taste, feel, visible presence and so on. For example, if you go to the theatre, you cannot take the 'play' away with you.

b) **Inseparability/simultaneity**. Many services are created at the same time as they are consumed. (Think of **dental treatment**.) No service exists until it is actually being experienced/consumed by the person who is buying it.

c) **Variability/heterogeneity**. Many services face the problem of maintaining **consistency in the standard of output**. It may be hard to attain precise standardisation of the service offered, but customers expect it (such as with fast food).

Here also is the paradox: Is fast food a service or not? – the customer walks out with a burger or whatever (the tangible product), but cannot simply lift it off the shelf until it has been prepared and cooked – the intangible element.

d) **Perishability.** Services are innately perishable. The services of a beautician are purchased for a period of time.

e) **No transfer of ownership.** Services do not result in the transfer of property. The purchase of a service only confers on the customer access to or a right to use a facility.

Most 'offers' to the public contain a **product** and **service** element.

Exam Focus Point

You could be asked to discuss any of these characteristics in the exam and use examples from your own experience.

Quantitative/qualitative information and services

Service businesses need the same aggregate information as manufacturing firms, but also need performance data as to their cost and volume drivers. Operational information is likely to be more qualitative.

A **dental practice needs** a mix of **quantitative** and **non-quantitative** information to price its services properly, to optimise capacity utilisation and to monitor performance. Many small service businesses have similar concerns, for example garages or beauty parlours.

a) They need to control the **total cost** of providing the **service operation**.

b) They need positive **cash flow** to **finance activities**.

c) They need **operating information** to identify how costs are incurred and on what services.

Arguably, small service businesses, whose expenses are mainly overheads, provide a model, in miniature, of the requirements of **activity based costing**, mentioned in Study Unit 1.

Are **'mass services'** any different?

a) Because mass services, such as cheque clearing, are largely automated, there may be a large **fixed cost base**.

b) Even if a service is heavily automated, each time the service is performed is a 'moment of truth' for the customer. Ensuring consistency and quality is important but this is true for small service businesses too.

Quantitative information is information that can be expressed in numbers. A sub-category of quantitative information is **financial information** (also known as **monetary information**), which is information that can be expressed in terms of money.

Qualitative information is information that cannot be expressed in numbers.

Non-financial information (or **non-monetary information**) is information that is not expressed in terms of money, although this does not mean that it cannot be expressed in terms of numbers.

Below are a few examples of **monetary** and **non-monetary information** for a monthly report for a dentist practice. (*Hint*. Ask yourself what is the key resource of the practice).

a) **Monthly receipts and payments**

(i) Receipts include payments from the government for publicly-funded work, fees for private work and so on. Dentists are measured on Units of Dental Activity (UDA) and are given annual targets for UDAs that they must undertake.

(ii) Payments include operating costs such as wages for nursing staff, reception staff, rent, insurance, electricity, telephone expenses, medical equipment, medicine and so on.

b) **Capacity utilisation**. In other words, how busy has the practice been? Have all available appointments been booked or were there times when the dentist and his/her staff were kicking their heels? Just by looking at the **appointments diary** you can make comparatives.

c) **Treatment costs.** Simple treatments such as teeth cleaning can be performed by the dental hygienist. Other treatments, such as root canal surgery, require the dentist and perhaps a dental nurse in attendance.

The cost of providing these different treatments will vary depending on the level of staff and complexity of the treatment.

The **cost driver** is **time**.

The **mix** of treatments offered is thus significant in the total profitability of the practice.

The practice will probably profit more from relatively expensive treatments, such as 'crowns', but these come at a cost. Patients can also have several treatments within a price band and be charged a single fixed price. This may also have an effect on just how much work the dentist is willing to do for a single fixed charge.

The new treatment charges introduced in the UK in April 2006 have also affected how dental services are provided. Patients now pay one of three fixed charges based on the type of care and treatment required.

However, this information, while useful to monitor the financial health of the practice, does not give us a sufficiently detailed picture of the operating performance. The key resource is **time,** the dentist's time, and staff time.

For the **long-term health** of the practice, matters such as **customer satisfaction** and **repeat business** must be considered. (Does your dentist remind you to have a check up every six months?)

Colin Drury *(Management and Cost Accounting*) describes **qualitative factors** as those 'that cannot be expressed in monetary terms’. Thus the information 'German people are very fond of bananas' could be expressed as 'The value of the German banana market is Rwf x million pa', but the value of x is very questionable.

Example: qualitative information

As a more elaborate example, consider a firm that is thinking of sacking many of its customer service staff and replacing them by automated telephone answering systems. Now consider how difficult it would be to obtain the following information in order to appraise a decision whether or not to replace staff with an untested system.

a) The cost of **being sure** that the new system would do the job as well as people can

b) The cost of **loss of morale** amongst other workers if large numbers are made redundant

c) The cost of **compensating** the redundant staff for the psychological and financial impact of the decision on themselves and their families

d) The cost of **relocating** people

e) The cost of **retraining** staff made redundant to improve their job prospects

f) The cost to the community in **social and financial terms** of unemployment or relocation

These are not just political points. The company's treatment of its staff may have a profound impact upon its ability to **recruit** skilled employees in the future and on the way the company is **perceived** by potential **customers**. Whether the costs can be established or not, the questions need to be considered.

Service industries, perhaps more than manufacturing firms, **rely on their staff**. Front-line staff are those who convey the 'service' – and the experience of the brand – to the consumer. They convey the 'moment of truth' with the customer.

Case Study

In 2005 in the UK, BA (Brirish Airways) ground staff went on strike in support of sacked catering workers. This cost BA up to £40m in refunds and loss of flight revenue as well as a loss in reputation.

Management **information** therefore has to include **intangible factors** such as how customers feel about the service, whether they would use it again, and so on.

There are some demonstrable relationships between **staff revenue** and **positive customer experiences**. High staff revenue not only means higher recruitment and training costs but it may also have an adverse impact on the firm's ability to **retain** customers (which is cheaper than finding new ones).

For service businesses, **management accounting information** should **incorporate** the **key drivers of service costs**.

a) Repeat business
b) Churn rate (for subscriptions)*
c) Customer satisfaction surveys, complaints
d) Opportunity costs of not providing a service
e) Avoidable / unavoidable costs

* For any given period of time, the number of participants who discontinue their use of a service divided by the average number of total participants is the churn rate. Churn rate provides insight into the growth or decline of the subscriber base as well as the average length of participation in the service.

Case Study

Banks

Banks typically have high fixed costs of running a network of branches. At the same time, they are trying to promote Internet and other services, as they are competing with internet-only banks.

The traditional banks have responded in a number of ways

a) Set up their own Internet operations, which offer higher rates of interest for savers

b) Closing down branches, at a cost of adverse publicity at times

However, there have been some opposing trends

a) A bank might advertise that it will put a moratorium on closure programmes

b) Most of the internet banks are not making money; some see the benefit of opening branches

The key issue is productivity. The expensive branch networks are useful for selling other services.

A third alternative to branch and Internet banking is the telephone banking service. The banking service is conducted by telephone and lately over the Internet. There is no formal branch network although customers may be offered the use the branch network of the parent company.

This service operates at a lower cost than the traditional branch network but offers some branch facilities and an alternative service for users who want 24 hour access and do not require face to face banking.

Strategic, tactical and operational information

Just as we did for manufacturing businesses, we can consider the strategic, tactical and operational information requirements of service businesses.

Information type	Examples
Strategic	Forecast sales growth and market share Profitability, capital structure
Tactical	Resource utilisation such as average staff time charged out, number of customers per hairdresser, number of staff per account Customer satisfaction rating
Operational	Staff timesheets Customer waiting time Individual customer feedback

Organisations have become **more customer and results oriented** over the last decade or so. As a consequence, **the differences between service organisations' and other organisations' information requirements has decreased.** Businesses have realised that most of their activities can be measured, and many can be measured in similar ways regardless of the business sector.

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INSTANT ACCESS TO DATA

Access to data has been facilitated by **groupware**, **intranets, extranets, databases, data warehousing** and **data mining.**

Via distribution of data

Developments in IT have facilitated the distribution of data, making it instantly available to those who require it. Such developments are known generally as office automation systems.

a) Word processing/spreadsheets
b) Electronic schedules
c) Desktop databases (see below)
d) Web publishing
e) Voice mail
f) E-mail

Via sharing of data

There have also been significant developments in the ways in which data can be shared.

Groupware

Groupware is a term used to describe software that provides functions that can be used by collaborative work groups.

Typically, groups using groupware are small project-oriented teams that have important tasks and tight deadlines.

Features might include the following.

a) A **scheduler** allowing users to keep track of their schedules and plan meetings with others

b) An **address book**

c) '**To do'** lists

d) A **journal**, used to record interactions with important contacts, items (such as e-mail messages) and files that are significant to the user, and activities of all types and track them all without having to remember where each one was saved

e) A **jotter** for jotting down notes as quick reminders of questions, ideas, and so on

f) File sharing and distribution utilities

There are clearly advantages in having information such as this available from the desktop at the touch of a button, rather than relying on scraps of paper, address books, and corporate telephone directories. It is when groupware is used to **share information** with colleagues that it comes into its own. Here are some of the features that may be found.

a) **Messaging**, comprising an **e-mail** in-box which is used to send and receive messages from the office/home/on the road and **routing** facilities, enabling users to send a message to a single person, send it sequentially to a number of people (who may add to it or comment on it before passing it on), or sending it to everyone at once.

b) Access to an **information database**, and customisable **'views'** of the information held on it, which can be used to standardise the way information is viewed in a workgroup.

c) **Group scheduling**, to keep track of colleagues' itineraries.

d) **Public folders**. These collect, organise, and share files with others on a team or across the organisation.

e) **Hyperlinks** in mail messages. The recipient can click the hyperlink to go directly to a Web page or file server.

Intranets

Intra- means within so an **intranet** is an internal network used to share information within the company or group. Intranets utilise Internet technology. A firewall surrounding an intranet fends off unauthorised access.

The idea behind an 'intranet' is that companies set up their own **mini version of the Internet.** Intranets use a combination of the organisation's own networked computers and Internet technology. Each employee has a browser, used to access a server computer that holds corporate information on a wide variety of topics, and in some cases also offers access to the Internet.

Potential applications include company newspapers, induction material, online procedure and policy manuals, employee web pages where individuals post details of their activities and progress, and **internal databases** of the corporate information store.

The **benefits** of intranets are diverse.

a) Savings accrue from the **elimination of storage**, **printing** and **distribution** of documents that can be made available to employees on-line.

b) Documents on-line are often **more widely used** than those that are kept filed away, especially if the document is bulky (e.g. manuals) and needs to be searched. This means that there are **improvements in productivity** and **efficiency**.

c) It is much **easier to update** information in electronic form.

d) Wider access to corporate information should open the way to **more flexible working patterns**, as material available on-line may be accessed from remote locations.

Remote access to intranets can be available **quickly** and **easily**. This means that people working at different parts of the organisation or away from the office can access data when they need it. Developments in IT allow information from a data warehouse (see below) to be displayed and Excel has facilities to post spreadsheets straight to the intranet and for users to drill down to the detail from a summary level.

Extranets

An **extranet** is an intranet that is accessible to authorised outsiders.

Whereas an intranet resides behind a firewall and is accessible only to people who are members of the same company or organisation, an extranet provides various levels of accessibility to outsiders.

Only those outsiders with a valid username and password can access an extranet, with varying levels of access rights enabling control over what people can view. Extranets are becoming a very popular means for **business partners to exchange information**.

Databases

A **typical accounting application package** processes only one sort of data. A payroll file processes only payroll data and an inventory file only inventory data. An organisation might end up with separate files and processing subsystems for each area of the business. However, in many cases the underlying data used by each application might be the same. A major consequence is that data items are duplicated in a number of files **(data redundancy).** They are input more than once (leading to **errors and inconsistencies**) and held in several files (**wasting space**). For example, data relating to the hours which an hourly-paid employee has worked on a particular job is relevant both to the payroll system, as the employee's wages will be based on the hours worked, and to the job costing system, as the cost of the employee's time is part of the cost of the job.

The **problem of data redundancy is overcome**, partly at least, by an **integrated system**. An integrated system is a system where **one set of data is used for more than one application**. In a cost accounting context, it might be possible to integrate parts of the sales ledger, purchase ledger, inventory control systems and nominal ledger systems, so that the data input to the sales ledger updates the nominal ledger automatically.

The integrated systems approach, where different applications update each other, is a half-way house between a system based on separate application-specific files and a database approach.

Broadly speaking, a **database** is a file of data organised in such a way that it can be accessed by many applications and users.

Using the example of hours worked given above, the following situations are possible.

a) The employee's hours are **input twice**, once to the payroll application, once to the job costing system, in a non-integrated system of **application-specific files**.

b) In an **integrated system**, the data would have been **input once**, to the HR database which is used by the payroll application and by the job costing application.

c) In a **database system** it would only be **input once** and would be **immediately available to both systems**.

A database provides a **comprehensive file of data for a number of different users. Each user will have access to the same data**, and so different departments **need not keep their own data files**, containing duplicate information but where the information on one file disagrees with the corresponding information on another department's file.

Database management systems

The database management system (DBMS) is a complex **software** system **that organises the storage of data in the database in the most appropriate way** to facilitate its storage, retrieval and use in different applications. It also provides the **link between** the **user and the data**.

Data warehousing

A **data warehouse** contains **data from a range of internal** (e.g. sales order processing system, nominal ledger) **and external sources**. One reason for including individual transaction data in a data warehouse is that if necessary the user can drill-down to access transaction-level detail. Data are increasingly obtained from newer channels such as customer care systems, outside agencies or websites.

The warehouse provides a coherent **set of information** to be **used across the organisation** for management **analysis** and **decision-making**. The reporting and query tools available within the warehouse should facilitate management reporting and analysis.

The reporting and query tools used within the warehouse need to be flexible enough to allow multidimensional data analysis, also known as on-line analytical processing (**OLAP**). Each aspect of information (e.g. product, region, price, budgeted sales, actual sales, time period and so on) represents a different dimension. OLAP enables data to be viewed from each dimension, allowing each aspect to be viewed in relation to the other aspects. So, for example, information about a particular product sold in a particular region during a particular period would be available on-line and instantly.

Organisations may build a single central data warehouse to serve the entire organisation or may create a series of smaller **data marts**. A data mart holds a selection of the organisation's data for a specific purpose.

A data mart can be constructed more quickly and cheaply than a data warehouse. However, if too many individual data marts are built, organisations may find it is more efficient to have a single data warehouse serving all areas.

Advantages of setting up a data warehouse system include:

a) Decision makers can access data without affecting the use of operational systems.

b) Having a wide range of data available to be queried easily encourages the taking of a wide perspective on organisational activities.

c) Data warehouses have proved successful in a number of areas.
   (i) Quantifying the effect of marketing initiatives
   (ii) Improving knowledge of customers
   (iii) Identifying and understanding an enterprise's most profitable revenue streams

d) Information can be made available to business partners. For example, if customer sales order information is in the data warehouse, it could be made available to customers and even suppliers. Internal information on products and services could also be provided.

Data mining

Data mining software looks for hidden patterns and relationships in large pools of data.

True data mining software discovers **previously unknown relationships**. Data mining provides insights that cannot be obtained through OLAP. The hidden patterns and relationships the software identifies can be used to guide decision-making and to **predict future behaviour**.

Case Study

(1) The American retailer Wal-Mart discovered an unexpected relationship between the sale of **nappies** and **beer!** Wal-Mart found that both tended to sell at the same time, just after working hours, and concluded that men with small children stopped off to buy nappies on their way home, and bought beer at the same time. Logically therefore, if the two items were put in the same shopping aisle, sales of both should increase. Wal-Mart tried this and it worked.

(2) Some credit card companies have used data mining to predict which customers are likely to switch to a competitor in the next few months. Based on the data mining results, the bank can take action to retain these customers.

Reports

To make use of data, a suitable reporting framework is needed. **Enterprise resource planning** packages aim to integrate all of a company's applications to give a **single point of access**. A problem is that accessing source data is difficult if it is held in different formats and systems.

Case Study

Time and time again finance directors say that their key IT issue is lack of reporting capabilities in the systems they are using. Reporting problems tend to fall into three categories.

First, the **inability to access the source data**. This is either because it is in a format that cannot be accessed by PC technology or it is held in so many places that its structure is incomprehensible to a member of the finance team.

Second, the **tools to make the enquiries** or produce the reports are often **difficult to use** and do not produce the reports in a 'user friendly' format with 'drill down' capabilities.

Third, there is the issue of **consistency of information** across systems. In order to get an overall picture of your organisation's performance you will usually need to access data from different operation applications. All too often the data is not the same across these systems.

The argument for replacing what you have is well rehearsed. New systems promise the latest technology for reporting and enquiries. **Enterprise Resource Planning (ERP**) packages promise to integrate your different applications smoothly and give you a single point of access to all data. **Customer Relationship Management (CRM)** software has been added to this recipe to give this approach a better chance of happening.

“There are a myriad of reporting tools costing from a few pounds to hundreds of thousands of pounds. One that is regularly overlooked is the **spreadsheet**. Excel is the product most commonly used by accountants. With the advent of Microsoft Office 2000 there is a bewildering array of features to present information on your desktop or paper. **Pivot tables** are starting to be used more widely for multi-dimensional analysis and can be combined with the increasingly powerful **graphical capabilities** of Excel. Spreadsheets are much underrated and it is surprising how many organisations go out and buy expensive new knowledge-management tools when they already have a product on their computer that will deliver all the reporting/enquiry performance they require.

So, see how far your spreadsheet will take you and see if you can avoid the cost of another new IT tool.”

Adapted from an article by John Tate, *Management Accounting,* April 2000

REMOTE INPUT OF DATA

Developments in IT have enabled the **remote input of data**.

It is no longer the case that data input requires someone to sit at a desk and to tap away at a keyboard. There is a wide range of data capture techniques, a number of which allow staff to input data into the organisation's system whether or not they are in the office.

a) Sales staff can communicate sales orders directly to head office using **laptop computers,** ‘smart’ phones etc .

b) The use of **hand-held computers**, often with touch sensitive screens, means there is no need for subsequent manual entry of data, speeding up processes and reducing the chance of error, because there are no transcription errors and computerised data validation techniques can be employed.

c) **EPOS (**Electronic Point of Sale**)** systems (**barcode** scanners and tills) are primarily intended to speed up and avoid error in the check-out process in supermarkets, to allow customers to complete transactions, and to manage inventories. In addition, however, they collect precise and detailed information about **how many** of **what products** are being bought at **what times**. If linked to a **loyalty scheme, 'and by whom' can be added** since this allows the purchase data to be combined with demographic data.

d) Items such as **pressure mats** that sound a buzzer in smaller shops or **sliding doors** in larger ones have the practical purpose of either alerting staff to the fact that there is someone in the shop or simply for letting customers in and out, but if linked to a computer they also collect information about number and movements of customers. The same applies to ticket scanners in car parks, stations, and leisure facilities like sports venues.

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DEVELOPING MANAGEMENT ACCOUNTING SYSTEMS

Developments in IT have revolutionised the **potential for management accounting data**, increasing the volume and variety of **possible reports.**

Management information systems (MIS)

Most information is provided by an information system, or management information system (MIS).

Management information system is 'a system to convert data from internal and external sources into information and to communicate that information, in an appropriate form, to managers at all levels in all functions to enable them to make timely and effective decisions for planning, directing and controlling the activities for which they are responsible'.(Lucey)

A **management information system** is therefore a **system of disseminating information** that will enable managers to do their job. It should provide managers with **data** that they can use **for benchmarking** and **control purposes**.

Management information is by no means confined to accounting information, but until relatively recently accounting information systems have been the most formally-constructed and well-developed part of the overall information system of a business enterprise. This is still the case in all but the most advanced organisations.

Most management information systems are not designed, but **grow up informally**, with each manager making sure that he or she gets all the information considered necessary to do the job. Much accounting information, for example, is easily obtained, and managers can often get along with frequent face-to-face contact and co-operation with each other. Such an informal system works best in small organisations.

However, **some** information systems are **specially designed**, often because the introduction of computers has forced management to consider its information needs in detail. This is especially the case in large companies.

Management should try to **develop/implement** a **m**anagement **i**nformation **s**ystem for their enterprise **with care**. If they allow the MIS to develop without any formal planning, it will almost certainly be inefficient because data will be obtained and processed in a random and disorganised way and the communication of information will also be random and hit-and-miss.

a) Some managers will keep data in their heads and will not commit information to paper. Stand-ins/successors will not know as much as they could or should because no information has been recorded to help them.

b) The organisation will not collect and process all the information that it should.

c) Information may be available but not disseminated to the appropriate managers.

d) Information is communicated late because the need to communicate it earlier is not understood and appreciated by the data processors.

The **consequences of a poor MIS** might be dissatisfaction amongst employees who believe they should be told more, a lack of understanding about what the targets for achievement are and a lack of information about how well the work is being done.

Whether a management information system is formally or informally constructed, it should therefore have **certain essential characteristics**.

a) The **functions of individuals and their areas of responsibility** in achieving company objectives should be **defined**.

b) **Areas of control** within the company (e.g. cost centres, investment centres) should also be clearly **defined**.

c) Information required for an area of control should flow to the manager who is responsible for it. (**Management structure of the organisation should therefore be considered**.)

Types of MIS

Three particular types of management information system deserve special mention.

Type of MIS	Detail
Decision support systems (DSS)	Used by management to help make decisions on poorly defined problems (with high levels of uncertainty). They provide access to information with a wide range of information gathering and analytical tools. Decision support systems allow the manager to scan the environment, consider a number of alternatives and evaluate them under a variety of potential conditions. There is a major emphasis upon flexibility and user-friendliness.
Executive information systems (EIS)	Give executives a straightforward means of access to key internal and external data. They provide summary-level data, captured from the organisation's main systems (which might involve integrating the executive's desk top PC with the organisation's mainframe), data manipulation facilities (such as comparison with budget or prior year data and trend analysis) and user-friendly presentation of data.
Expert systems	Draw on a computerised knowledge base (such as details of the workings of tax legislation) and can give factual answers to specific queries, as well as indicating to the user what a decision ought to be in a particular situation.

Setting up a management accounting system

Taking a broad view, the following factors should be considered when setting up a management accounting system (which is just one part of an overall MIS).

a) The **output required**. This is just another way of saying that the management accountant must **identify the information needs of managers**. If a particular manager finds pie-charts most useful the system should be able to produce them. If another manager needs to know what time of day machinery failures occur, this information should be available. Levels of detail and accuracy of output and methods of processing must be determined in each case.

b) **When the output is required**. If information is needed within the hour the system should be capable of producing it at this speed. If it is only ever needed once a year, at the year end, the system should be designed to produce it **on time**, no matter how long it takes to produce.

c) The **sources of input information**. It is too easy to state that the outputs required should dictate the inputs made. The production manager may require a report detailing the precise operations of his machines, second by second. However, the management accounting system could only acquire this information if suitable production technology had been installed.

The need for management accounting systems to develop

Globalisation and **competition** require an external, forward-looking focus, with greater facilities for modelling.

In the Study Guide, the ACCA states that management accounting systems need to be defined and developed 'in an increasingly competitive and global market'.

Environmental analysis is covered in detail in Paper P3 *Strategic Business Analysis***.**

We shall now describe some pointers for issues of **competition** and **globalisation.** The key development is the use of management accounting systems for strategic decision making.

a) **Competition**

Impact	Management accounting impact
• More competitors	Better competitor intelligence Model competitor cost structures
• More competing products	Identify which features add most value; model impact on cost
• Faster response	Management accounting information has to be produced speedily and be up-to-date for decision making

b) **Globalisation**

Impact	Management accounting impact
• Increases competition	• Similar impact to (a) • Attention to **behavioural** impact on management accounting systems in different markets
• Access to overseas capital	• The cost of operating in different local markets • Aggregating information
• Overseas activities	• Repaid for exchange differences

We consider management accounting systems later in the text in Parts C and F.

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GAME THEORY

Scenario planning and foresight both highlight the inherent uncertainty in trying to predict the future. One particular aspect of this uncertainty comes from how competitors will react to any new strategy an organisation introduces.

Game Theory is the study of the ways in which the strategic interactions among rational players produce strategic outcomes which were not intended by any of the players.

Game theory approach to strategy

Game-based approaches to strategy treat **strategy as an interaction** between an organisation and its competitors. To this end, an organisation cannot simply develop its strategy by analysing its current position in the environment, and looking at its internal resources. Instead it also needs to look at its competitors, identify their strengths and weaknesses and examine how their responses to a strategy could affect the effectiveness of that strategy.

Anticipating competitors' moves is a crucial part of strategic thinking: gauging competitors' likely reactions to a strategy greatly improves an organisation's ability to choose a strategy that will be successful.

We can illustrate this with a simple example.

Example: soft drinks market

Firms A and B are the local market-leaders in the soft drinks market, and between them they hold virtually 100% of the market share. Firm A is considering launching a major advertising campaign, because its marketing director believes this will not only increase its own sales and profit, but will also reduce those of its rival (B).

However, the marketing director has not considered B's response. B has become aware of A's campaign, and is now considering launching a campaign of its own to restore its market share.

At this moment, both A and B make profits of RWF250m per year. A is thinking of spending RWF25m on its campaign, because it wants a major campaign to generate a significant increase in revenue. The anticipated increase of revenue from the campaign is RWF75m.

Because A and B essentially share the market, A's revenue increase is expected to come from customers who switch to it from B. therefore, alongside A's revenue increase of RWF75m, B will suffer a revenue reduction of RWF75m.

Consequently, at the end of A's initial campaign, and in the short term, B will have suffered a reduction in profit of RWF75m, while A will have enjoyed an increase in profit of RWF50m (RWF75m revenue less RWF25m marketing cost). This is a '**win-lose'** situation, because A has 'won' while B has 'lost'.

However, B then runs a rival campaign, also costing RWF25m, and which also generates RWF75m additional revenue following the logic from before, this is now a 'lose-lose' situation because although A has 'lost' and B has 'won', the contest has cost each them RWF25m to gain nothing..

Let us look at the impact these campaigns have on A and B's profits, and the overall profits earned by the soft drink industry.

Option	*A's profit*	*B's profit*	*Industry profit*
Currently (no advertising)	RWF250m	RWF250m	RWF500m
A advertises	RWF300m	RWF175m	RWF475m
B then launches counter advert	RWF225m	RWF225m	RWF450m

Interestingly, after the advertising campaigns **both firms are worse off** than they were before, and the industry profit has reduced by the cumulative cost of the advertising campaigns. So overall the advertising campaign, created a '**lose –lose** ' situation.

The figures show that although one firm can gain in the short run from a competitive strategy, in the long run both firms are likely to be better off by working together and not advertising, rather than competing with each other.

One of the assumptions of game theory is that the firms do not have any collusive agreements and do not know what the other is going to do. So A and B must select their strategies based solely on the outcome which they think is best for them regardless of the decision made by their rival.

Under these circumstances, both firms will choose to advertise, because their own campaign increases their own profit by RWF50m. However, collectively this course them both to lose RWF25m each.

In this way, game theory illustrates the key problem of **interdependent decision-making** which organisations face.

Organisations need to consider the possible responses of their competitors when making strategic decisions or introducing new strategies.

Moreover, game theory also suggests that it may benefit firms to **co-operate** and **negotiate** with others in the search for optimal solutions rather than simply working alone and **competing** with all the other players in a market place. In order to create a '**win-win'** scenario, firms are likely to have to compromise and co-operate rather than always seeking to compete with each other.

In this context of networks and co-operation being preferable to constant competition, game theory can help explain the reasoning behind **strategic alliances.** Game theory also supports the cartel arrangement which the OPEC nations have established to control the production and price of oil.

Case Study: GlaxoSmithKline's strategy for the developing world:

"GlaxoSmithKline(GSK), the world's second largest pharmaceutical company is radically to shift its attitude to providing cheap drugs to millions of people in the developing world.

In a major change of strategy, Andrew Witty, the new head of GSK has announced [in 2009] he will slash prices of all medicines in the poorest countries, give back profits to be spent on hospitals and clinics and - most ground-breaking of all - share knowledge about potential drugs that are currently protected by patents.

Witty says he believes drug companies have an obligation to help the poor get treatment, and he has challenged other pharmaceutical giants to follow his lead.

Pressure on the industry has been growing over the past decade as drug companies have been repeatedly criticised for failing to drop their prices for HIV drugs while millions died in Africa and Asia. Campaigners have criticised the drug companies for defending the patents, which allow them to maintain high prices.

Campaigners have also been critical of the way drug companies have attempted to crush competition from generic manufacturers, who undercut them dramatically in countries where patents do not apply.

However, the moves which Witty has announced go a long way to addressing these concerns, and mark a significant change to the way GSK does business in the developing world.

He said that GSK will:

- Cut its prices for all drugs in the 50 least developed countries to no more than 25% of the levels in the UK and US – and less if possible – and make drugs more affordable in middle-income countries such as Brazil and India.
- Put any chemicals or processes over which it has intellectual property rights that are relevant to finding drugs for neglected diseases into a "patent pool", so they can be explored by other researchers.
- Reinvest 20% of any profits it makes in the least developed countries in hospitals, clinics and staff.

The extent of these changes is likely to stun not only critics of drug companies but also other pharmaceutical companies, who risk being left exposed.

Witty accepts that his stance may not win him friends in other drug companies, but he is inviting them to joy him in an attempt to make a significant difference to the health of people in poor countries.

Witty explained that the changes reflect his desire that GSK finds solutions for developing and developed countries alike. However he is aware that the move may raise concerns among GSK's shareholders.

"I think the shareholders understand {the need to help the developing countries as well as the richer, developed countries) and it's my job to make sure I can explain it. I think we can. I think it's absolutely the kind of thing large global companies need to be demonstrating, that they've got a more balanced view of the world than short-term returns".

The move on intellectual property, until now regarded as the sacred cow of the pharmaceutical industry, will be seen as the most radical of his proposals." I think it's the first time anybody's really come out and said we're prepared to start talking to people about pooling our patens to try to facilitate innovation in areas where, so far, there hasn't been progress" he said.

However, a key question now is how the other major pharmaceutical companies will respond."

(based on an article by Sarah Boseley inguardian.co.uk, 13 February 2009. *Drug giant Glaxo Smith Kline pledges cheap medicine for world's poor*)

The value of game theory is that it highlights that both competition and co-operation can exist in an industry. An important part of an organisation's strategy is how it interacts with the other players in an industry in this respect.

Although both scenario planning and foresight aim to assist an organisation in designing their future strategies, their effectiveness will depend in part on the organisation's current strategic intelligence.

However, critics of game theory argue that its value to strategic management is limited because it focuses on only a small fraction of the strategy process. For example, it does not provide any insight into the development of the competitive resources or capabilities of an organisation. Equally, it does not provide any useful guidance as to how to actually **implement** whatever co-operative strategies may have been negotiated.

Section summary

Game theory illustrates that an organisation cannot develop its strategy without considering the possible reactions of its competitors. Competitor reaction may mean that the outcomes of a strategy are very different to what was initially intended.

CHAPTER ROUNDUP

- Unlike manufacturing companies, services are characterised by **intangibility, inseparability, variability, perishability** and no **transfer of ownership.**

- **Mass services** are standard services provided to large numbers of people, and are often automated. **Personal services** vary on the circumstances of the service delivery, and are generally one-to-one.

- **Service businesses need the same aggregate information** as manufacturing firms, but also need performance data as to their cost and volume drivers. Operational information is likely to be more qualitative.

- **Access to data** has been facilitated by **groupware**, **intranets, extranets, databases, data warehousing** and **data mining.**

- Developments in IT have enabled the **remote input of data**.

- Developments in IT have revolutionised the **potential for management accounting data**, increasing the volume and variety of **possible reports.**

- **Globalisation** and **competition** require an external, forward-looking focus, with greater facilities for modelling.

- **Game theory** illustrates that an organisation cannot develop its strategy without considering the possible reactions of its competitors. Competitor reaction may mean that the outcomes of a strategy are very different to what was initially intended.

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STUDY UNIT 26

Benchmarking

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BENCHMARKING BENEFITS AND DIFFICULTIES

Traditionally, control involves the comparison of actual results with an internal standard or target. The practice of **setting targets using external information** is known as benchmarking.

The **value of external data** to management accounting systems is its contribution to planning, decision-making and control.

Here are **examples.**

Management function	Type of information	Accounting document/process
Planning	• Demand estimates • Market research	• Sales budget
Decision making	• Demand estimates • Market research • Competitor research	• Breakeven analysis • Production costs of providing product features • Competitor costs
Control	• Demand estimates • Price variances	• Sales variance reports • Benchmarking for variances (see below)

Clearly, **some external information**, such as 'technological' or 'political' developments, **does not feed into the management accounting system**, even though it can be in a broader category of management information.

External information of a **quantitative** nature is **easier to feed into the management accounting system**. For example, forecasts of revenues, costs and profits derived from market research and targets based on competitors' performance (the information having been sourced from the Internet) are easier to incorporate than qualitative information.

Benchmarking

Benchmarking schemes enable precise comparisons to be drawn between firms. The use to which benchmarking information is put is the key to its value. Benchmarking is best for firms which have to 'catch up' rather than innovate.

Benchmarking. '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. Types of benchmarking include the following.

- **Internal benchmarking**. A method of comparing one operating unit or function with another within the same industry.
- **Functional benchmarking**. 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).
- **Competitive benchmarking**. Information is gathered about direct competitors, through techniques such as reverse engineering.*
- **Strategic benchmarking**. A type of competitive benchmarking aimed at strategic action and organisational change.

* Reverse engineering is the process of buying a competitor's product and dismantling it, in order to understand its content and configuration.

As you will see from the list of the types of benchmarking, a benchmarking exercise **doesn’t necessarily have to involve the comparison of operations with those of a competitor**. In fact, it might be difficult to persuade a direct competitor to part with any information which is useful for comparison purposes. Functional benchmarking, for example, does not always involve direct competitors. A railway company could be identified as the 'best' in terms of on-board catering, and an airline company that operates on different routes would seek opportunities to improve by sharing information and comparing their own catering operations with those of the railway company.

Exam Focus Point

There is ample information here on benchmarking to allow you to write a good essay including the stages of benchmarking and the pros and cons of using this method.

Stages of benchmarking

Organisations should begin by asking themselves the following questions.

a) Is it possible and easy to obtain **reliable competitor** information?

b) Is there any wide **discrepancy** between different **internal divisions**?

c) Can **similar processes** be identified in **non-competing environments** and are these non-competing companies willing to co-operate?

d) Is best practice operating in a similar environmental setting?

e) Is there time to complete the study?

f) It is possible to benchmark companies with similar objectives and strategies

The benchmarking exercise can then be divided into stages.

Step 1 **Set objectives** and determine the areas to benchmark

Step 2 Establish **key performance measures**

Step 3 **Select organisations** to study

Step 4 **Measure** own and others' performance

Step 5 **Compare** performances

Step 6 Design and implement **improvement programme**

Step 7 **Monitor** improvements

Step 1 requires consideration of the **levels of benchmarking**.

Level of benchmarking	Through	Examples of measures
Resources	Resource audit	<u>Quantity of resources</u> • Revenue/employee • Capital intensity <u>Quality of resources</u> • Qualifications of employees • Age of machinery • Uniqueness (e.g. patents)
Competences in separate activities	Analysing activities	Sales calls per salesperson Output per employee Materials wastage
Competences in linked activities	Analysing overall performances	Market share Profitability Productivity

Step 4 requires information. **Financial information** about competitors is **easier** to acquire than non-financial information. Information about **products** can be obtained from **reverse engineering**, **product literature**, **media comment** and **trade associations**. Information about **processes** (how an organisation deals with customers or suppliers) is more **difficult** to find.

Such information can be obtained from **group companies** or possibly **non-competing organisations** in the same industry (such as the train and airline companies mentioned above).

Why use benchmarking?

a) **Position audit**. Benchmarking can assess a firm's existing position, and provide a basis for establishing standards of performance.

b) The sharing of information can be a **spur to innovation**.

c) Its flexibility means that it can be used in both the **public and private sectors** and by people at different levels of responsibility.

d) **Cross comparisons** (as opposed to comparisons with similar organisations) are more likely to expose radically different ways of doing things.

e) It is an effective method of **implementing change**, people being involved in identifying and seeking out different ways of doing things in their own areas.

f) It identifies the **processes** to improve.

g) It helps with **cost reduction**.

h) It improves the **effectiveness** of operations.

i) It delivers **services** to a defined standard.

j) It provides a focus on **planning**.

k) It can provide early warning of **competitive disadvantage**.

l) It should lead to a greater incidence of **team working** and **cross-functional learning**.

Disadvantages of benchmarking

a) It implies there is **one best way** of doing business – arguably this boils down to the difference between efficiency and effectiveness. A process can be efficient but its output may not be useful. Other measures (such as amending the value chain) may be a better way of securing competitive advantage.

b) The benchmark may be **yesterday's solution to tomorrow's problem**. For example, a coffee-bar/fast-food restaurant might benchmark its activities (e.g. the quality of the coffee, cleanliness and ambience) against another coffee bar, whereas the real competitor could be a grocery store selling really good coffee and ready-made meals to cook easily and eat at home.

c) It is a **catching-up exercise** rather than the development of anything distinctive. After the benchmarking exercise, the competitor might improve performance in a different way.

d) It depends on **accurate** information about comparator companies.

e) It can be difficult to decide **which activities to benchmark**.

CHAPTER ROUNDUP

- **Benchmarking schemes** enable precise comparisons to be drawn between firms. The use to which benchmarking information is put is the key to its value. Benchmarking is best for firms which have to' catch up' rather than innovate.

STUDY UNIT 27

Business Process Re-Engineering

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BUSINESS PROCESS RE-ENGINEERING

Read this section to understand what business process re-engineering is. Also think about how business process re-engineering affects systems development and its influence on organisational performance (see the Case study).

Business process re-engineering involves focusing attention inwards to consider how business processes can be redesigned or reengineered to improve efficiency.

Business process re-engineering involves focusing attention **inwards** to consider how business **processes** can be **redesigned** or re-engineered to **improve efficiency**. It *can* lead to fundamental changes in the way an organisation functions. In particular, it has been realised that processes, which were developed in a paper-intensive processing environment, may not be suitable for an environment that is underpinned by IT.

The main writing on the subject is Hammer and Champy's *Reengineering the Corporation* (1993), from which the following definition is taken.

Business Process Re-engineering (BPR) is the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical contemporary measures of performance, such as cost, quality, service and speed.

The key words here are '**fundamental', 'radical', 'dramatic'** and **'process'**.

a) **Fundamental** and **radical** indicate that BPR is somewhat akin to zero based budgeting: it starts by asking basic questions such as 'why do we do what we do', without making any assumptions or looking back to what has always been done in the past.

b) **Dramatic** means that BPR should achieve 'quantum leaps in performance', not just marginal, incremental improvements.

c) **Process**. BPR recognises that there is a need to change functional hierarchies: 'existing hierarchies have evolved into functional departments that encourage functional excellence but which do not work well together in meeting customers' requirements' (Rupert Booth, *Management Accounting*, 1994).

A **process** is a collection of activities that takes one or more kinds of input and creates an output.

For example, order fulfilment is a process that takes an order as its input and results in the delivery of the ordered goods. Part of this process is the manufacture of the goods, but under **BPR** the **aim** of **manufacturing** is **not merely to make** the goods. Manufacturing should aim to **deliver the goods that were ordered,** and any aspect of the manufacturing process that hinders this aim should be re-engineered. The first question to ask might be 'Do they need to be manufactured at all?'

A **re-engineered process** has certain **characteristics**.

a) Often several jobs are **combined** into one.

b) Workers often **make decisions.**

c) The **steps** in the process are performed in **a logical order.**

d) **Work** is performed where it **makes most sense.**

e) Checks and controls may be reduced, and **quality 'built-in'.**

f) One manager provides a **single point of contact.**

g) The advantages of **centralised and decentralised** operations are combined.

Case Study

Based on a problem at a *major car manufacturer*.

A company employs 25 staff to perform the standard accounting task of matching goods received notes with orders and then with invoices. About 80% of their time is spent trying to find out why 20% of the set of three documents do not agree.

One way of improving the situation would have been to computerise the existing process to facilitate matching. This would have helped, but BPR went further: why accept any incorrect orders at all? What if all the orders are entered onto a computerised database? When goods arrive at the goods inwards department they either agree to goods that have been ordered or they don't. It is as simple as that. Goods that agree to an order are accepted and paid for. Goods that are not agreed are sent back to the supplier. There are no files of unmatched items and time is not wasted trying to sort out these files.

Exam Focus Point

You may well get a question on BPR requiring you to **assess** its impact on the organisation.

Hammer's principles of BPR

a) Processes should be designed to achieve a desired **outcome rather than** focusing on existing **tasks**.

b) **Personnel who use** the **output** from a process should **perform the process**. For example, a company could set up a database of approved suppliers; this would allow personnel who actually require supplies to order them themselves, perhaps using on-line technology, thereby eliminating the need for a separate purchasing function.

c) **Information processing** should be **included in the work, which produces the information**. This eliminates the differentiation between information gathering and information processing.

d) **Geographically dispersed resources** should be **treated** as if they are **centralised.** This allows the benefits of centralisation to be obtained, for example, economies of scale through central negotiation of supply contracts, without losing the benefits of decentralisation, such as flexibility and responsiveness.

e) **Parallel activities** should be **linked rather than integrated.** This would involve, for example, co-ordination between teams working on different aspects of a single process.

f) **'Doers'** should be allowed to be **self-managing.** The traditional **distinction** between **workers** and **managers** can be **abolished**: decision aids such as expert systems can be provided where they are required.

g) **Information** should be **captured once** at **source.** Electronic distribution of information makes this possible.

Business processes and the technological interdependence between departments

The value chain describes a series of activities from input of raw materials to output of finished goods/services for the customers. These activities may be organised into departments even though the actual process of adding value may cross departmental boundaries.

The **links between different departments of a business can vary**, however, and hence the **need to manage the relationships between them**. **Interdependence** is the extent to which **different departments depend on each** other to accomplish their tasks. It is possible to identify three types of interdependence.

a) In **pooled interdependence**, each department/section works **independently** of the others, subject to achieving the overall goals of the organisation.

b) **Sequential interdependence** is when there is a sequence (or a **linked** chain of activities) with a **start** and **end** point. An example is an assembly line: raw materials are taken, moulded to the right sizes and shapes and are assembled into a product. The **outputs** of each stage sequence must be precisely tailored to the **inputs** of the next – standardisation of outputs, might be one form of co-ordination used. The first activity must be performed correctly before the second can be tackled. **Management effort** is required to ensure that the **transfer of resources between departments is smooth**. They therefore need information about the process as a whole.

c) **Reciprocal interdependence** exists when a **number of departments acquire inputs from and offer outputs to each other**. In other words, while resources have to be transferred, there is **no pre-set sequence**. The output of one department might be sent to another for processing, and then returned to the original department.

You should now have some idea as to the complexities of business processes overlapping different departments. **Some organisations have redesigned their structures on the lines of business processes**, adopting BPR to **avoid** all the co-ordination problems caused by reciprocal interdependence.

Key characteristics of organisations, which have adopted BPR

a) **Work units change from functional departments to process teams**, which **replace the old functional structure**.

   (i) For example, within a functional framework, a sales order may be handled by many different people, in different departments or business functions. (One person takes the order in the department, and one person delivers).

   (ii) In process teams, the people are grouped together. A case team might combine to do all the work on a process and this applies not only to one-off projects but to recurring work.

   Multi-skilling/Multi-tasking also means that one individual has several skills and does many of the tasks in a process.

b) **Jobs change**. People do more, as team members are responsible for results. This ties in with **job enlargement** and **job enrichment**.

c) **People's roles change**. They are empowered to make decisions relevant to the process.

d) **Performance measures concentrate on results** rather than activities. Process teams create 'value' which is measurable.

e) Organisation structures change from **hierarchical** to **flat** (i.e. delayered).

   (i) When a process becomes the work of a **whole team**, managing the process is the **team's responsibility**. Interdepartmental issues become matters the team resolves itself, rather than matters requiring managerial intervention.

   (ii) Companies require less managerial input. **Managers have less to do**; there are fewer of them and so fewer layers.

   (iii) Organisation structure determines lines of communication, and in many organisations is a weighty issue. This is not the case in process organisations, as **lines of communication 'naturally' develop around business processes**.

Implications of BPR for accounting systems

Issue	Implication
Performance measurement	Performance measures must be built around processes not departments: this may affect the design of responsibility centres.
Reporting	There is a need to identify where value is being added.
Activity	ABC might be used to model the business processes.
Structure	The complexity of the reporting system will depend on the organisational structure. Arguably the reports should be designed round the process teams, if there are independent process teams.
Variances	New variances may have to be developed.

Case Study

The case of **Taco Bell (**Taco Bell is a chain of fast food restaurants based in California USA, but now operates world-wide. They specialise in Mexican foods**)** is one of the examples quoted in Hammer and Champy's book. The emphasis is the editor's.

In the 1980s, the company was entrenched in a command and control hierarchy that claimed to understand what customers wanted, but did not ask directly. But major re-engineering efforts – automating, changing the organisational structure and management system, reducing kitchen space, and increasing customer space – focusing on what customers really wanted, greatly simplified their processes.

These changes have had a huge impact on the company. It went from a failing regional Mexican-American fast food chain with $500 million in sales in 1982, to a $3 billion national company 10 years later, with a goal to expand further to $20 billion.

One BPR initiative was the **K-Minus program, or kitchenless restaurant**. Based on the belief that they were a service company, not a manufacturer, a large majority of the restaurants' food preparation is now "outsourced" and occurs at central commissaries rather than in the restaurant, **pushing 15 hours of work a day out of the restaurant**, **improving quality control and employee morale**, **reducing employee accidents and injuries**, and resulting in **substantial savings on utilities**. The K-Minus program saves Taco Bell about $7 million a year.

Examples of business process re-engineering

a) A move from a traditional functional plant layout to a JIT cellular product layout is a simple example.

b) **Elimination of non-value-added activities**. Consider a materials handling process, which incorporates scheduling production, storing materials, processing purchase orders, inspecting materials and paying suppliers.

   This process could be re-engineered by sending the production schedule direct to nominated suppliers with whom contracts are set up to ensure that materials are delivered in accordance with the production schedule and that their quality is guaranteed (by supplier inspection before delivery).

   Such re-engineering should result in the elimination or permanent reduction of the non-value-added activities of storing, purchasing and inspection.

Exam Focus Point

Be prepared to apply your knowledge of BPR to a particular scenario or to examples that you are aware of from your reading or own experience. Examiners have stated that good answers often draw on the candidate's own experience in the context of the question set.

CHAPTER ROUNDUP

- **Business process re-engineering** involves focusing attention inwards to consider how business processes can be redesigned or reengineered to improve efficiency.