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APPLICATION OF MANAGEMENT ACCOUNTING TECHNIQUES

MAC3701

Semester 1 and 2

Department of Management Accounting

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PART 1, TOPIC 1 – ADVANCED BEHAVIOURAL ASPECTS OF COSTS

INTRODUCTION

In MAC2601 you learnt that there are different ways to classify costs. One of these is to classify costs according to behaviour. By cost behaviour, we mean the manner in which costs react to changes in the activity levels of production or service. It is also important for you to understand at what level in the organisation the cost is incurred. An understanding of cost behaviour enables managers to predict costs at different levels of activity and at different levels in the organisation. We can use various methods of cost prediction to calculate total costs and, based on this information, we can make informed decisions that can increase the sustainable wealth of the organisation and its stakeholders.

Topic 1 is made up of the following study units:

STUDY UNIT	TITLE
STUDY UNIT 1	PLANNING AND CONTROLLING INVENTORY
STUDY UNIT 2	FURTHER ISSUES IN OVERHEAD ALLOCATIONS
STUDY UNIT 3	COST ESTIMATION AND COST BEHAVIOUR

LEARNING OUTCOMES

After studying this topic, you should be able to

- describe the three motives for holding inventory
- apply the economic order quantity (EOQ) to determine production run size
- decide about quantity discounts and the EOQ
- decide when to place an order
- calculate elementary safety stock levels (no probabilities used)
- describe how just-in-time (JIT) purchasing differs from traditional purchasing principles
- provide advice on the allocation of non-manufacturing overheads in manufacturing and service organisations for decision-making purposes

- allocate inter-service department overheads
- determine cost hierarchies in an activity-based costing (ABC) system
- apply product profitability analysis using ABC hierarchies
- discuss the use of ABC in service organisations and its other management applications
- calculate and interpret the coefficient of determination
- compute the correlation coefficient
- implement the steps in estimating cost functions
- estimate hourly-driven costs when a learning curve effect is present

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- defined the different cost objects
- classified and explained the behaviour of costs
- estimated costs using different techniques
- accounted for the acquisition of material, labour and overheads
- considered the appropriate allocation of these costs to cost objects
- calculated the EOQ using various methods
- calculated labour and overhead allocation rates
- distinguished between the different types of remuneration
- calculated gross and net pay
- appropriately allocated labour costs
- calculated a labour recovery rate
- identified the main reasons for applying a budgeted predetermined overhead recovery rate when costing products in respect of production overheads
- distinguished between budgeted, applied (recovered) and actual production overheads
- determined the over and under recovery of overheads
- accounted for overheads in the financial records of an entity
- differentiated between approaches required between single product range entities and multiple product range entities
- selected an appropriate allocation base and a suitable denominator or capacity level
- distinguished between a blanket overhead rate and a departmental overhead rate
- applied primary and secondary allocations of overheads when determining departmental overhead rates
- valued inventory on the first-in-first-out (FIFO) basis

- valued inventory on the weighted average method
- distinguished between different types of cost systems
- identified the differences between the direct and absorption costing methods
- drafted the income statements according to both the direct and absorption costing method by using different inventory valuation methods
- reconciled the difference between the direct and absorption costing methods' net profits
- identified which method is most appropriate in different circumstances
- compared traditional and ABC systems
- recognised and described the differences between ABC and the traditional costing method
- identified environments which are favourable for the implementation of an ABC system
- designed an ABC system and implemented it to cost products

Please refer to your second year guide if you want to refresh your knowledge.

For another perspective, you may also refer to the following subsections in your prescribed Drury textbook:

Chapter	**Subsection**
2	*Cost objects*
2	*Manufacturing, merchandising and service organisations*
2	*Direct and indirect costs*
2	*Period and product costs*
2	*Cost behaviour*
2	*Relevant and irrelevant costs and revenues*
2	*Avoidable and unavoidable costs*
2	*Sunk costs*
2	*Opportunity costs*
2	*Incremental and marginal costs*
3	*Assignment of direct and indirect costs*
3	*Assigning direct costs to cost objects*
3	*Plant-wide (blanket) overhead rates*
3	*The two-stage allocation process*
3	*An illustration of the two-stage process for a traditional costing system*
3	*Budgeted overhead rates*
3	*Under- and over-recovery of overheads*

23 *General principles applying to estimating cost functions*

23 *Cost estimation methods – graphical or scatter graph method*

23 *Cost estimation methods – high-low method*

23 *Cost estimation methods – the least-squares method*

24 *Why do firms hold inventories?*

24 *Relevant costs for quantitative models under conditions of certainty*

24 *Determining the economic order quantity (EOQ)*

24 *Assumptions of the EOQ formula*

11 *Types of cost systems*

11 *A comparison of traditional and ABC systems*

11 *The emergence of ABC systems*

11 *Volume-based and non-volume-based cost drivers*

11 *Designing ABC systems*

STUDY UNIT 1 PLANNING AND CONTROLLING INVENTORY

1. Introduction

Traditionally organisations used to hold or manufacture inventory according to available capacity. Nowadays, inventory models and techniques are used to optimise profitability and cash flow. The EOQ is one such technique that can assist us to make good decisions regarding inventory. In this study unit, we will investigate the use of the EOQ further.

This study unit is based on *selected sections* from chapter 24 in your prescribed textbook.

You can attempt the following activity to refresh your skills on how to calculate the EOQ which was taught in MAC2601:

Revision activity 1.1

Solve review problem 24.13 in the Drury textbook 8th edition or 24.14 in the 9th edition.

Solution to revision activity 1.1

Find the solution to review problem 24.13 at the back of the Drury textbook 8th edition or 24.14 in the 9th edition.

Note:
The holding cost for inventory item G is calculated as 13,33% of \$200 = \$26,66. The EOQ is therefore equal to 300,0375 units (if rounded to 4 decimals). We always **round up** when determining the EOQ, unless the answer is already a full integer. The principle of rounding up is applied in order to get a whole number of units and to ensure that the full annual demand is met. The answer should therefore be 301.

The holding cost for inventory item H is calculated as 8% of \$25 = \$2.

When calculating the total annual holding cost of an inventory item, take note that you use the average inventory levels. We assume equal daily issues or sales; therefore the average inventory level is the EOQ/2.

*****

2. Alternative formulae for calculating the Economic order quantity (EOQ)

In this section we discuss why organisations hold inventory and compare two mathematical models for calculating the EOQ.

Now study the following subsections in Drury, chapter 24, and attempt the activity:

Chapter	Subsection
24	*Why do firms hold inventories*
24	*Relevant costs for quantitative models under conditions of certainty*
24	*Determining the economic order quantity: Formula method*

The above sections were also covered in MAC2601.

Drury uses slightly different symbols than those taught in MAC2601, but it is basically the same formula:

<table>
<tr><th colspan="2">MAC2601</th><th colspan="2">Drury</th></tr>
<tr><td colspan="2">$\sqrt{\frac{2 \text{ x } U \text{ x } C}{H + (P \text{ x } i)}}$</td><td colspan="2">$\sqrt{\frac{2 \text{ x } D \text{ x } O}{H}}$</td></tr>
<tr><td>2 =</td><td>a constant</td><td>2 =</td><td>a constant</td></tr>
<tr><td>U =</td><td>annual usage (demand)</td><td>D =</td><td>total demand for the period</td></tr>
<tr><td>C =</td><td>variable cost of placing an order</td><td>O =</td><td>ordering cost per order</td></tr>
<tr><td>H =</td><td>other variable inventory holding cost (excl. interest if calculated below#) per annum per unit</td><td rowspan="3">H =</td><td rowspan="3">holding cost per unit</td></tr>
<tr><td>P =</td><td>#purchase price per unit (should be used when it is provided)</td></tr>
<tr><td>i =</td><td>#interest rate or required return (should be used when it is provided)</td></tr>
</table>

Note:

The formula provided in MAC2601 is more comprehensive than that provided in Drury. If the question provides the relevant information to apply the MAC2601 formula, you should use that.

*****

In the day-to-day decision making regarding inventory levels, the three primary motives for carrying inventory will continuously be balanced with the cost of investing in inventory. The EOQ method is one attempt to balance these sometimes conflicting demands.

Activity 1.2

Palm (Pty) Ltd is a supplier of woodworking tools. One of its products is a sanding machine selling at R4 900. The company sells on average approximately 20 sanding machines per week. Sales take place evenly throughout the year which consists of 50 weeks.

The company purchases the sanding machines at a cost of R3 430 each. The cost to place an order amounts to R300 and orders are executed within 5 weeks.

Direct inventory holding costs are R35,00 per unit and insurance on the sanding machines amounts to 10% of the unit cost per year.

The company implemented the economic order quantity type to manage its inventory.

The current required after tax cost return on capital is 4% per annum.

REQUIRED

Calculate the economic order quantity (EOQ) for the sanding machines.

Solution to Activity 1.2

Economic order quantity (EOQ)

$$= \sqrt{\frac{2 \text{ x U x C}}{\text{H}+(\text{P x i})}}$$

$$= \sqrt{\frac{2 \text{ x } (20 \text{ x } 50) \text{ x R300}}{\text{R35}+ (\text{R3 430 x } 10\%) + (\text{R3 430 x } 4\%)}}$$

$$= \sqrt{\frac{R600\,000}{R515{,}20}}$$

= 34,13

≈ 35 units (rounded up)

Note:

Insurance on the sanding machines is part of inventory holding costs and should therefore be included in the denominator. Also take note that the number of units have been rounded up.

3. Using the EOQ to make decisions

Now that you have worked through the alternate formulae for calculating the EOQ, we will explain how to use the EOQ to make other decisions regarding inventory management.

Now study the following subsections in Drury, chapter 24, and attempt the activities:

Chapter	Subsection
24	*Application of the EOQ model in determining the optimum batch size for a production run*
24	*Quantity discounts*
24	*Determining when to place the order*
24	*Uncertainty and safety stocks*

Did you notice that you may use the EOQ to determine the size of a production run? Take note of the calculation of the number of production runs required per annum as well as the point (in units) where the production run should be started. Pay special attention to example 24.2* in Drury where a quantity discount is offered. Also, make sure you understand the calculation of the re-order point with and without safety stock.

***Errata Drury textbook 8th edition example 24.2:**

The saving in ordering cost should be 255 and not 15.
The total savings will then be equal to 2 145 and not 1905.

This errata has been corrected in the Drury textbook 9th edition.

Activity 1.3

Answer review problems 24.12 and 24.15 in the Drury 8th edition textbook or review problems 24.12 and 24.16 in the Drury 9th edition textbook.

Solution to Activity 1.3

Find the solution to review problems 24.12 and 24.15 at the back of the Drury 8th edition textbook or 24.12 and 24.16 in the Drury 9th edition textbook.

Note:
In MAC3701 we will indicate to you the basis on which the level of safety stock is calculated, for example the number of days or the percentage of inventory. In later MAC modules you will learn to incorporate uncertainty into the calculation.

*****

4. Just-in-time (JIT) purchasing

Advances in information technology have made it possible for organisations and their suppliers to link their computer systems. Organisations also strive to engage in mutually rewarding long-term relationships with their suppliers. This has greatly facilitated JIT purchasing.

Now study the following subsection in Drury, chapter 24:

Chapter	Subsection
24	*Just-in-time purchasing arrangements*

Note:
Although Drury indicates that you should also study *JIT purchasing arrangements* in chapter 21, it is not required for our purposes; the content on JIT purchasing is sufficiently covered in the above subsection in chapter 24.

*****

As can be seen, the supporters of JIT argue that we have completely underestimated the cost of holding inventory in the past. It, therefore, makes business sense to try and reduce inventory holding costs by carrying lower inventories. They also believe that by having long-term orders with fewer suppliers the ordering cost will be lower.

With this idea in mind and using the EOQ equation, the EOQ will obviously decrease when the order costs (O) in the equation are decreased and the holding costs (H) are increased.

This can be explained with reference to the following example: Let us use the information in example 24.2 in Drury.

The total ordering costs will be (9 000/150) x 5 = 300 and
the total holding costs will be (150/2) x 4 = 300.
Therefore, total costs = 600

Assume the company entered into a JIT purchasing arrangement with its supplier and that the ordering cost is reduced to 3 and the holding cost is increased to 6. Then:

$$EOQ = \sqrt{\frac{2 \times D \times O}{H}}$$

$$= \sqrt{\frac{2 \times 9\ 000 \times 3}{6}}$$

$$= 95 \text{ units}$$

The total ordering costs will be (9 000/95) x 3 = 284
The total holding costs will be (95/2) x 6 = 285.
Therefore, total costs = 569

Do you notice that the reduction in ordering costs has led to a reduction in the order size, the resulting average inventory levels and total ordering and holding costs?

5. Summary

In this study unit, you learnt to

- describe the three motives for holding inventory
- apply the EOQ to determine production run size
- make decisions with regard to quantity discounts and the EOQ
- decide when to place an order
- calculate elementary safety stock levels (no probabilities used)
- describe how JIT purchasing differs from traditional purchasing principles

In the next study unit, we will discuss further issues with regard to overhead costs with specific reference to inter-service reallocations and cost hierarchies in ABC.

6. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer the review questions in the Drury textbook, 8th or 9th edition covering the theory at the end of chapter 24 (refer only to review questions 24.1 to 24.7 and 24.11).

The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

7. Online enrichment activity

Complete the online activities for chapter 24 that relate to the learning outcomes specified. The online activities can be found on the internet using your CourseMate account.

What is a CourseMate account?

The Drury textbook gets accompanied by the online student resource, CourseMate. Students can access CourseMate by using the unique personal access card included in the front of the textbook. Students should activate their CourseMate accounts at http://login.cengagebrain.co.uk. Please note that MAC3701 mainly refers to the CourseMate resources for *enrichment* activities and that it is not an instructor-led course.

8. Self-assessment questions

After working through all the relevant sections in the textbook, guidance and activities provided by this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 1.1

Answer question 24.1 in the Drury student manual, 8th or 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 1.1

Find the solution to question 24.1 at the back of the Drury student manual, 8th or 9th edition.

QUESTION 1.2

Answer question 24.2 in the Drury student manual, 8th or 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 1.2

Find the solution to question 24.2 at the back of the Drury student manual, 8th or 9th edition.

QUESTION 1.3

Answer question 24.4 in the Drury student manual, 8th edition or question 24.6 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 1.3

Find the solution to question 24.4 at the back of the Drury student manual, 8th edition, or to question 24.6 at the back of the 9th edition.

QUESTION 1.4

Mbali Skins is a wholesaler of laptop covers. The company sells approximately 1 500 of these laptop covers per month. Sales take place evenly throughout the year, which consists of 300 working days.

The company currently purchases the laptop covers at a cost of R350 each. Orders are executed within five days. Safety stock should amount to the sales requirement for three working days. There is no seasonal fluctuation in the demand for laptop covers.

According to estimate, the cost to place an order amounts to R150. Direct inventory holding costs amount to R10,50 per unit. Insurance cost is 7% of the unit cost per year.

The company has been approached by another supplier, offering a price of R330 per laptop cover, provided that orders are placed in batches of at least 500 units each. The lead time for delivery would remain five days. The ordering cost per order for this supplier is only R120 per order.

REQUIRED

a. Determine the number of orders to be placed annually, without taking the special offer into account.

b. Determine the re-order point for laptop covers.

c. Recommend to Mbali Skins whether or not the special offer should be accepted. Support you recommendations with appropriate calculations.

SOLUTION TO SELF-ASSESSMENT QUESTION 1.4

a. Calculation of the number of orders to be placed annually

$$\text{Number of orders} = \frac{\text{Total annual demand ①}}{\text{EOQ ②}}$$

$$= \frac{18\ 000}{393}$$

$$= 45{,}80$$

$$\approx 46 \text{ orders}$$

Note:
Remember that it is not possible to place “half an order” or a partial order – you either place an order or you don’t. The number of orders was therefore rounded up to 46 orders.

① Calculation of total annual demand

Total annual demand = expected sales per month x 12 months
= 1 500 x 12
= 18 000

② Calculation of EOQ

$$EOQ = \sqrt{\frac{2 \times D \times O}{H}}$$

$$= \sqrt{\frac{2 \times 18\,000 \text{ ①} \times R150}{(7\% \times R350) + R10{,}50}}$$

$$= \sqrt{\frac{R5\,400\,000}{R35}}$$

$$= 392{,}79$$

$$\approx 393 \text{ units}$$

b. Re-order point

= Average usage during lead time + safety stock

= [(60③ x 5 days) + (60③ x 3 days)]

= 300 + 180

= 480 units

③ Average daily usage

= 18 000 / 300 working days

= 60 laptop covers per working day

c. Decision on special offer from competitor

		R
Saving in purchase price	(R350 – R330) x 18 000	360 000
Saving in ordering costs	(R150 x 46) – (R120 x 18 000/500)	2 580
Total **savings**		362 580

		R
Previous holding cost	[(R350 x 0,07) + 10,50] x (393/2)	6 877,50
	+ safety stock R35 x 180	6 300,00
		13 177,50
New holding cost	[(R330 x 0,07) + 10,50] x (500/2)	8 400,00
	+ safety stock R33,60 x 180	6 048,00
		14 448,00
Total **increase** in holding cost		1 270,50

Recommendation:

The additional savings far exceed the additional cost and, therefore, the special offer should be accepted.

STUDY UNIT 2 FURTHER ISSUES IN OVERHEAD ALLOCATIONS

1. Introduction

In the previous study unit you learnt how to plan and control inventory using the EOQ and we touched on the use of JIT purchasing arrangements. In this study unit you will learn more about overhead cost allocations and cost hierarchies in ABC. Overheads are a major portion of the modern organisation's costs. Allocating these indirect costs can be a complex task which affects many decisions in the organisation.

This study unit is based on *selected sections* from the following chapters in your prescribed Drury text book:

- Chapter 3
- Chapter 11

2. Non-manufacturing overheads

In MAC2601 you learnt that we allocate indirect manufacturing costs or manufacturing overheads to inventory based on a budgeted recovery or allocation rate. However, there are scenarios where management, for decision-making purposes, need to allocate even non-manufacturing costs to products, services or other cost objects.

Now study the following subsections in Drury, chapter 3:

Chapter	Subsection
3	*Non-manufacturing overheads*
3	*Cost assignment in non-manufacturing organisations*

You should be guided by the background in questions as to how the overheads are allocated. The calculations of the recovery rate and the allocation process itself works in the same way as that for manufacturing overheads.

3. Inter-service department reallocations

Before you calculate a budgeted overhead allocation rate, you should first assign all the budgeted costs to the cost or activity centre (in the case of ABC). This means that you will do first stage allocations as well as the second stage allocations. Part of the second stage allocations is where service departments render services to other service departments, production departments and non-production or administrative departments. In MAC2601 we excluded scenarios where the service departments rendered reciprocal services to each other.

Now study the following subsections in Drury, chapter 3, and attempt the activities:

Chapter	Subsection
3	*The indirect cost assignment process*
3	*Appendix 3.1 Inter-service departmental reallocations*

Note:
Make sure that you understand the simultaneous equation method. This is a mathematical tool that you will encounter again later in the study unit on linear programming.

Simultaneous equation method: The aim of using the simultaneous equation method, is to solve one of the variables, either x or y. In order to do this, we want to add two equations together (or subtract two equations from each other) and cancel out one variable completely – for example:

Refer to Example 3A.1 in your Drury textbook– Simultaneous equation method:

If we multiply equation 1 by 5, it will result in $x – 0{,}2y = 14\ 040$, to become $5x – y = 70\ 200$. Take note that $0{,}2y$ multiplied by 5 is equal to 1y.

$5x – y = 70\ 200$ (The new equation 1 after multiplying all the variables with 5).

By rearranging equation 2, you will see that $-0{,}1x + y = 18\ 000$.

As already mentioned, the aim of using the simultaneous equation method, is to solve one variable, either x or y and we have to therefore cancel out one of the variables in order to be left with only one variable.

Adding the two equations together will now give you the following:

$5x \quad - y = 70\ 200$

$\underline{-0{,}1x \quad + y = 18\ 000}$

$4{,}9x \quad + 0 = 88\ 200$

Can you see that the variable, y, cancels out when you add the two equations together? It is now possible to solve the variable x. After you've solved the equation for x, you can solve the equation for y by substituting the value for x into any one of the two equations.

*****

Activity 2.1

Solve review problem 3.24 in the Drury textbook 8th edition or 3.25 in the 9th edition.

Solution to Activity 2.1

Find the solution to review problem 3.24 at the back of the Drury textbook 8th edition or 3.25 in the 9th edition.

You get two equations, $x - 0{,}05y = 100\ 000$ and $-0{,}1x + y = 50\ 000$.

To get the 2 x'es equal with opposite signs (in order to cancel them out when adding the two equations together), you would have to multiply equation 2 with 10. {To get $-0{,}1x \times 10 = x$}. Then you have $x - x = 0$ and thus you can solve for y.

Alternatively you could have left equation 2 as $-0{,}1x + y = 50\ 000$. But then you would have had to multiply equation 1 by 20 in order to get $-y$ when you multiply $-0{,}05y$ by 20. {$-0{,}05y \times 20 = -y$}

Please note that in the solutions, figures have been rounded off and your own calculations may differ slightly.

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4. Background and introduction to Activity based costing (ABC)

In MAC2601 you learnt about the difference between a traditional costing system and ABC as well as the advantages and disadvantages of ABC. You also learnt how to design an ABC system and calculate product costs using ABC. We will now focus more attention on the hierarchy of activities in the organisation and its implications for profit calculations at different levels.

Now study the following subsections in Drury, chapter 11, and attempt the activities:

Chapter	Subsection
11	*The need for a cost accumulation system in generating relevant cost information for decision-making*
11	*Activity hierarchies*
11	*Activity-based costing profitability analysis*

Using these different levels assist in combining various activities and grouping them into different levels of activity. Pay attention to figure 11.2 in your Drury textbook, 8th or 9th edition, which is an illustration of hierarchical profitability analysis.

Revision activity 2.2

Having attended a CIMA course on activity-based costing (ABC) you decide to experiment by applying the principles of ABC to the four products currently made and sold by your company. Details of the four products and relevant information are given below for one period:

Product	**A**	**B**	**C**	**D**
Output in units	120	100	80	120
Costs per unit:	**R**	**R**	**R**	**R**
Direct material	40	50	30	60
Direct labour	28	21	14	21
Machine hours (per unit)	4	3	2	3

The four products are similar and are usually produced in production runs of 20 units and sold in batches of 10 units.

The production overhead is currently absorbed by using a machine hour rate, and the total of the production overhead for the period has been analysed as follows:

	R
Machine department costs (rent, business rates, depreciation and supervision)	10 430
Set-up costs	5 250
Stores receiving	3 600
Inspection/Quality control	2 100
Materials handling and dispatch	4 620

You have ascertained that the 'cost drivers' to be used are as listed below for the overhead costs shown:

Cost	**Cost driver**
Set up costs	Number of production runs
Stores receiving	Requisitions raised
Inspection/Quality control	Number of production runs
Materials handling and despatch	Orders executed

The number of requisitions raised on the stores was 20 for each product type and the number of orders executed was 42, each order being for a batch of 10 of a product.

REQUIRED

a. Calculate the total costs for each product if all overhead costs are absorbed on a machine hour basis.
b. Calculate the total costs for each product, using activity-based costing.
c. Calculate and list the unit product costs from your figures in (a) and (b) above, to show the differences and to comment briefly on any conclusions which may be drawn which could have pricing and profit implications.

[Source: Drury textbook, 8th edition, 2012, 11.20]

Solution to Revision activity 2.2

a. Total machine hours = (120 × 4 hrs) + (100 × 3 hrs) + (80 × 2 hrs) + (120 × 3 hrs) = 1300 hrs

Machine hour overhead rate $= \dfrac{R10\ 430 + R5\ 250 + R3\ 600 + R2\ 100 + R4\ 620}{1\ 300 \text{ hrs}}$

= R20 per machine hour

	A	**B**	**C**	**D**
	R	**R**	**R**	**R**
Direct material	40	50	30	60
Direct labour	28	21	14	21
Overheads at R20 per machine hour	80	60	40	60
	148	131	84	141
Units of output	120	100	80	120
Total cost	**17 760**	**13 100**	**6 720**	**16 920**

b.

Cost	**R**	**Cost driver**	**Cost driver transactions**	**Costs per unit R**
Machine department	10 430	Machine hours	1300 hours	8,02
Set-up costs	5 250	Production runs ①	21	250,00
Stores receiving	3 600	Requisitions raised	80 (4 × 20)	45,00
Inspection/quality control	2 100	Production runs ①	21	100,00
Materials handling	4 620	Number of orders executed ②	42	110,00

Note:

① Number of production runs = Total output (420 units)/20 units per set-up.

② Number of orders executed = Total output (420 units)/10 units per order.

The total costs for each product are computed by multiplying the cost driver rate per unit by the quantity of the cost driver consumed by each product.

Product	**A**	**B**	**C**	**D**
	R	**R**	**R**	**R**
Prime costs	8 160 (R68 x 120)	7 100	3 520	9 720
Set ups	1 500 (R250 x 6)	1 250 (R250 x 5)	1 000	1 500
Stores/receiving	900 (R45 x 20)	900	900	900
Inspection/quality	600 (R100 x 6)	500	400	600
Handling despatch	1 320 (R110 x 12)	1 100 (R110 x 10)	880	1 320
Machine dept cost	3 851 ③	2 407 ④	1 284	2 888
Total costs	**16 331**	**13 257**	**7 984**	**16 928**

Note:

③ Machine dept cost = A = 120 units x 4 hrs x R8,02; ④ B = 100 units x 3 hrs x R8,02

c. Cost per unit

	A	**B**	**C**	**D**
	R	**R**	**R**	**R**
Costs from (a)	148,00	131,00	84,00	141,00
Costs from (b)	136,09	132,57	99,80	141,07
Difference	**(11,91)**	**1,57**	**15,80**	**0,07**

Product A is over-costed with the traditional system. Products B and C are under-costed and similar costs are reported with Product D. It is claimed that ABC more accurately measures resources consumed by products. Where cost-plus pricing is used, the transfer to an ABC system will result in different product prices. If activity-based costs are used for stock valuations then stock valuations and reported profits will differ.

Note:

① When determining the number of production runs for part (b) of the question, the calculation is as follows:

Product A	**Product B**	**Product C**	**Product D**
120 units/20 units per run	100 units/20 units per run	80 units/20 units per run	120 units/20 units per run

= 6 + 5 + 4 + 6

= 21

Please take note that the differences in the machine department costs are due to rounding!

Activity 2.3

Solve review problem 11.25 in the Drury textbook 8th or 9th edition.

Solution to Activity 2.3

Find the solution to review problem 11.25 at the back of the Drury textbook 8th or 9th edition.

It is important that you should be able to classify cost drivers and activities at the correct level. Using ABC for profitability analysis is a very handy management tool. It highlights which costs should be eliminated over the longer period if certain activities are eliminated.

Note:
In the short run, most overhead costs will be fixed, regardless of the activity level. In the long run, all costs become variable as the decision to eliminate the cost driver can be implemented. You will encounter this concept again in the study unit on relevant costing.

Multiplying a recovery or cost driver rate with an activity quantity **does not** make it a variable cost!

*****

5. Further aspects of ABC

You can also employ ABC fruitfully in service organisations, as certain service departments perform repetitive actions which could be identified as the cost drivers.

Now study the following subsections in Drury, chapter 11, and attempt the activities:

Chapter	Subsection
11	*Periodic review of an ABC database*
11	*ABC in service organisations*
11	*ABC cost management applications*

Did you notice that it was found that service organisations are more likely to use an ABC system? In the following enrichment activity you will see how ABC is used in service organisations.

Enrichment activity 2.4

Answer the questions posed in Real World Views 11.2 and 11.3 in the Drury textbook 8th edition or Real World Views 11.3 and 11.4 in the Drury textbook 9th edition.

Solution to Enrichment activity 2.4

Find the solutions to the Real World View questions online via your CourseMate account.

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6. Summary

In this study unit you learnt to

- provide advice on the allocation of non-manufacturing overheads in manufacturing and service organisations for decision-making purposes
- allocate inter-service department overheads
- determine cost hierarchies in an ABC system
- apply product profitability analysis using ABC hierarchies
- discuss the application of ABC in service organisations and other management applications

In the next study unit, we will demonstrate how to make predictions about costs by using regression analysis. We will also examine the concept "learning curve effect" and how to make informed decisions when a learning curve effect is present.

7. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer the review questions in the Drury textbook, 8th or 9th edition covering the theory at the end of chapters 3 and 11. The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

You can ignore questions 11.15 and 11.16, as these are covered in later MAC modules.

8. Online enrichment activity

Complete the online activities for chapters 3 and 11 that relate to the learning outcomes specified.

9. Self-assessment questions

After working through all the relevant sections in the textbook, guidance and activities provided by this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 2.1

Answer question 3.3 in the Drury student manual, 8th edition or question 3.6 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 2.1

Find the solution to question 3.3 at the back of the Drury student manual, 8th edition or question 3.6 in the 9th edition.

QUESTION 2.2

Answer question 3.9 in the Drury student manual, 8th edition or question 3.12 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 2.2

Find the solution to question 3.9 at the back of the Drury student manual, 8th edition or question 3.12 in the 9th edition.

QUESTION 2.3

Answer question 11.1 in the Drury student manual, 8th or 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 2.3

Find the solution to question 11.1 at the back of the Drury student manual, 8th or 9th edition.

QUESTION 2.4

Solve review problem 11.23 in the Drury textbook, 8th or 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 2.4

Find the solution to review problem 11.23 at the back of the Drury textbook, 8th or 9th edition.

STUDY UNIT 3 COST ESTIMATION AND COST BEHAVIOUR

1. Introduction

In the previous study unit you learnt about assigning overhead costs and making decisions using ABC techniques. In this study unit, we will discuss how to determine the reliability and fit of the regression analysis as well as the effect the learning curve has on labour cost and how to make decisions with regard to these techniques.

This study unit is based on *selected sections* from chapter 23 in your prescribed Drury textbook.

In MAC2601 you learnt how to use the basic linear equation (simple regression) to split semi-variable costs into their fixed and variable components. We will start off by doing some revision activities to refamiliarise you with the equations and formulae.

Revision activity 3.1

X Ltd incurred costs as indicated below. During the 6 periods below, these costs changed, but not in direct relation to the volume .

PERIOD	NUMBER OF UNITS PRODUCED	HISTORICAL COST (R)
1	196	3 960
2	200	4 000
3	210	4 100
4	190	3 900
5	208	4 080
6	212	4 120

REQUIRED

a. Use the high-low method to determine the variable cost per unit and the total fixed costs.

b. Forecast the total costs if an estimated 220 units are to be manufactured in period 7.

Solution to Revision activity 3.1

a. Variable cost per unit and total fixed costs

Variable cost per unit	=	$\frac{R4\ 120 - R3\ 900}{212 - 190 \text{ units}}$
		$\frac{R220}{22 \text{ units}}$
	=	R10 per unit
Total fixed costs (@ highest observation)	=	R4 120 – (212 x R10)
	=	R4 120 – R2 120
	=	R2 000

OR

Total fixed costs (@ lowest observation)	=	R3 900 – (190 x R10)
	=	R3 900 – R1 900
	=	R2 000

b. Forecast for 220 units

y = R2 000 + (R10 x X units) = R2 000 + (R10 x 220 units)

= R4 200

Revision activity 3.2

The management accountant at Josephine Ltd is trying to predict the quarterly total maintenance cost for a group of similar machines. She has extracted the following information for the last eight quarters:

Quarter number	1	2	3	4	5	6	7	8
Total maintenance cost (R'000)	265	302	222	240	362	295	404	400
Production units ('000)	20	24	16	18	26	22	32	30

The effects of inflation have been eliminated from the above costs.

The management accountant is using linear regression to establish an equation of the form $y = a + bx$ and has produced the following preliminary calculations:

Σ(total maintenance cost x production units)	= R61 250 million
Σ(total maintenance cost)^2	= R809 598 million
Σ(production units)^2	= 4 640 million

REQUIRED

Establish the equation which will allow the management accountant to predict quarterly total maintenance costs for given level of production. Interpret your answer in terms of fixed and variable maintenance costs.

Refer to the formulae for calculating "a" and "b" under the section "*The least-squares method".*

[Source: Drury textbook 8th edition, 2012: 23.15a]

Solution to Revision activity 3.2

The dependent variable (y) is the maintenance cost (in R'000) and the independent variable is production units (in '000).

Σy = (265 +302 + 222 + 240 + 362 +295 + 404 + 400) = 2 490
Σx = (20 + 24 + 16 + 18 + 26 + 22 + 32 + 30) = 188
n = 8

Use the formulae provided in chapter 23 under the section "The least-squares method". In the examination, we will provide these formulae to you if needed, so you don't have to memorise them.

It is, however, important that you can establish from the information in the question which are the dependent and independent variables, and which formula is used for the fixed cost and which for the variable cost per unit of activity.

$$b = (n\Sigma xy – \Sigma x\Sigma y)/(n\Sigma x^2 – (\Sigma x)^2)$$
$$= [(8 \times 61\ 250) – (188 \times 2490)]/[(8 \times 4640) – (188)^2]$$
$$= 12{,}32$$

a = $(\Sigma y/n) – (b\Sigma x/n)$

= (2 490/8) – [(12,32 x 188)/8]

= 21,73

Therefore the linear equation is: y = 21,73 + 12,32x where x and y are in ‘000s. This can be interpreted as fixed costs being equal to R21 730 and the variable cost per unit of production is R12,32.

The figures provided in the solution are derived at as follows:

Quarter	(x) Units	(y) Maintenance	xy	x^2	y^2
1	20 000	265 000	5 300 000 000	400 000 000	70 225 000 000
2	24 000	302 000	7 248 000 000	576 000 000	91 204 000 000
3	16 000	222 000	3 552 000 000	256 000 000	49 284 000 000
4	18 000	240 000	4 320 000 000	324 000 000	57 600 000 000
5	26 000	362 000	9 412 000 000	676 000 000	131 044 000 000
6	22 000	295 000	6 490 000 000	484 000 000	87 025 000 000
7	32 000	404 000	12 928 000 000	1 024 000 000	163 216 000 000
8	30 000	400 000	12 000 000 000	900 000 000	160 000 000 000
Σ	**188 000**	**2 490 000**	**61 250 000 000**	**4 640 000 000**	**809 598 000 000**

2. Further aspects of regression analysis

Other than estimating the fixed and variable components of mixed costs, regression analysis provides other useful information, for example, how reliable the estimates are. In practice you may find that in many cases the total cost can be explained by establishing a linear equation using different independent variables (cost drivers). It is then important that you find the one that BEST explains the total cost behaviour as that will improve the accuracy and dependability of your forecast and decision making. For this we use reliability or fitness tests.

Now study the following subsections in Drury and attempt the activities:

Chapter	Subsection
23	*Tests of reliability*
23	*Relevant range and non-linear cost functions*
23	*A summary of the steps involved in estimating cost functions*

Please work through the calculation of the correlation coefficient (r) using the information from exhibit 23.1 in your Drury textbook, 8th or 9th edition. Make sure you understand the effect of extrapolation cost in figure 23.6 and take note that you cannot rely on the mathematical techniques without looking at/investigating all the relevant information.

Activity 3.3

Use the information provided in revision activity 3.2.

REQUIRED

Using the equation established in revision activity 3.2, predict the total maintenance cost for the next quarter when planned production is 44 000 units. Suggest a major reservation, other than the effect of inflation, you would have about this prediction.

[Source: Drury textbook 8th edition, 2012: 23.15b]

Solution to Activity 3.3

Predicted maintenance cost at 44 000 units = 21,730 + (12,320 x 44) = 536,81 or R563 810. The major reservation about this prediction is that 44 000 units of production is well outside the relevant range of data (16 000 to 32 000 units) that has been used to establish the linear regression equation. For example a step increase in fixed cost may apply outside the relevant range of output.

Activity 3.4

Solve review problem 23.16 (a) and (c) in Drury textbook, 8th or 9th edition.

Solution to Activity 3.4

Find the solution to review problem 23.16 (a) and (c) at the back of Drury text book, 8th or 9th edition.

The correlation coefficient (r) indicates the *extent* to which a relationship exists between dependent and independent variables. Once we have established an acceptable correlation, we can use regression analysis to formulate a forecasting model. We do this mathematically with the aid of statistical methods (formulae). We can then test the model for goodness of fit by calculating the coefficient of determination (r^2).

Note:

The coefficient of determination is sometimes known as the coefficient of variation.

*****

3. Cost estimation with the learning curve

When a new product or process is developed, learning takes place. As the total output increases, the time required to produce each additional unit/batch decreases. The effect of this learning on output is often depicted by a learning curve. A learning curve is a graphical expression of the decrease in the average time required to produce each unit as cumulative output increases. The time taken to learn a job has a nonlinear (curve) effect on costs. This information enables management to calculate cost changes as the process matures.

Now study the following subsections in Drury and attempt the activities:

Chapter	Subsection
23	*Cost estimation when the learning effect is present*
23	*Estimating incremental hours and incremental cost*

Take note of exhibit 23.2 in your Drury textbook, 8th or 9th edition where the application of the learning curve is shown and also figure 23.7. Make sure you understand the formula for calculating the average time per unit of cumulative production and how to calculate the logarithms.

Enrichment activity 3.5

Answer the questions posed in Real World Views 23.1 in Drury text book, 8th edition or Real World Views 23.2 in Drury text book, 9th edition.

Solution to Enrichment activity 3.5

Find the solution to the Real World View questions online via your CourseMate account.

Activity 3.6

Kago (Pty) Ltd is a property developer, and is presently building a complex of 32 identical sectional title houses. The project manager has approached you, the accountant, to help him estimate the time required to make and erect the roof trusses. As many other activities cannot commence before the roof trusses have been erected, he realises that this activity will probably delay the progress of the project. A subcontractor has been appointed to make and erect the roof trusses. To date, the trusses of two townhouses have been made and erected. The productive time taken to erect the roof trusses for the first house was 16 hours and for the second house 15,04 hours. The subcontractor works on weekdays from 07:00 to 16:00, including an hour break for lunch. The subcontractor charges a daily rate of R950.

REQUIRED

a. Calculate the learning curve.

b. Calculate the total number of weekdays that the subcontractor will need to make and erect the roof trusses of the whole complex.

   i. Use the tabular method.
   ii. Use the mathematical formula.

c. What should Kago (Pty) Ltd budget to pay the subcontractor to complete the rest of the roof trusses?

Round off the hours to two decimals at each point.

Solution to Activity 3.6

a. The learning curve

$$\text{Learning curve} = \frac{\text{Cumulative average time per unit}}{\text{Previous cumulative average time per unit}} \times \frac{100}{1}$$

$$= \frac{(15{,}04 + 16)/2}{16} \times \frac{100}{1}$$

$$= 0{,}97 \times \frac{100}{1}$$

$$= 97\%$$

b. The total weekdays needed for the roof trusses of the complex

i. Tabular method

Cumulative Units	Doubling	Hours of cumulative average time per roof
1	-	16,00
2	1	15,52 (16 x 97%)
4	2	15,05 (15,52 x 97%)
8	3	14,60 etc
16	4	14,16 etc
32	5	13,74 etc

Note:

When using the tabular method, remember that the total cumulative production is computed by doubling the output each time.

*****

ii. Formula method ($Y = ax^b$)

Cumulative average time per roof

$Y = ax^b$

= time for 1st unit x total number of units$^{\text{(log learning curve/log 2)}}$

$= 16 \times 32^{(-0{,}03046/\ 0{,}693147)}$

= 13,73974

= 13,74 rounded

Note:

The logarithm function ("log") is indicated by the (LN)-key on your calculator. What does this mean? Instead of typing (LOG) 0,97 on your calculator, you should type (LN) 0,97, which will give you -0,03046 rounded to 5 decimal places. (LN) 2 = 0,693147. The index of learning (b) is calculated as a logarithm of the learning curve divided by a logarithm of 2.

*****

Days required for roof trusses is, therefore, 54,96 days (32 x 13,74 ÷ 8 hours), rounded up to 55 days.

c. The cost to complete the roof trusses of the complex

First calculate how many days will be required to complete the other 30 roofs:

		Hours
Expected total hours for the whole complex	32 x 13,74 =	439,68
Less: First two units already completed (given)	16 + 15,04 =	31,04
Expected hours to complete the complex		408,64

Days required for completing the work on the roof of the project (408,64 ÷ 8) = 51,08 days, rounded up to 52 days.

Total trusses cost = R950 x 52 = R49 400

The learning curve effect normally relates only to costs that are labour driven or where learning takes place until a steady state is achieved. Read carefully whether you should compute total time, or incremental time, to complete additional units.

4. Summary

In this study unit you learnt to

- calculate and interpret the coefficient of determination
- compute the correlation coefficient
- implement the steps in estimating cost functions
- estimate hourly-driven costs when there is a learning curve effect present using the tabular and mathematical method

In the next study unit, we will discuss more advanced aspects of process costing.

5. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to solve the review questions in the textbook covering the theory at the end of chapter 23. The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

6. Online enrichment activity

Complete the online activities for chapter 23 that relate to the learning outcomes specified.

7. Self-assessment questions

After working through all the relevant sections in the textbook, guidance and activities provided by this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 3.1

Answer question 23.1 in the Drury student manual 8th edition or 23.2 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 3.1

Find the solution to question 23.1 at the back of the Drury student manual or 23.2 9th edition.

QUESTION 3.2

Tshipi Limited manufactures and sells metal ornaments that are welded from scrap metal. It seems that the power bill varies with the number of units made. You are the newly appointed management accountant and have been asked to determine the fixed and variable elements of cost of power (electricity) for the purposes of a breakeven analysis.

You have been given the following information:

Month	Number of units	Cost of power
		R
June	22	3 600
July	23	3 950
August	31	4 300
September	24	3 740
October	29	4 160
November	30	4 300
December	51	5 700
January	18	3 460

REQUIRED

a. Determine the correlation coefficient and the coefficient of determination.

b. Describe the need to determine a coefficient of correlation before applying regression analysis to make forecasts about any two sets of data.

c. The HR manager has suggested that the number of welders is a better indicator of the total power cost. You have calculated the correlation coefficient as being 57%. Recommend which cost driver should be selected in a linear regression model to forecast the total welding costs.

SOLUTION TO SELF-ASSESSMENT QUESTION 3.2

a. Calculating the correlation coefficient

The number of units to be welded should have a bearing on the cost of power. Therefore, the number of units represents *x*, the independent variable, and the cost of power *y*, the dependent variable.

Year	(x)	(y)	xy	x²	y²
June	22	3 600	79 200	484	12 960 000
July	23	3 950	90 850	529	15 602 500
August	31	4 300	133 300	961	18 490 000
September	24	3 740	89 760	576	13 987 600
October	29	4 160	120 640	841	17 305 600
November	30	4 300	129 000	900	18 490 000
December	51	5 700	290 700	2 601	32 490 000
January	18	3 460	62 280	324	11 971 600
Σ	**228**	**33 210**	**995 730**	**7 216**	**141 297 300**

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

$$= \frac{8(995\ 730) - (228)(33\ 210)}{\sqrt{8\ (7\ 216) - (228)^2}\ \sqrt{8\ (141\ 297\ 300) - (33\ 210)^2}}$$

$$= \frac{7\ 965\ 840 - 7\ 571\ 880}{\sqrt{57\ 728 - 51\ 984}\ \sqrt{1\ 130\ 378\ 400 - 1\ 102\ 904\ 100}}$$

$$= \frac{393\ 960}{\sqrt{5\ 744}\ \sqrt{27\ 474\ 300}}$$

$$= \frac{393\ 960}{(75{,}7892)\ (5241{,}59)}$$

$$= \frac{393\ 960}{397\ 255{,}8147}$$

$$= 0{,}9917$$

Calculation of the coefficient of determination

Coefficient of determination	=	coefficient of correlation^2
	=	r^2
	=	$0{,}9917^2$
	=	0,9835

b. The coefficient of correlation measures the degree of relationship between two sets of data. You should determine it before applying regression analysis in order to establish the reliability of forecasts made by this means. It is no use making a forecast with an independent variable that have a weak correlation with the dependent variable.

c. The correlation coefficient of the number of units (99,17%) is higher than 57%. Therefore, reject number of welders as independent variable.

QUESTION 3.3

Poplar Limited manufactures woodwork machinery. The company has manufactured two routers and the direct labour cost amounted to R90 000. The direct labour hours for the first two routers were as follows:

	Hours
First router	8 000
Second router	7 360
Total time for first two routers	15 360

The learning curve was calculated at 96% and is expected to continue for the first 16 routers built. An order for six more routers has just been received. Since the first two routers were manufactured the price of labour increased by 10%.

REQUIRED

a. Calculate the cumulative average time per router (rounded to two decimals), for the manufacture of the first eight routers.

b. Calculate the total labour cost (rounded to the nearest Rand) for the manufacture of the next six routers.

Note: Here we refer to the next six routers **after the first two routers**. Throughout this question, round to two decimals. Round only your final answer to the nearest Rand.

SOLUTION TO SELF-ASSESSMENT QUESTION 3.3

a. The cumulative average time per router for the manufacture of the first eight routers is:

Cumulative average time per unit = $8\,000 \times 0{,}96^3$
= 7 077,89 hours

Alternative 1:

$Y = ax^b$
$= 8\,000(8)^{(\log 0{,}96/\log 2)}$
$= 8\,000(8)^{(-0{,}040822/0{,}693147)}$
= 7 077,89 hours

Note:
The logarithm function ("log") is indicated by the (LN)-key on your calculator.

Alternative 2:

Doubling	Total units	Cum. ave. time per unit (hours)	Total time (hours)
	1	8 000,00	8 000,00
1	2	7 680,00	15 360,00
2	4	7 372,80	29 491,20
3	8	**7 077,89**	56 623,12
4	16	6 794,77	108 716,32

Note:
The question asked for the average time **per router** for the manufacture of the first eight routers. This, therefore, includes the first two routers already manufactured.

This question gave information that could have been used for the calculation of the learning curve. The question needn't have said that the learning curve was calculated at 96%. You could have been expected to calculate this yourself.

$$\text{Learning Curve} = \frac{\text{Cumulative average time per unit}}{\text{Previous cumulative average time per unit}}$$

$$= \frac{(8\ 000 + 7\ 360)/2}{8\ 000}$$

$$= 96\%$$

The total labour cost for the manufacture of the next six routers is:

Total time to manufacture the first eight routers (7 077,89 x 8)	=	56 623,12
Less: Total time to manufacture the first two routers (given in question)	=	15 360,00
Total time to manufacture the next six routers	=	41 263,12
Increased labour rate per hour (R90 000 / 15 360 x 1,10)	=	R6,45
Total labour cost for the manufacture of the next six routers	=	R266 147,12
Rounded to the nearest Rand	=	R266 147

Note:

In certain repetitive production environments, the learning curve only arises at the beginning of implementing a new process/technique. Once the steady state is achieved, the time required or standard throughput rate can be determined.

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PART 1, TOPIC 2 – ADVANCED CONCEPTS IN COSTING SYSTEMS

INTRODUCTION

In MAC2601, you learnt the basics of process costing. You also learnt about costing joint and by-products. The purpose of a costing system is to **cost** the output units, which is to determine a value for the inventory and the cost of sold goods for accounting purposes.

We will look at the treatment of proceeds from selling scrap or waste and the valuation of completed and work-in-progress (WIP) units from manufacturing processes consisting of more than one consecutive process. (Please note: some sources use "work-in-process" for "work-in-progress") In joint and by-product costing, we will investigate decision-making regarding the further processing of output from the joint process.

We dealt with job costing sufficiently in MAC2601 and will not investigate it further in this module. However, you should make sure you understand the accounting entries. In process and joint-product costing, we debit the resources utilised to a **process account**, instead of to a **job account**.

Topic 2 is made up of the following study units:

STUDY UNIT	TITLE
STUDY UNIT 4	PROCESS COSTING
STUDY UNIT 5	JOINT AND BY-PRODUCT COSTING

LEARNING OUTCOMES

After studying this topic, you should be able to

- allocate the proceeds from the sales of normal and abnormal scrap to the correct accounts
- account for transfers from previous processes in completed and WIP inventories
- apply the short-cut method for allocating normal losses in appropriate circumstances
- discuss the suitability of process costing in a service organisation
- describe the principles of batch or operation costing
- decide whether to process a joint or by-product further, or whether to sell it at the split-off point

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- described the uses of a process costing system
- calculated unit costs in a system with a **single** manufacturing process and in a system with two or more consecutive manufacturing processes (**all units completed**)
- calculated completed units and the **equivalent units** for WIP
- calculated the **normal and abnormal losses** for a period depending on the wastage point (WP)
- prepared a quantity statement, production cost statement and cost allocation statement (all of which include losses) based on the **weighted average method** and on the **first-in-first-out (FIFO) method** of inventory valuation
- recorded and allocated process costs in the general ledger
- differentiated between joint and by-products
- allocated joint costs, using different methods
- accounted for the net proceeds of by-products
- calculated the value of joint and by-product inventory
- calculated profits from the sale of joint products
- identified when a job costing system is appropriate
- recorded costs in a job costing system
- calculated the profit or loss per job

If you want to refresh your knowledge, please refer to your MAC2601 study guide.

For another perspective, you may also refer to the following sections in your prescribed Drury textbook:

Chapter	Subsection
5	*Flow of production and costs in a process costing system*
5	*Costing when all output is fully complete*
5	*Process costing with ending work in progress partially complete*
	– no losses within the process
	– normal losses in the process with NO scrap value
	– abnormal losses in the process with NO scrap value
5	*Process costing with ending work in progress partially complete*
	– Elements of costs with different degrees of completion
5	*Beginning and ending work in progress of uncompleted units*
5	*Partially completed output and losses in process (excluding Appendix 5.1)*
6	*Joint products and by-products*
6	*Methods of allocating joint costs*
6	*Accounting for by-products*
4	*Materials recording procedure*
4	*Pricing the issues of materials*
4	*Control accounts*
4	*Recording the purchase of raw materials*
4	*Recording the issue of materials*
4	*Accounting procedure for labour costs*
4	*Accounting procedure for manufacturing overheads*
4	*Non-manufacturing overheads*
4	*Accounting procedures for jobs completed and products sold*
4	*Costing profit and loss account*

STUDY UNIT 4 PROCESS COSTING

1. Introduction

In the previous study unit, you learnt about regression analysis and the learning curve effect. You also learnt how to make decisions using these techniques. In this study unit, we will delve deeper into process costing and discuss how to account for normal and abnormal losses with a scrap value. We will also learn how to compute the value of opening (beginning) and closing (ending) WIP when consecutive processes are involved (transfers in from previous processes), using the weighted average and the FIFO methods.

This study unit is based on **selected sections** from chapter 5 of your prescribed Drury textbook.

Important principles from MAC2601:

<u>MAC2601 study guide (1 of 2), page 255 [Place and size of normal wastage (normal losses)]:</u>

It is important to note that there is a difference between *where* the normal loss occurs and *how much* (what the quantity/size of) normal wastage is. Both will influence the calculation of normal loss; it is however important not to confuse the two concepts with each other.

Wastage could occur at any of the following stages of the production process:

-At the beginning of the process (when the process is 0% complete); for example, spillage when material is added.
-At the end of the process (when the process is 100% complete); for example, after quality inspections.
-During the process (anywhere between 0% and 100% completion); for example, when chemicals evaporate.

Wastage is identified at the wastage point or in other words, WHERE normal losses occur in the process.

The HOW MUCH is usually **a percentage estimate** of the size of the normal loss and is, in most instances, expressed as a percentage of units that enter or pass/reach the wastage point in the current period.

MAC2601 study guide (1 of 2), page 255 [Determining the number of units subject to the normal loss]:

In order to determine how many units are subject to the normal loss, you have to determine which of the units will reach the spillage/wastage point.

You have to thus determine whether the **opening WIP** has already passed the wastage point or whether it still has to pass the wastage point. (Remember opening wip units start somewhere in the process and go through the process and reach the end – 100%). If the opening wip units have reached the wastage point already in the previous process, it will mean that they will not go to waste again in the current process. If they have not reached the wastage point in the previous process, they will still reach the wastage point in the current process and it means some of the units will go to waste in the current period when it reaches the wastage point

(This is effectively the result of Rule 16.1 taught in MAC2601)

The units that are **completed from current production (excluding closing WIP)** start at 0% and finish at 100% and therefore will always go through the wastage point, irrespective of where the wastage point is in the process – this is an assumption.

You have to determine whether the **closing wip** has already passed the wastage point in the current period or whether it will only pass through the wastage point in the next period. (Remember, closing wip units are incomplete units in the current period that start at 0% and go through the process. They do not reach the end, but stop somewhere in the process). The closing wip units will go to waste in the current process if it reaches the wastage point in the current process. If the closing wip units have not reached the wastage point yet in the current period, it means they will only go to waste in the next period when they reach the wastage point.

(This is effectively the result of Rule 16.2 taught in MAC2601).

MAC2601 study guide (1 of 2) page 264-265 [Determining equivalent units of normal and abnormal loss – general guidelines]:

Raw materials – For the purposes of MAC2601, raw materials will always be added at the beginning of the process. In other words, the materials will always be added to a process when the conversion process is 0% complete.

When material is added at the beginning of the process and any wastage of units occurs at any stage of the production process, this means that all the material added for purposes of these wasted units will effectively be wasted. Therefore, for normal and abnormal losses, the equivalent unit percentage to use in MAC2601 will always be 100% for raw materials.

Conversion cost – In general, conversion cost will be “lost” due to wastage to the extent that conversion has taken place up to the point where the wastage occurred. Therefore, for normal losses, the equivalent unit percentage to use in MAC2601 regarding conversion cost will be the percentage of the conversion work that has been done up to the point where wastage occurs (ie the wastage point percentage if conversion took place evenly).

For abnormal losses, we will also use the wastage point percentage if conversion took place evenly, unless the abnormal loss incident took place at a different time from the normal loss. In such a case, the percentage to use for the abnormal loss occurring at a different point in time from the normal loss will be the percentage of completion of the units (in terms of conversion cost) when this abnormal loss incident took place. If the question does not state at which stage the abnormal loss occurred, you may assume the wastage point is the same as that for normal loss.

<u>MAC2601 study guide (1 of 2) page 272 [Extract from summary]:</u>

The percentages to use when calculating equivalent units for the losses for purposes of the quantity statement are:

Normal loss – Material = 100%; Conversion cost (if conversion takes place evenly) = % at wastage point (% of completion *where* wastage occurs).

Abnormal loss – Material = 100%; Conversion cost (if conversion takes place evenly) = % at wastage point ((% of completion *where* wastage occurs).

PLEASE TAKE NOTE OF THE FOLLOWING:

As already mentioned above, for the purposes of MAC2601, raw materials will always be added at the beginning of the process.

This will however not always necessarily be the case.

According to Drury “Materials may be issued at different stages of production… Normally, material costs are introduced at one stage in the process and not uniformly throughout the process.

If the work in progress has passed the point at which the materials are added then the materials will be 100% complete. If this point has not been reached then the equivalent production for materials will be zero."

If materials are introduced uniformly throughout the process, the equivalent units will be only a % of materials. (Equal to the % of conversion that has been incurred as it would only have gone through the process up to a certain point and thus material would only have been added up to a certain point).

Please work through the following activities for revision purposes.

Activity 4.1

The following details relate to the main process of W Limited, a chemical manufacturer:

Opening work in process	2 000 litres, fully complete as to materials and 40% complete as to conversion
Material input	24 000 litres

Normal loss is 10% of input that reaches the wastage point

Output to process 2	19 500 litres
Closing work in process	3 000 litres, fully complete as to materials and 45% complete as to conversion

Losses occur at the beginning of the process.

REQUIRED

a. Assume losses occur at the beginning of the process. Prepare the quantity statement of W Limited using a FIFO basis of valuation.

b. Assume losses occur at the end of the process. Prepare the quantity statement of W Limited using a FIFO basis of valuation.

[Source: Drury textbook 8th edition, 2012: 5.14 adapted]

Solution to Activity 4.1

Using MAC2601 principles, the answer will look as follows:

a. **Wastage point: 0% (using the LONG method)**

			Equivalent units			
Input		**Output**	**Raw materials**		**Conversion costs**	
(units)	**Details**	**(units)**	**Units**	**%**	**Units**	**%**
2 000	Work-in-process (opening)					
24 000	Put into production					
	Completed from:					
	- Opening inventory	2 000	-	-	1 200	60
	- Current production	17 500	17 500	100	17 500	100
	Completed and transferred	19 500	17 500		18 700	
	Normal loss	2 400	2 400	100	-	-
	Abnormal loss	1 100	1 100	100	-	-
	Work-in-process (closing)	3 000	3 000	100	1 350	45
26 000		26 000	24 000		20 050	

Because the opening WIP has already passed the wastage point in the previous period, this will mean that the normal loss on these units of opening inventory has already been accounted for in the past. The units in opening WIP that was included in our current period's input column, are therefore already net of the normal loss incurred on these units in the past. In the output column, the units completed from opening wip will be equal to the units carried forward from opening WIP.

<u>Wastage point 0%</u>:

Output column opening inventory: The opening inventory passed through the point of spoilage during the previous period (it's already at 40% in the process). Therefore no units will go to waste *in the current process/period* and the input = output = 2 000 units.

Abnormal loss = Balancing figure

Normal loss = 24 000 x 10% = 2 400 (can you see that we do not take into account the opening work-in-process units here, because they already went to waste in the previous process)

b. Wastage point: 100% (using the LONG method)

Input (units)	Details	Output (units)	Equivalent units Raw materials Units	%	Conversion costs Units	%
2 000	Work-in-process					
24 000	Put into production					
	Completed from:					
	- Opening inventory	1 800	-	-	1 080	60
	- Current production	17 700	17 700	100	17 700	100
	Completed and transferred	19 500	17 700		18 780	
	Normal loss	2 300	2 300	100	2 300	100
	Abnormal loss	1 200	1 200	100	1 200	100
	Work-in-process	3 000	3 000	100	1 350	45
26 000		26 000	24 200		23 630	

Wastage point: 100%

Because the opening WIP still has to reach the wastage point in the current period, this will mean that the normal loss on these units of opening inventory has to be accounted for in the current period. The units in opening WIP that was included in our current period's input column, will not be equal to the units completed from opening inventory in the output column. The opening inventory will reach the wastage point during the current period when it reaches the end of the process (at 100%). Therefore 10% of these units will go to waste *in the current process/period* and the input will not be equal to the output.

Abnormal loss = Balancing figure

Normal loss: The opening WIP will go through the wastage point, therefore 2 000 + 24 000 = 26 000 units that potentially goes through the wastage point, but take note that the closing wip will not reach the wastage point, and therefore it has to be subtracted from the total input before the calculation of the normal loss. Thus 26 000 – 3 000 = 23 000 x 10% = 2 300.

Now refer to Question 5.14 in your Drury textbook 8th edition or Question 5.15 in the 9th edition.

Original question as per Drury:

The following details relate to the main process of W Limited, a chemical manufacturer:

Opening work in process	2 000 litres, fully complete as to materials and 40% complete as to conversion
Material input	24 000 litres

Normal loss is 10% of input

Output to process 2	19 500 litres
Closing work in process	3 000 litres, fully complete as to materials and 45% complete as to conversion

REQUIRED

The number of equivalent units to be included in W Limited's calculation of the cost per equivalent unit using a FIFO basis of valuation

<u>Why this question creates a problem:</u>

1) This question does not state where in the process losses occur. It only states (in the answer) that it is assumed that losses are detected at the end of the process.
(Please take note - Drury sometimes makes the assumption that losses occur evenly throughout the process).
In MAC2601 you were taught that losses occur at a certain point in the process.

2) The normal loss is 10% of input. {Note: The question does not state which input is being referred to – one could easily assume that they refer to the total input being the opening work in progress as well as the input put into production in the current period} (Drury is however just referring to the "input put into production in the current period").

<<The lecturers' suggested solution to this question follows later on in this document>>

We will explain Drury's approach to their original question later on in this document – you might have noticed in their answer that they refer to the "short cut"-method. The short-cut method is taught in MAC3701.

Enrichment activity 4.2

Answer the questions posed in Real World Views 5.1 in your Drury textbook, 8^{th} or 9^{th} edition.

Solution to enrichment activity 4.2

Find the solution to the questions in Real World Views 5.1 online via your CourseMate account.

2. Summary steps for process costing

In a process costing system, the manufacturing costs are accumulated per process or department. The unit cost is only calculated at the end of the financial period. When some units are partially completed (WIP) at the end of the financial period, both the completed and WIP units must be expressed in terms of equivalent units.

There are three main steps to follow when using a process costing system. The table below shows these three steps (in bold) and includes the steps given in your MAC2601 study guide (not in bold):

1.	**Calculate the number of units to be accounted for.**	
	1.	Determine total inputs for the period and complete the input column of the quantity statement.
	2.	Determine the units subject to normal wastage by subtracting the units that did not pass the WP from the total of the input column.
	3.	Calculate the normal loss units.
	4.	If FIFO is used, split units completed between opening WIP and new production.
	5.	Fill in the output column of the quantity statement.
	6.	Complete the equivalent units section of the quantity statement for **ALL** line items, including the normal and abnormal losses.
2.	**Determine the cost per equivalent unit.**	
	7.	Complete the production cost statement and calculate the equivalent production cost per unit.
3.	**Reconcile the total cost for the period.**	
	8.	Determine the value of normal loss based on its equivalent units separately for material and conversion cost.
	9.	Determine whether opening WIP, abnormal loss and/or closing WIP will have to be excluded when normal loss is allocated. (Also refer to step 2.)
	10.	Allocate the value of normal loss for material and conversion cost **separately,** based on the ratio of equivalent units in the quantity statement of those units sharing in normal loss (long method).

	11.	Complete the allocation statement by multiplying each category of equivalent output by its equivalent cost per unit. Remember to include that category's share of normal loss (long method).
	12.	Determine rounding and balance.
	13.	Complete T-accounts (if required).

Source: MAC2601, 2012 (adapted)

3. Treatment of proceeds from scrap with a value

In MAC2601, you learnt how to calculate the cost per unit for processes with lost units (rejects, spillage or waste) that have no scrap value. However, there are times when the losses in a process have some monetary value. The following section explains how we treat losses that have a scrap value.

Now study the following subsections in Drury, chapter 5, and attempt the activities:

Chapter	Subsection
5	*Process costing when all output is fully complete*
	- Normal losses in process with a scrap value
	- Abnormal losses in process with a scrap value

Pay particular attention to the difference in the treatment of the scrap value of normal and abnormal losses. The value of the normal loss goes straight to the process account, whereas we account for the scrap value of the abnormal loss in the abnormal loss account**.** The difference between the actual abnormal loss and the scrap value is then transferred to the profit and loss account (income statement).

Enrichment activity 4.3

Answer the questions posed in Real World Views 5.2 in your Drury textbook, 8th or 9th edition.

Solution to Enrichment activity 4.3

Find the solutions to the questions in Real World Views 5.2 online via your CourseMate account.

Activity 4.4

Solve review problem 5.18 in Drury textbook 8^{th} edition or 5.19 in 9^{th} edition.

Please add the following to the question, in order to make the answer valid:

ALL the units in the OUTPUT column of the quantity statement have been subjected to spillage in THIS (CURRENT) period.

Solution to Activity 4.4

Find the solution to review problem 5.18 at the back of the Drury textbook 8^{th} edition or 5.19 in the 9^{th} edition.

Note:

① In the solution, the total cost for material of 484 000 is made up as follows:
98 000 + 387 800 – [180 x 10 (selling price of normal loss)②].

The calculation of the WIP equivalent units is as follows:

Material	-	500 x 100% completed	=	500
Labour	-	500 x 90% completed	=	450
Overheads	-	500 x 40% completed	=	200

② The proceeds from the scrap, waste or rejects should always be credited to the material cost component (column) in the production cost statement for the purpose of calculating the equivalent cost per unit.

4. Valuing inventory when units are transferred in from a prior process

In MAC2601, we valued opening and closing WIP and completed inventory assuming that only **one** process was involved. We will now learn what to do when there is a process prior to the one for which the output units are valued.

Now study the following subsections in Drury, chapter 5, and attempt the activities:

Chapter	Subsection
5	*Process costing with ending work in progress partially complete*
5	*Beginning and ending work in progress of uncompleted units*

Activity 4.5

Answer question 5.2 in the Drury student manual, 8th edition or question 5.5 in the 9th edition.

Solution to Activity 4.5

Find the solution to question 5.2 at the back of the Drury student manual, 8th edition or question 5.5 in the 9th edition.

Note:

① The units transferred in from a prior process are treated in the same way as material that is added at the beginning of a process.

② Opening and closing WIP units will always be 100% complete with regard to the prior process cost in the equivalent unit calculations of the quantity statement.

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5. Valuing output using the short-cut method for allocating a normal loss

In MAC2601, we valued the output from the process by allocating the value of the normal loss to only those units that were subjected to the inspection or WP. This involves two steps:

1. valuing the equivalent units of the normal loss (for each input)
2. allocating the value determined in step 1 to those units that passed the WP

Allocating normal loss in a two-step process is also called the long method.

We will now demonstrate how the short-cut method works by means of a short example.

R300 000 was spent in the period to produce 6 000 units. After inspection, 5% of the units were rejected in a quality inspection. There was no opening or closing WIP.

Using the long method

Equivalent cost per unit	= R300 000 / 6 000 units
	= R50 per unit
Normal loss units	= 5% x 6 000 units
	= 300 units
Completed units transferred	= 6 000 – 300
	= 5 700 units
Value of normal loss	= 300 x R50 per unit
	= R15 000

This normal loss is allocated in full to the completed units since they all passed the wastage point (WP) in this period.

Completed inventory value	= (5 700 x R50) + R15 000
	= R285 000 + R15 000
	= R300 000

Using the short-cut method

Equivalent cost per unit	= R300 000 / 5 700 units
	= R52,63 per unit (rounded)
Completed inventory value	= 5 700 x R52,63
	= R300 000

INTRODUCTION OF SHORT-CUT METHOD:

Explanation from Drury: The short-cut method allocates the cost of the normal loss to both closing WIP and completed units based on the ratio of WIP and completed units equivalent production. The short cut method is only theoretically correct where losses occur at an earlier stage in the production process and the WIP has reached this stage. In these circumstances it is appropriate to allocate the cost of the normal loss between WIP and completed units.

Where WIP has reached the stage where the losses are assumed to occur, the short-cut method is theoretically correct. However, even when circumstances exist where the short-cut method is not theoretically correct (WIP has not reached the stage where losses are assumed to occur) examination questions are normally based on the assumption that you will adopt this method because of its simplicity.

PLEASE NOTE: We are not in agreement with the Drury explanation:

Conditions for using the short-cut method

It is very important for you to understand that the short-cut' method can **only** be used under **one condition:**

ALL the units in the OUTPUT column of the quantity statement should have been subjected to spillage or should have passed the wastage point in THIS (CURRENT) period.

This means that the opening WIP, the units started and completed, the closing WIP and the abnormal loss (if any) should all have been included in the calculation of the lost units,

OR

should not have been excluded from the input column total in the calculation of the lost units.

Let's now consider Drury review problem 5.14 in the 8th edition or 5.15 in the 9th edition again:

(Remember – the question did not state where losses occur in the process):

In the original Question in Drury, IF THE spillage point is at the beginning of the process, it would mean that the opening wip will not have been subjected to spillage in this period as it was already beyond the point where spillage/wastage occur – can't use short cut method.

In the original Question in Drury, IF THE spillage point is at the end of the process, it would mean that the closing wip will not have been subjected to spillage in this period as the closing wip will not reach the end of the process – can't use the short cut method.

The short cut method is thus not theoretically being used in the correct manner.

Drury stated that they adopt this method because of its simplicity and not because it is necessarily theoretically correct.

Note:

You are studying for a professional qualification. Contrary to Drury's comments, in MAC3701 you will be assessed on whether you can correctly identify the circumstances in which you can use the short-cut method. You should therefore always be very careful when using the short-cut method, because you would lose all the marks awarded for the cost allocation statement if you should have used the long method instead.

Use the original question as per Drury, but take note of the following

Assume that losses in this question were incurred throughout the process

It is important to realise that whenever losses get incurred evenly throughout the process, it is safe to assume that all the units in the output column of the quantity would have been subjected to spillage in this (current) period.

Why can we say this?

Opening wip units start somewhere in the process and go through the process until it reach the end. Although these units don't start at the beginning of the process, it would be subject to spillage if losses occur evenly throughout the process, as it move through the process.

Completed from input in the current period-units start at 0% and reaches the end (100%). (It would be subject to spillage if losses occur evenly throughout the process, as it moves through the process)

Closing wip units start at 0% in the process and go through the process until it stop somewhere in the process. Although it doesn't reach the end, it would be subject to spillage if losses occur evenly throughout the process, as it moves through the process.

THUS, IF LOSSES ARE INCURRED EVENLY THROUGHOUT THE PROCESS, IT IS SAFE TO ALWAYS USE THE SHORT-CUT METHOD

Drury-revision question 5.14 in the 8th edition or 5.15 in the 9th edition with the assumption that losses are incurred evenly throughout the process and that normal losses of 10% of units only refer to the units that were put into production in the current period.

Below we present the solution in the format taught in MAC2601:

Quantity statement

Physical units			**Equivalent units**			
Input		**Output**	**Raw materials ①**		**Conversion cost ①**	
(units)	**Details**	**(units)**	**Units**	**%**	**Units**	**%**
2 000	Opening WIP					
24 000	Put into production					
	Completed from:					
	Opening WIP	**2000**			②1 200	60
	Current production	**17500**	17 500	100	17 500	100
	Completed and transferred	**19 500**	17 500		18700	
	Normal loss	2 400	-	-	-	-
	Abnormal loss	1 100	1 100	100	1 100	100
	Closing WIP	3 000	3 000	100	1 350	45
26 000		26 000	21 600		21 150	

Note the following differences between the approach followed in Drury and the Unisa approach:

① With Unisa's approach, the equivalent units relating to each input are presented in columns and not in rows.

② When using FIFO, we **ADD** the equivalent units required to complete the opening WIP to the new units started and completed, for example 1 200 + 17 500 to arrive at 18 700 equivalent units for conversion costs. Drury starts with all the physical units that are 100% complete and have been transferred to the completed goods in this period and then **DEDUCTS** the equivalent units of opening WIP which were completed in the previous period, for example 19 500 – (40% of 2 000) = 18 700.

We prefer you to use the Unisa format, as illustrated above.

*****

Adjusted example 5.1 in Drury:

A department with no opening wip introduces 1 000 units into the process; 600 are completed, 300 are half-completed and 100 units are lost (all normal). Losses occur upon completion (ie at the end of the process).

Materials are introduced at the start of the process and conversion occurs evenly throughout the process

REQUIRED

Prepare the quantity statement using a FIFO basis of inventory valuation.

Suggested solution to adjusted example 5.1 in Drury:

Drury uses the short-cut method, however, the short-cut method could not be used in this question as the closing wip units would not have reached the spillage/wastage point. For MAC3701 purposes, you should stick to the long method in this scenario (as explained previously).

Wastage point: 100% (using the LONG method)

			Equivalent units			
Input		**Output**	**Raw materials**		**Conversion costs**	
(units)	**Details**	**(units)**	**Units**	**%**	**Units**	**%**
0	Work-in-process					
1 000	Put into production					
	Completed from:					
	- Opening stock	0	0	0	0	0
	- Current production	600	600	100	600	100
	Completed and transferred	600	600		600	
	Normal loss	100	100	100	100	100
	Abnormal loss	0	0	0	0	0
	Work-in-process	300	300	100	150	50
1 000		1 000	1000		850	

Now study the following subsections in Drury, chapter 5, and attempt the activities:

Chapter	Subsection
5	*Partially completed output and losses in process*
5	*Appendix 5.1*

Please study example 5.3 in your Drury textbook, 8th or 9th edition carefully and take note of the differences when using the weighted average method versus the FIFO method. Also, make sure you understand how to do examples 5A.1 and 5A.2.

Activity 4.6

Corin Limited manufactures a single product in two processes. The following information is available for process 1 in respect of October 20X3:

WIP - 1 October 20X3		Nil
Material issued for 10 000 units		R85 000
Direct labour		R174 000
Overheads allocated		R78 300
Transferred to process 2		5 000 units
WIP - 31 October 20X3		3 000 units
Percentage completed:		
Material	100%	
Labour and overheads	75%	

Additional information:

- Material is issued at the beginning of the production process.
- Labour and overheads are incurred evenly throughout the process.
- Normal spoilage occurs when the process is 20% completed and is estimated at 15% of input.
- The company uses the FIFO method of inventory valuation.

REQUIRED

(a) Value the inventories using the long method.
(b) Value the inventories using the short-cut method.

You should complete the following for each method:

- Quantity statement
- Production cost statement (Round equivalent cost per unit off to four decimal places.)
- Cost allocation statement (Round figures off to the nearest rand.)

Solution to Activity 4.6

CORIN LIMITED

(a) The long method

Quantity statement for 20X3

Physical units			Equivalent units			
Input (units)	**Details**	**Output (units)**	**Raw materials Units**	**%**	**Labour and overheads Units**	
-	Opening WIP					
10 000	Put into production					
	Transferred to Process 2 from:					
	Current production	5 000	5 000	100	5 000	100
	Completed and transferred ①	5 000	5 000		5 000	
	Normal loss (15% x 10 000)	1 500	1 500	100	300	20
	Abnormal loss	500	500	100	100	20
	Closing WIP ②	3 000	3 000	100	2250	75
10 000		10 000	10 000		7 650	

Note:

① Completed units transferred to the finished goods store or to the next process will always be "good" units, that is after all normal and abnormal loss units have been removed.

② The physical quantity of WIP on hand at the end of the period will also be good units (in this case), since the percentage of completion is greater than the WP. Remember, these units will be completed in the next period without any further losses.

*****

Production cost statement for October 20X3

	Total	Material	Conversion costs (labour and overheads)
	R	R	R
Opening WIP	nil	nil	nil
Current production cost	337 300	85 000	252 300
Total	337 300	85 000	252 300
Equivalent units			
- per quantity statement		10 000	7 650
Equivalent cost per unit	**R41,4804 =**	**R8,50 +**	**R32,9804**

Calculating the rand value of the normal loss

NLR = NLM + NLC

= (1 500 x R8,50) + (300 x R32,9804)

= 12 750 + 9 894,12

= R22 644,12

Allocating the rand value of the normal loss

Material

	Units	Calculation	R
Completed and transferred	5 000	5 000 / 8 500 x R12 750	① 7 500
Abnormal loss	500	500 / 8 500 x R12 750	② 750
Closing WIP	3 000	3 000 / 8 500 x R12 750	③ 4 500
TOTAL	8 500		12 750

Conversion costs

	Units	Calculation	R
Completed and transferred	5 000	5 000 / 7 350 x R9 894,12	④ 6 730,70
Abnormal loss	100	100 / 7350 x R9 894,12	⑤ 134,61
Closing WIP	2 250	2 250 / 7 350 x R9 894,12	⑥ 3 028,81
TOTAL	7 350		9 894,12

Allocation statement for October 20X3

	R
Total cost of units transferred	221 633
Cost of units completed 5 000 x R41,4804	207 402
Cost of normal loss allocated (① R7 500 +④ R6 730,70)	14 231
Total cost of abnormal loss	8 433
Material (500 x R8,50)	4 250
Conversion costs (100 x 32,9804)	3 298
Cost of normal loss allocated (② R750 + ⑤ R134,61)	885
Total cost of closing WIP	107 235
Material 3 000 x R8,50	25 500
Conversion costs 2 250 x R32,9804	74 206
Share of normal loss (③ R4 500 + ⑥ R3 028,81)	7 529
Total production cost	337 301

Difference due to rounding.

(b) The short-cut method

Quantity statement for 20X3

Physical units			Equivalent units			
Input (units)	**Details**	**Output (units)**	**Raw materials Units**	**%**	**Labour and overheads Units**	**%**
-	Opening WIP					
10 000	Put into production					
	Completed and transferred	**5 000**	5 000	100	5 000	100
	Normal loss	1 500				
	Abnormal loss	500	500	100	100	20
	Closing WIP	3 000	3 000	100	2 250	75
10 000		10 000	8 500		7 350	

Production cost statement for 20X3

	Total R		Material		Conversion costs
Opening WIP	nil		nil		nil
Current production cost	337 300		85 000		252 300
Total	337 300		85 000		252 300
Equivalent units					
- per quantity statement			8 500		7 350
Equivalent cost per unit	R44,3265	=	10,00	+	R34,3265

Allocation statement for October 20X3

		R
Total cost of units completed and transferred		
(5 000 x R44,3265)		221 633
Total cost of abnormal loss		8 433
Material (R10 x 500)		5 000
Conversion costs (R34,3265 x 100)		3 433
Total cost of closing WIP		107 235
Material	3 000 x R10	30 000
Conversion costs	2 250 x R34,3265	77 235
Total production cost		337 301

Difference due to rounding.

Note:

Did you notice that we arrive at the same value (ignoring small rounding differences) for the completed units, abnormal loss and the closing WIP, but that the valuation process is much shorter?

*****

Conditions for using the short-cut method

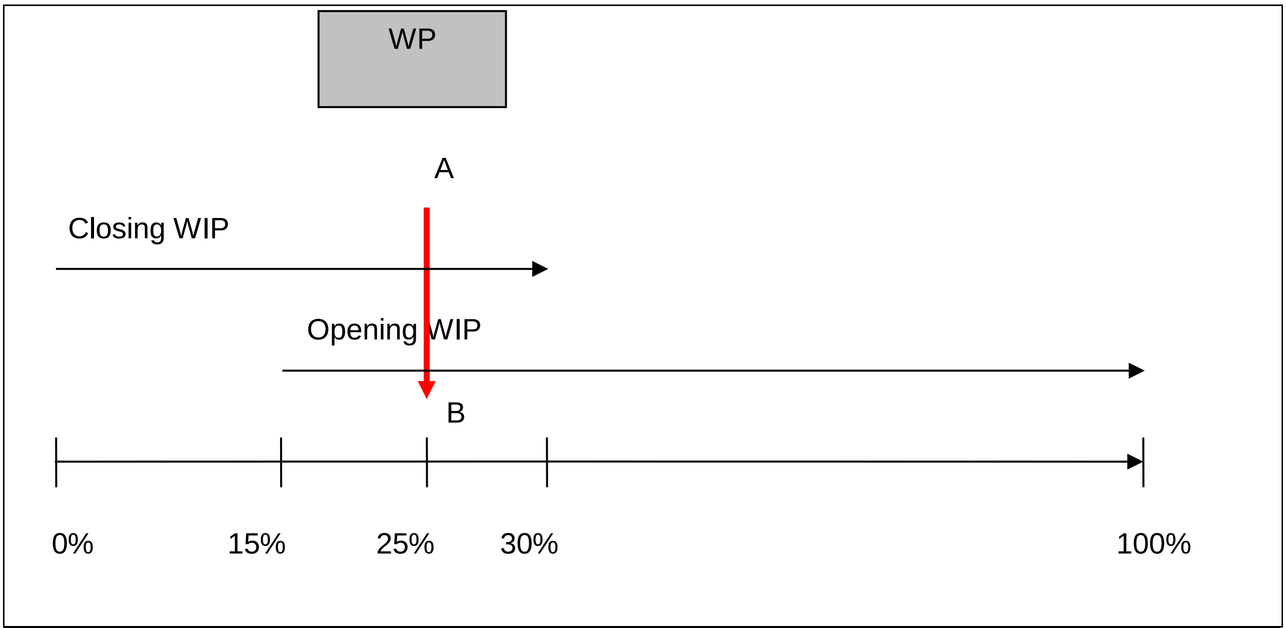
It is very important for you to understand that the short-cut' method can **only** be used under **one condition:**

ALL the units in the OUTPUT column of the quantity statement should have been subjected to spillage or should have passed the wastage point (WP) in THIS (CURRENT) period.

This means that the opening WIP, the units started and completed, the closing WIP and the abnormal loss (if any) should all have been included in the calculation of the lost units, OR, should not have been excluded from the input column total in the calculation of the lost units.

Assume, for example, that the percentage of completion of the opening WIP (90 000 units) is 15% with regard to conversion cost, while the closing WIP (40 000 units) is 30% complete and wastage occurs when the process is 25% complete. 200 000 new units were put into the process in this period. The normal loss is 10% of all units that pass the WP.

The diagram and normal loss calculation would look as follows:



WP	Input	Opening WIP (15%) 90 000		Closing WIP (30%) 40 000		Subject to loss	Units lost (10%)
		>=WP?	Keep/Deduct	<WP?	Keep/Deduct		
25%	290 000	No	Keep	No	Keep	290 000	29 000

The AB-line (indicating the WP) has to cross **both** the closing and opening WIP lines (as well as abnormal loss, if any). In the table, your decision should be 'Keep'.

It will be unfair to allocate the normal loss to the units that did not pass the WP **in this period**.

[Remember basically **ALL THE UNITS SHOULD** have been subjected to spillage or should have passed the WP in **THIS (CURRENT) period**].

Activity 4.7

Consider the following scenarios:

(a)

	Units
Opening inventory, 20% complete	30 000
Put into process	120 000
Closing inventory, 40% complete	40 000

Normal loss is estimated as 10% of the units that have passed the WP. Wastage occurs when the process is 50% complete.

(b)

	Units
Opening inventory, 40% complete	30 000
Put into process	120 000
Closing inventory, 30% complete	40 000

Normal loss is estimated as 10% of the units that have passed the WP. Wastage occurs when the process is 25% complete.

(c)

	Units
Opening inventory, 15% complete	30 000
Put into process	120 000
Closing inventory, 30% complete	40 000

Normal loss is estimated as 10% of the units that have passed the WP. Wastage occurs when the process is 20% complete.

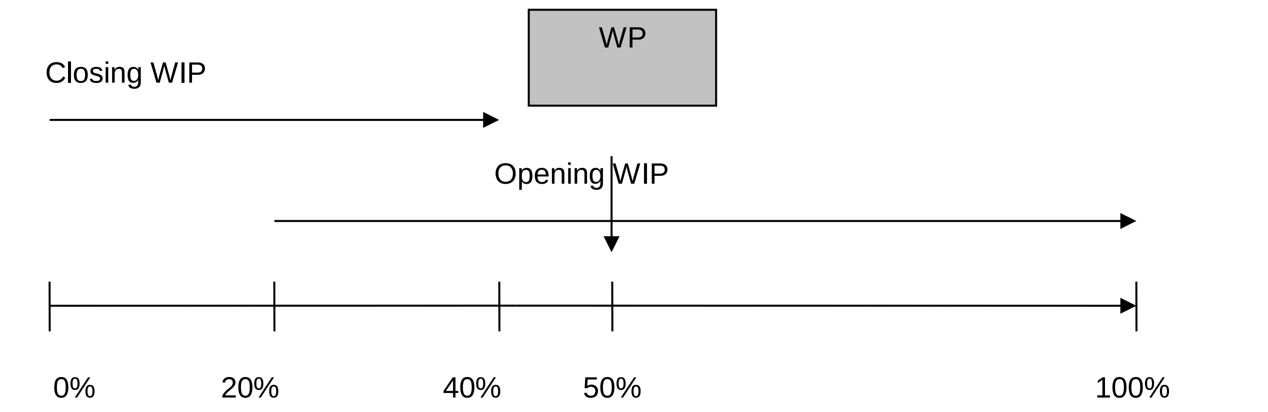
REQUIRED

Calculate the normal loss to be included in the output column of the quantity statement and indicate whether the short-cut method can be applied in each case. Motivate your answer with a suitable diagram.

Solution to Activity 4.7

Input	**Units**
Opening inventory	30 000
Put into process	120 000
	150 000

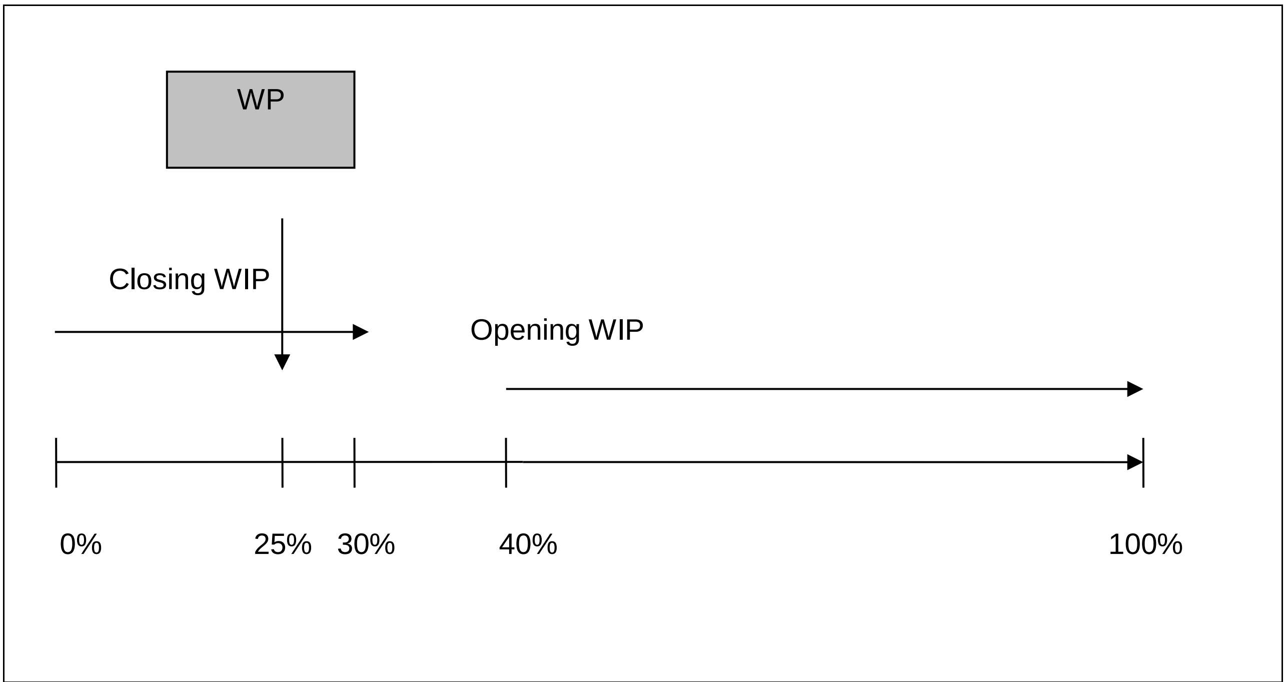
(a) Wastage occurring when the process is 50% complete



WP	**Input**	**Opening WIP (20%) 30 000**		**Closing WIP (40%) 40 000**		**Subject to loss**	**Units lost (10%)**
		>=WP?	**Keep/Deduct**	**<WP?**	**Keep/Deduct**		
50%	150 000	No	Keep	Yes	Deduct – 40 000	110 000	11 000

You **cannot** use the short-cut method here, since all the units in the output column of the quantity statement **have neither** been subjected to spillage **nor** passed the WP in this period (the closing WIP).

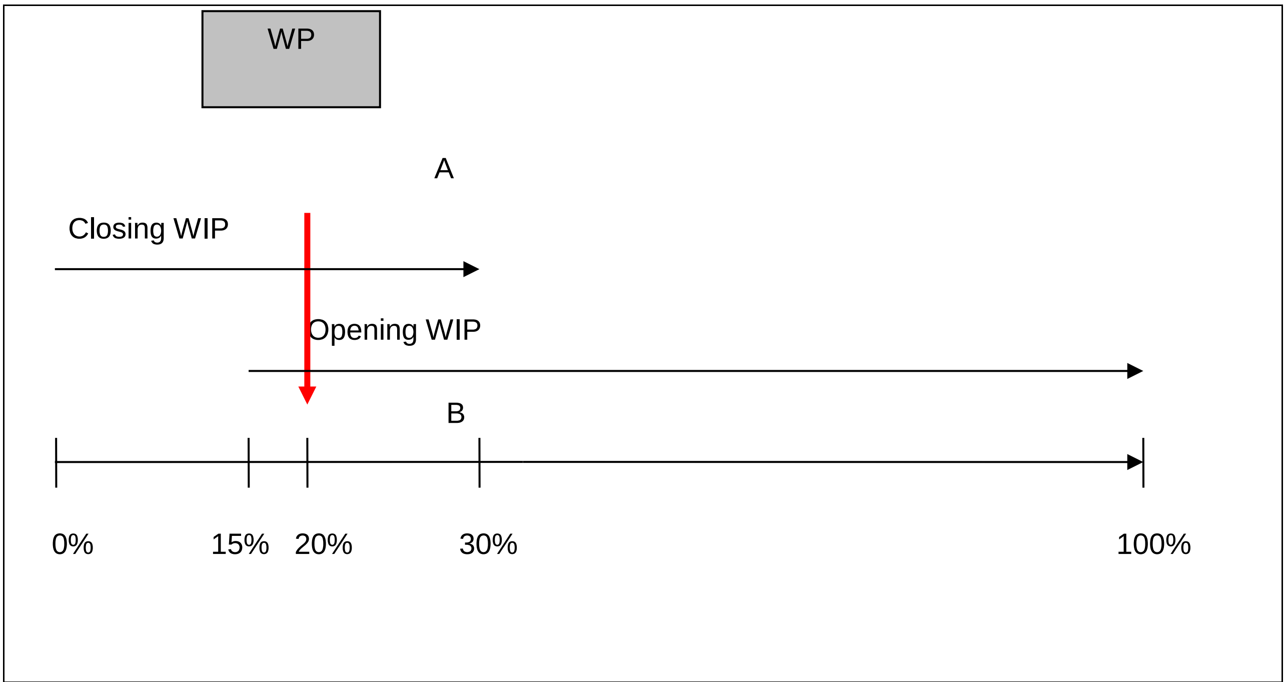
(b) Wastage occurring when the process is 25% complete



WP	Input	Opening WIP (40%) 30 000		Closing WIP (30%) 40 000		Subject to loss	Units lost (10%)
		>=WP?	Keep/Deduct	<WP?	Keep/Deduct		
25%	150 000	Yes	Deduct – 30 000	No	Keep	120 000	12 000

You **cannot** use the short-cut method here, since all the units in the output column of the quantity statement **have neither** been subjected to spillage **nor** passed the WP in this period. The opening WIP has already been subjected to loss in the previous period (40% > 25%).

(c) Wastage occurring when the process is 20% complete



WP	Input	Opening WIP (15%) 30 000		Closing WIP (30%) 40 000		Subject to loss	Units lost (10%)
		>=WP?	**Keep/Deduct**	**<WP?**	**Keep/Deduct**		
20%	150 000	No	Keep	No	Keep	150 000	15 000

You **can** use the short-cut method here, since all the units in the output column of the quantity statement **have either** been subjected to spillage **or** passed the WP in this period.

Note:

① You are studying for a professional qualification. Contrary to Drury's comments, in MAC3701 you will be assessed on whether you can correctly identify the circumstances in which you can use the short-cut method. You should therefore always be very careful when using the short-cut method, because you would lose all the marks awarded for the cost allocation statement if you should have used the long method instead.

② The lost units calculated in the three tables above are the physical units subjected to inspection or loss. Remember to deduct the lost or scrapped units from the units completed from opening WIP, new units started and completed as well as closing WIP (if they passed the WP in this period) and to reflect only the good units in the output column. You should still apply percentage completion to the conversion cost equivalent units.

③ Do not confuse WIP (work in process, which is inventory) and WP (the wastage point, where the loss occurs or the units are inspected). Read carefully!

*****

6. Other aspects of process costing

Process costing principles might also be applied in other scenarios.

Now study the following subsections in Drury, chapter 5, and attempt the following activities:

Chapter	Subsection
5	*Process costing in service organizations*
5	*Batch/operating costing*

Activity 4.8

Solve review problem 5.21(b) in Drury textbook, 8th edition or 5.22(b) in 9th edition.

Solution to Activity 4.8

Find the solution to review problem 5.21(b) at the back of Drury textbook, 8th edition or 5.22(b) in 9th edition.

7. Summary

In this study unit, you learnt to

- allocate the proceeds from normal and abnormal scrap sales to the correct accounts
- account for transfers from previous processes in completed and WIP inventories
- use the short-cut method for allocating normal losses in appropriate circumstances
- discuss the suitability of process costing in a service organisation
- describe the principles of batch or operation costing

In the next study unit, we will investigate how to decide whether to process joint and by-products further or to sell these at the split-off point.

8. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer the review questions covering the theory in the textbook at the end of chapter 5.

The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

9. Online enrichment activity

Complete the online activities for chapter 5 that relates to the specified learning outcomes.

10. Self-assessment questions

After working through all the relevant sections in the textbook, as well as the guidance and activities provided in this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 4.1

Answer question 5.4 in the Drury student manual, 8th edition or 5.7 in the 9th edition.

Please add the following to the question, in order to make the answer valid: ALL the units in the OUTPUT column of the quantity statement have been subjected to spillage in THIS (CURRENT) period.

SOLUTION TO SELF-ASSESSMENT QUESTION 4.1

Find the solution to question 5.4 at the back of the Drury student manual 8th edition or 5.7 in the 9th edition.

QUESTION 4.2

Answer question 5.7 (a) in the Drury student manual, 8th edition or 5.10 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 4.2

Find the solution to question 5.7 (a) at the back of the student manual, 8th edition or 5.10 in the 9th edition.

Note:

① This is an interesting question, since the input units (sheets) are measured differently from the output (cans). It is important for you to be able to convert the weight of the sheets into the weight of a can, using normal loss parameters, since we use this to determine the abnormal loss (the rejected cans were more than expected) as well as the proceeds of the normal and abnormal loss sales.

② The proceeds of abnormal loss sales are **never** credited to the process account, in other words, it does not reduce the cost of producing normal or good output. It is offset to the abnormal loss account only.

③ When costing output from processes it is important for you to know the conversion rules of physical measurements as well as time, for example 1 000 mℓ = 1 ℓ and 60 minutes = 1 hour. We do **not** give these to you in the examination.

④ In some questions we might give the closing WIP units to you and ask you to calculate the completed units by determining which units have passed the WP and deducting the normal loss percentage. The abnormal loss is still the balancing figure.

*****

QUESTION 4.3

Solve review problem 5.21(a) in Drury textbook, 8th edition or 5.22(a) in 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 4.3

Find the solution to review problem 5.21(a) at the back of Drury textbook, 8th edition or 5.22(a) in 9th edition.

Note:

The equivalent units are made up as follows:

Material cost	(8 000 current production + 3 000 closing WIP + 500 abnormal loss) = 11 500
Conversion cost	[1 400 (2 000 x 70%) opening WIP + 8 000 current production + 1 350 (3 000 x 45%) closing WIP + 500 abnormal loss] = 11 250

*****

STUDY UNIT 5 JOINT AND BY-PRODUCT COSTING

1. Introduction

In the previous study unit, you learnt more about process costing. In this study unit, you will learn how to decide whether to process the joint or by-product further, or to sell these at the split-off point.

This study unit is based on **selected sections** from chapter 6 of your prescribed Drury textbook.

Please work through examples 6.1 and 6.2 in your Drury textbook, 8th or 9th edition, thoroughly for revision purposes.

Revision activity 5.1

A company simultaneously produces three products (X,Y and Z) from a single process. X and Y are processed further before they can be sold; Z is a by-product that is sold immediately for R6 per unit without incurring any further costs. The sales prices of X and Y after further processing are R50 per unit and R60 per unit respectively.

Data for October are as follows:

	R
Joint production cost that produce 2 500 units of X, 3 500 units of Y and 3 000 units of Z	140 000
Further processing costs for 2 500 units of X	24 000
Further processing costs for 3 500 units of Y	46 000

REQUIRED

Joint costs are apportioned using the final sales value method. Calculate the total cost of the production of X for October. **[Source: Drury textbook 8th edition, 2012: 6.10]**

Solution to Revision activity 5.1

Joint cost to be allocated = R140 000 - by-product revenues (3 000 x R6)
= R140 000 – R18 000
= R122 000

Sales value of X = 2 500 x R50 = R125 000
Sales value of Y = 3 500 x R60 = R210 000

Total sales value = R125 000 + R210 000 = R335 000

Cost allocated to X	= joint cost allocated to X + further processing cost
	= (R125 000/R335 000 x R122 000) + R24 000
	= R 69 552
Cost allocated to Y	= joint cost allocated to Y + further processing cost
	= (R210 000/R335 000 x R 122 000) + R46 000
	= R 122 478

[Source: Drury textbook 8th edition, 2012: 6.10]

The following subsection in Drury, chapter 6, contains a handy comparison of the four most popular methods for allocating joint product costs, which you learnt about in MAC2601:

Chapter	Subsection
6	*Methods of allocating joint costs: Comparison of methods*

You should always read the information supplied in questions carefully to establish which method is required for the allocation of joint costs.

2. More features of joint products

In MAC2601 you learnt that further processing costs are costs incurred to further process (convert) the separated joint products into final products after the split-off point. Further processing costs may also be incurred to prepare by-products for sale. You will now learn how to decide whether to process the output from a joint process further or simply to sell it after split-off.

Now study the following subsections in Drury, chapter 6, and attempt the activity:

Chapter	Subsection
6	*Irrelevance of joint cost allocations for decision-making (excl. Learning Note 6.1)*

Pay particular attention to example 6.3 Drury textbook 8th or 9th edition, which explains that, as a general rule, a product may be processed further as long as the extra (also called incremental) income is more than the extra (incremental) costs.

Activity 5.2

Solve review problem 6.14 in Drury textbook for both 8th and 9th editions

Solution to Activity 5.2

Find the solution to review problem 6.14 at the back of Drury textbook for both 8th and 9th editions.

Note:
The further processing decision is taken **after** the joint process is completed for the **regular** production output of the organisation. Therefore, the joint costs are irrelevant for the decision to further process the output (sunk costs). However, in certain circumstances (e.g. change in output, or with special orders) the variable joint costs might be considered, but that is too advanced for the purposes of MAC3701. This aspect will be dealt with in later modules.

*****

3. Similarity of treatment: by-product proceeds from regular sales or markets

In MAC2601 you learnt about the three main methods for dealing with accounting for by-products and the effect these methods have on the valuation of the joint product inventories. After completing the previous section on the treatment of proceeds from scrap or waste in process costing, you can now appreciate that the treatment of by-product proceeds from **regular sales** is similar to the way we treat the proceeds from waste or scrap in process costing.

Review the following subsection in Drury, chapter 6, and attempt the activities:

Chapter	Subsection
6	*Accounting for by-products*

Please work comprehensively through example 6.4 Drury textbook 8th or 9th edition.

Enrichment activity 5.3

Answer the questions posed in Real World Views 6.2 Drury textbook 8th or 9th edition.

Solution to Enrichment activity 5.3

Find the solutions to the questions in Real World Views online via your CourseMate account.

You should also review your MAC2601 study material on the treatment of the proceeds on by-products (regular market versus irregular sales) and further processing costs, since Drury does not cover this in enough detail.

Activity 5.4

Solve review problem 6.15 (a) and (b) in the Drury textbook 8th or 9th edition.

Solution to Activity 5.4

Find the solution to review problem 6.15 (a) and (b) at the back of the Drury textbook 8th or 9th edition.

Note:

① The wording "… *can sell as much B1Z as it can produce* …" is indicative of a regular market for the by-product B1Z. This allows us to offset the net revenue against the process costs for the process that generates the by-product.

The net revenues for the by-product are calculated as follows:

	R
Sales per unit (given)	1,50
Absorption cost per unit	
= R10 000 / 10 000 units	1,00
	0,50

The net revenue from the by-product sales are **only** offset against process Y as it arises from that process alone.

Did you notice the benefit offered by drawing a diagram of the processes and their output? This will help you allocate costs and revenue correctly.

② All costs are accounted for on a full absorption basis because we are costing the existing utilisation of capacity.

③ We are in effect applying the short-cut method for normal losses, since all the process costs are divided by the good output only, in other words, the normal loss equivalent units are zero.

*****

In terms of organisations' environmental responsibilities, it is important for them to treat and dispose of by-products and other waste and emissions in a responsible manner.

4. Summary

In this study unit you

- learnt how to evaluate whether to process a product further or to sell it at the split-off point
- revisited the treatment of proceeds on the sale of by-products

In the next study unit in Part 2, we will investigate how to compile operational budgets.

5. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer the review questions covering the theory in the textbook at the end of chapter 6. The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

6. Online enrichment activity

Complete the online activities for chapter 6 that relates to the specified learning outcomes.

7. Self-assessment questions

After working through all the relevant sections in the textbook, as well as the guidance and activities provided in this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 5.1

Answer question 6.6 in the Drury student manual 8th edition or 6.7 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 5.1

Find the solution to question 6.6 at the back of the Drury student manual 8th edition or 6.7 in the 9th edition.

Note:

① When using the physical units method to allocate joint costs, remember to use the **production output** of the joint process and **not** the units that were sold in the period.

② Notice the important comments in part (b) of the question. When considering profitability decisions, it is important to always consider the **breakeven point** in units, as well as the **safety margin**.

③ Given the current cost and revenue structure for further processing, product C will never be profitable and should not be considered. Product B might be profitable, if its market share can be expanded to more than its current output (but that means producing more of A and C as well – joint process). Product A is currently selling for less than its breakeven point, which is worrying.

*****

QUESTION 5.2

Answer question 6.7 in the Drury student manual 8th edition or 6.8 in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 5.2

Find the solution to question 6.7 at the back of the Drury student manual 8th edition or 6.8 in the 9th edition.

PART 2, TOPIC 3 – INTEGRATED PLANNING AND BUDGETING

INTRODUCTION

Budgets are short-term operational plans based on set strategic goals. They assist management in the planning, coordination and control of the organisation. By comparing actual and budgeted information, management can evaluate performance and take the necessary corrective steps to realign actual and budgeted data.

In MAC2601, we introduced you to the stages in the planning and control process and you learnt how to compile a fixed overhead budget. In MAC3701, we focus on the integrated design, preparation and analysis of operational budgets. We will also discuss the behavioural implications of budgeted targets from a control perspective.

Topic 3 is made up of the following study unit:

STUDY UNIT	TITLE
STUDY UNIT 6	THE OPERATING BUDGET

LEARNING OUTCOMES

After studying this topic, you should be able to

- discuss the multiple, and sometimes conflicting, functions of a budget and the administration thereof
- compile different sub-budgets and master budgets derived from strategic organisational targets
- appreciate the role of computerised budgeting
- use spreadsheet software to compile sub-budgets
- discuss the behavioural implications of the budgeted targets

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- defined the concepts "budgeting" and "budgetary control"
- explained the functions and aims of budgetary control
- differentiated between controllable and uncontrollable costs
- defined the different responsibility centres
- listed the various types of budgets
- drafted any fixed cost budgets
- drafted a cash budget using information on payments and receipts
- defined a flexible budget
- compiled a flexible budget
- listed the advantages and disadvantages of budgeting

Please refer to your second year guide if you want to refresh your knowledge.

For another perspective, you may also refer to the following subsections in your prescribed Drury textbook:

Chapter	Subsection
15	*The strategic planning, budgeting and control process*
15	*Stages in the budgeting process*
15	*Production budget and budgeted inventory levels*
15	*Factory overhead budget*
15	*Selling and administration budget*
15	*Cash budgets*

STUDY UNIT 6 THE OPERATING BUDGET

1. Introduction

The operating budget is a detailed projection of all estimated income and expenses based on forecasted sales revenue and quantities for a given period. In other words, it gives an overview of the day-to-day income and expenses of a business. The operating budget consists of several sub-budgets, namely, the sales budget, production budget, direct materials budget, labour budget, manufacturing overheads budget, selling and administrative expense budget. The sales budget is prepared first, as all the other sub-budgets are based on the sales budget.

Since an operating budget is a short-term budget (for the next twelve months), capital outlays are excluded from it because they are long-term costs. However, they are included in the capital budget. On the other hand, the cash inflows and outflows relating to the operating and capital budgets are presented together in the cash flow budget (cash flow statement) and the budgeted statement of financial position (balance sheet).

One of the main purposes of the operating budget is the preparation of the budgeted income statement, which will indicate the planned profit/loss for the period. It is imperative that the budget process is managed carefully and that it has the desired behavioural effect on employees.

This study unit is based on **selected sections** from the following chapters in your prescribed Drury textbook:

- Chapter 15
- Chapter 16

Activity 6.1

Reflect on how budgets are used in your employer's organisation or your own personal life. Consider issues such as the following: Who is involved? How is your department's budget compiled? How much detail is given in the budget? When is the budget compiled? Are you measured against the budget?

2. Functions and management of the budget

Budgets have many uses, and the management team compiling the budget should carefully consider each aspect when they decide on targets.

Now study the theory covered in the following subsections in Drury:

Chapter	Subsection
15	*The multiple functions of budgets*
15	*Conflicting roles of budgets*
15	*The budget period*
15	*Administration of the budgeting process*

Did you notice that when management only examine **considerable** differences between planned and actual results, it is known as "management by exception"? This gives them more time to spend on more important issues.

Administering and compiling the budget is one of the most important tasks of an accountant. In practice you will find that it takes a huge amount of your time and effort. It is important for you to understand the business so you will be able to evaluate whether the inputs provided by the different parties or departments in the organisation are reasonable.

In the next section, we will show you how the budget is compiled using the different inputs.

3. Compiling the sub-budgets and master budgets

Now that you are aware of the theory behind the functions and administration of the budget, we will compile the detailed budgets. Always remember that the short-term budget (for the next twelve months) is derived from the long-term objectives that were set for the organisation in the strategic plan. In MAC2601, we only focused on compiling budgets for fixed overhead costs (which do not vary with sales activity). Now you will learn how to compile a comprehensive budget that is driven by the sales activity and production capacity of the organisation.

The master budget records the costs of the goods and the services the company proposes to utilise during the operating period as well as the benefits it expects its activities to produce. A master budget contains a combined set of departmental operating plans, detailed budgets, a cash forecast and the resulting budgeted financial statements.

Now study the following subsections in Drury, chapter 15:

Chapter	Subsection
15	*A detailed illustration (all the sub-budgets and master budget)*

Pay careful attention to example 15.1 in your Drury textbook, 8^{th} or 9^{th} edition. Make sure you know how to compile all the different sub-budgets and how to combine them in the master budget.

We will now discuss the sub-budgets in more detail and provide you with further activities to practice your skills.

3.1 Sales budget

The sales budget forms the basis of all the other budgets, as expenses will be based on planned sales. The sales budget gives the expected sales in the number of units as well as the rand value. The sales forecasts provided by the marketing department need to be accurate, because incorrect estimates will render the entire planning process meaningless.

Activity 6.2

Answer the questions posed in Real World Views 15.1 in the Drury textbook, 8^{th} or 9^{th} edition.

Solution to Activity 6.2

Find the solution to the questions in Real World Views 15.1 online via your CourseMate account.

Activity 6.3

Vanegly Ltd manufactures and sells three products, namely Bee, Gee and Dee. The following information relates to actual results for 20X3:

	Bee	**Gee**	**Dee**
Sales (units)	20 000	2 000	50 000
Selling price (per unit)	R25	R500	R1
Finished goods inventory	2 000	100	3 000

Additional budgeted information for 20X4

1. Sales
   - product Bee: Selling price per unit will increase by 20%, and the volume will decrease by 10%.
   - product Gee: Selling price per unit will increase by 10%, and the volume will decrease by 5%.
   - product Dee: Selling price per unit will decrease by 5%, and the volume will increase by 250%.

2. Closing inventory (finished goods)

	Units
- product Bee	1 500
- product Gee	75
- product Dee	4 000

3. The standard cost to produce a completed unit

	R
- product Bee	17,75
- product Gee	428,00
- product Dee	0,65

REQUIRED

Prepare the sales budget for 20X4.

Solution to Activity 6.3

Vanegly Ltd

Sales budget

	Volume (units)	**Selling price R**	**Revenue R**
Bee	①18 000	②30,00	540 000
Gee	③1 900	④550,00	1 045 000
Dee	⑤175 000	⑥0,95	166 250
			1 751 250

Calculations

①20 000 x 90%	=	18 000
②R25 x 1,20	=	R30
③2 000 x 95%	=	1 900
④R500 x 1,10	=	R550
⑤50 000 x 3,50	=	175 000 [100% (existing) + 250% (increase) = 350% new level]
⑥R1 x 95%	=	R0,95

Note:
You will learn more about the interplay of selling price and sales volume in topic 7, where we discuss the setting of selling prices.

*****

3.2 Production budget (units) and budgeted inventory levels

The production budget is based on the sales budget, plus required closing inventory, less available opening inventory. Take note that the production budget **only** deals with the **number of units**. Inventory levels should be well planned as too much inventory may lead to cash tied up in inventory, storage problems and obsolescence, whilst insufficient inventory may cause loss of sales. The supply chain manager should provide input regarding the optimum inventory levels.

For an organisation that only sells goods (a retailer) there would be a budget for the **purchase** of those goods instead of a production budget.

Activity 6.4

Use the information in activity 6.3 above.

REQUIRED

Prepare the production budget for 20X4.

Solution to Activity 6.4

Vanegly Ltd

Production budget (units)

	Bee	**Gee**	**Dee**
Sales	18 000	1 900	175 000
Plus: Closing inventory	1 500	75	4 000
Units required	19 500	1 975	179 000
Less: Opening inventory	2 000	100	3 000
Units to be produced (or purchased)	17 500	1 875	176 000

The budgeted units to be produced will now be used to determine the budgets for all the other production costs.

3.3 Direct materials usage budget

This budget provides details of materials required to achieve the production budget. It includes both the quantity needed and the rand value.

Activity 6.5

Use the information given in activity 6.3 as well as the following information for the year 20X4.

Three raw materials are used in the production of products Bee and Gee. The inputs are as follows (you may assume no spillage or wastage occurs in the process):

	Material M	**Material S**	**Material F**
Bee	1 kilogram	0,5 kilogram	4 units
Gee	30 kilograms	40 kilograms	12 units

The cost of the materials is as follows:

Material M	-	R5 per kg
Material S	-	R10 per kg
Material F	-	R0,20 per unit

REQUIRED

Prepare the direct material usage budget for products Bee and Gee for 20X4.

Solution to Activity 6.5

Vanegly Ltd

Material quantities needed

	Product Bee			**Product Gee**		
	Units to be produced	**Quantity per unit**	**Total raw material needed**	**Units to be produced**	**Quantity per unit**	**Total raw material needed**
Material M	17 500	1 kg	17 500	1 875	30 kg	56 250
Material S	17 500	0,5 kg	8 750	1 875	40 kg	75 000
Material F	17 500	4 units	70 000	1 875	12 units	22 500

Direct material usage (issued to production) budget

	Product Bee			**Product Gee**			**Total**		
	Total raw material needed	**Cost R**	**Total R**	**Total raw material needed**	**Cost R**	**Total R**	**Total raw material needed**	**Cost R**	**Total R**
Material M	17 500	5,00	87 500	56 250	5,00	281 250	73 750	5,00	368 750
Material S	8 750	10,00	87 500	75 000	10,00	750 000	83 750	10,00	837 500
Material F	70 000	0,20	14 000	22 500	0,20	4 500	92 500	0,20	18 500

The inventory policy of the organisation will determine how much of the required materials to be purchased management will have to budget for. This is covered in the next section.

Note:

In real life, management will compile the budgets for production and the usage of all resources on a month-to-month basis, based on the budgeted monthly sales forecasts. Once the new financial year is under way, monthly sales and production forecasts will be updated with the latest market information and inventory levels. Management would then explain their actual activities against those budgeted for as part of the controlling function of the budget. Also see topic 4 on standard costing and the analysis of variances.

*****

3.4 Direct materials purchase budget

Management must compile the direct materials purchase budget monthly to determine the quantities of direct materials to be procured. The organisation must take the inventory holding policy (EOQ, JIT etc) into account when planning purchases of direct materials and consumables.

Activity 6.6

H has a budgeted production for the next budget year of 12 000 units spread evenly over the year. H expects the same production level to continue for the next two years. Each unit uses 4 kg of material.

The estimated opening raw material inventory at the start of the next budget year is 3 000 kg. H’s future policy will be to hold sufficient raw material inventory at the end of each month to cover 110% of the following month’s production.

The budgeted material cost is R8 per kg for purchases up to 49 000 kg. The excess of purchases over 49 000 kg in a year will be at a cost of R7,50 per kg.

REQUIRED

Prepare the direct material purchases budget for the “next budget year” (representing a 12-month period).

[Source: Drury textbook 8th edition, 2012: 15.19 adapted]

Solution to Activity 6.6

Annual material usage	= 12 000 units X 4 kg
	= 48 000kg
Closing inventory	= 12 000 units per year / 12 months x 4kg x 110%
	= 1 000 units per month x 4kg x 1.1
	= 4 400kg
Less: Opening inventory	= 3 000kg (given)
Material to be purchased	= Annual material usage + closing inventory – opening inventory
	= 48 000kg + 4 400kg – 3 000kg
	= 49 400 kg
Material purchases	
49 000kg x R8,00	= R392 000
400kg x R7,50	= R 3 000
Total	= R395 000

[Source: Drury textbook 8th edition, 2012: 15.19 adapted]

Note:

① The inventory level in this question is based on the **monthly** production **in the next month**. Remember to divide the **annual** production by twelve to calculate the closing inventory.

Many questions will follow this scenario, so read carefully!

② When the question does not mention the time period, you may assume that the production and inventory levels refer to the same period.

*****

3.5 Direct labour budget

The direct labour budget is compiled based on the number of labour hours required to meet the budgeted production for the period.

Activity 6.7

Cyclamen CC manufactures machine parts namely Product A and Product B. The following information is the budgeted information available for the quarter July to September 2014:

	Product A	**Product B**
Material X (at R7,00 per kg)	12 kilograms	12 kilograms
Material Y (at R10 per kg)	6 kilograms	8 kilograms
Direct labour (at R20 per hour)	4 hours	6 hours
Expected sales	5 000 units	1 000 units
Selling price per unit	R600	R800
Value of opening inventory	R38 400	R26 200
Opening inventory (units)	100	50
Expected closing inventory (units)	1 100	50

Additional information:

1. It has been established that 10% of units completed are faulty and they cannot be rectified. These faulty units should not be taken into account as units available for sale. More units will have to be produced to replace the faulty units and still meet the expected inventory levels.

2. The inventory on hand at 30 June 2014 is 7 000 kg of material X and 6 000 kg of material Y.

3. The expected closing inventory of the materials is 8 000 kg of material X and 2 000 kg of material Y.

4. After the above information was obtained it was established that the cost of material Y was to increase by 20% as from July 2014.

REQUIRED

Prepare the following sub-budgets for Cyclamen CC:

a. Sales budget
b. Production budget (Round your figures to the nearest unit)
c. Raw material usage budget
d. Raw material purchases budget
e. Direct labour budget

Solution to Activity 6.7

Functional budgets of Cyclamen CC for the period July to September 2014:

a. Sales budget

	Volume	**Selling price**	**Revenue**
	Units	**R**	**R**
Product A (given)	5 000	600	3 000 000
Product B (given)	1 000	800	800 000
			3 800 000

b. Production budget (units)

	Product A	**Product B**
Sales	5 000	1 000
Plus: closing inventory	1 100	50
Units required	6 100	1 050
Less: opening inventory	(100)	(50)
Units to be produced before taking the faulty units into account	6 000	1 000
Plus: 10% faulty units (6 000/90x10)	667	
(1 000/90x10)		111
Units to be produced	**6 667**	**1 111**

Note:

The production budget is expressed in quantities only.

In the question it was stated that 10% of units completed are faulty and they cannot be rectified. It is important to realise that these faulty units should not be taken into account as units available for sale. More units will have to be produced to replace the faulty units and still meet the expected demand.

The units to be produced could also have been calculated as follows:
Product A: 6 000/90x100 = 6 667
Product B: 1 000//90x100= 1 111
(if you followed this approach, the 10% faulty units could then have been calculated as a balancing figure)

c. Raw material usage budget

	PRODUCT A			PRODUCT B		
	Units to be produced	**Quantity per unit**	**Total raw material needed**	**Units to be produced**	**Quantity per unit**	**Total raw material needed**
Material X	6 667	12 kg	80 004 kg	1 111	12 kg	13 332 kg
Material Y	6 667	6 kg	40 002 kg	1 111	8 kg	8 888 kg

Total:
Material X for Product A + Material X for Product B = 80 004kg + 13 332kg = 93 336kg
Material Y for Product A + Material Y for Product B = 40 002kg + 8 888kg = 48 890kg

Raw material usage budget (raw material issued to production)

	Total raw material needed	**Cost**	**Total**
Material X	93 336	R 7,00	**R653 352**
Material Y	48 890	R12,00	**R586 680**

Note:

This budget provides details of materials required to achieve the production budget. Also take note that the direct materials usage budget includes both the quantity needed and the rand value.

d. Raw material purchases budget

	Material X	Material Y
Material usage budget (kg)	93 336	48 890
Planned closing inventory	8 000	2 000
	101 336	50 890
Less: planned opening inventory	(7 000)	(6 000)
Total kg to be purchased	94 336	44 890
Cost per kg	R7,00	①R12,00
Total purchases	**R660 352**	**R538 680**

Calculations:

① R10 x 1,2 = R12

e. Direct labour budget

	Product A	Product B	Total
Budgeted production (units)	6 667	1 111	
Hours per unit	4	6	
Total budgeted hours	26 668	6 666	33 334
Wage rate per hour	R20	R20	
Total wages	**R533 360**	**R133 320**	**R666 680**

*****

3.6 Factory overhead budget

We compile the variable factory overhead budget by determining a budgeted variable overhead recovery rate and multiplying this with the budgeted activity level required to achieve the required (budgeted) production output.

We budget for fixed production overhead costs in total, per expense item. For absorption costing purposes, we also calculate a fixed production overhead recovery rate. Refer to your MAC2601 guide or Drury, chapter 3, if you want to refresh your prior knowledge of this topic.

Note:
It is very important to select the correct allocation base for fixed production overhead costs. When you use average long-run capacity utilisation, you might find that the budgeted production levels for individual years differ from the average. In that case, you will have an over or under recovery of fixed production overhead costs.

*****

Activity 6.8

Answer question 15.7(a), (i), (ii) and (iii) as well as (d) in the Drury student manual, 8th edition or question 15.10(a), (i), (ii) and (iii) as well as (d) in the 9th edition.

Solution to Activity 6.8

Find the solution to question 15.7(a), (i), (ii) and (iii) as well as (d) at the back in the Drury student manual, 8th edition or question 15.10(a), (i), (ii) and (iii) as well as (d) in the 9th edition.

Misprint in Drury student manual 8th edition:
In the solution to the direct labour budget, the total of the assembly department is 32 500 and **NOT** 2 500.

This mistake has been corrected in the 9th edition.

*****

3.7 Selling, distribution and administration budget

All non-manufacturing expenses, for example sales commission, salaries, delivery costs (distribution) and accounting services are shown in the selling, distribution and administrative budget. Selling and distribution expenses can be either fixed or variable. Expenses such as sales commissions or fuel for delivery vehicles may vary with sales volumes or may be fixed costs, such as the salaries of sales staff. You can compile this budget as soon as the sales budget has been completed.

Please note that you should compile separate monthly budgets for selling, distribution and administration. In MAC2601, you learnt how to compile the fixed cost budgets for this area of the business. We will now look at the variable budgets that change with sales.

Activity 6.9

Answer question 15.7(iv) in the Drury student manual, 8th edition or question 15.10(iv) in the 9th edition.

Solution to Activity 6.9

Find the solution to question 15.7(iv) at the back in the Drury student manual, 8th edition or question 15.10(iv) in the 9th edition.

3.8 Departmental budgets

Management should compile a combined labour, material usage and overheads budget for each production department.

3.9 Master budget

The master budget consists of the separate independent sub-budgets and non-production departmental budgets. It culminates in the budgeted set of financial statements.

Activity 6.10

Answer question 15.7(b) and (c) in the Drury student manual, 8th edition or question 15.7(b) and (c) in the 9th edition.

Solution to Activity 6.10

Find the solution to question 15.7(b) and (c) at the back in the Drury student manual, 8th edition or 15.10(b) and (c) in the 9th edition.

3.10 Final review

Once the master budget has been compiled, it is submitted to the budget committee for approval. They will consider whether the short-term targets for the organisation have been achieved. The entire budget or parts thereof might be sent back for amendments. The final budget is approved by the board of directors or the highest decision-making body in the organisation. The organisation's actual performance will then be measured against these budgeted activities.

4. Computerised budgeting

Computer software is especially useful in today's complex business environment. Enterprise resource planning and management (ERP and ERM) software is very useful in the planning and control function of the budget. The detailed budget is loaded in the finance and other modules of the software, such as production and inventory, and actual performance is measured against it. There are also many computerised budgeting applications you can use to determine the outcome of different scenarios when compiling the various drafts of the budget.

Activity 6.11

Answer the questions posed in Real World Views 15.2 in the Drury textbook, 8^{th} or 9^{th} edition.

Solution to Activity 6.11

Find the solution to the Real World Views 15.2 questions online via your CourseMate account.

Activity 6.92

Run an internet search on the following terms:

- ERP
- ERM
- budget software
- spreadsheet software

Do you recognise any of the popular names in the search list? What software does your employer use for planning and budgeting purposes?

Solution to activity 6.12

Popular names you would have found are SAP, Oracle, Pastel etc. The most popular spreadsheet software is MS Excel.

We will now proceed to do an activity in MS Excel. You have already learnt how to use MS Excel in your AIN2601 module.

Activity 6.13

Use the information in activity 6.3 and prepare the sales budget using MS Excel.

Solution to activity 6.13

Vanegly Ltd

A1 | SALES ACTUALS

	A	B	C	D	E
1	**SALES ACTUALS**	**20X3**			
2					
3		**Volume**	**Selling price**	**Revenue**	
4		**Units**	**R**	**R**	
5	Product Bee	20000	25	500000	=+B5*C5
6	Product Gee	2000	500	1000000	=+B6*C6
7	Product Dee	50000	1	50000	=+B7*C7
8				1550000	=SUM(E5:E7)
9					
10	**SALES BUDGET**	**20X4**			
11		**Volume**	**Selling price**	**Revenue**	
12		**Units**	**R**	**R**	
13	Change required:				
14	Product Bee	**-0.1**	**0.2**		
15	Product Gee	**-0.05**	**0.1**		
16	Product Dee	**2.5**	**-0.05**		
17					
18	Product Bee	=+B5*(1+B14)	=+C5*(1+C14)	540000	=+B18*C18
19	Product Gee	=+B6*(1+B15)	=+C6*(1+C15)	1045000	=+B19*C19
20	Product Dee	=+B7*(1+B16)	=+C7*(1+C16)	166250	=+B20*C20
21				1751250	=SUM(E18:E20)
22					

Note:

It is important that you put the variables that will change between different scenarios, for example change in units or price, in their own separate cells. By doing that, you can easily change the parameter, and the rest of the spreadsheet will update. For example, you could change the increase in Gee's selling price from 10% to 5% as the increase of 10% may seem very optimistic at the moment. MS Excel also has advanced features under the "data/what-if analysis" tab, such as "goal seek" that will change the parameters for you in order to achieve a certain outcome. This is beyond the scope of your studies, but be aware of the powerful features that are available.

5. Behavioural aspects surrounding budgets/targets

One of the purposes of budgets is to set targets against which to evaluate employees' performance. Often employees are rewarded with bonuses and other incentives if they reach their targets and, therefore, the budget should not be set too high as it will only serve to demotivate employees and could distort results.

Now study the following theory subsections in Drury, chapter 16:

Chapter	Subsection
16	*Setting financial performance targets and determining how challenging they should be*
16	*Participation in the budgeting and target setting process*

Activity 6.14

Answer question 16.12 (a), (b) and (c) in the Drury student manual, 8th or 9th edition.

Solution to activity 6.14

Find the solution to question 16.12 (a), (b) and (c) at the back of the Drury student manual, 8th or 9th edition.

In practice, the financial manager and other members of the management team must strike a fine balance between setting budgeted targets that are too easy to achieve and targets that are impossible to make.

It is also important that the whole organisation achieve goal congruency, that is, everyone must work together to achieve the same long-term sustainable strategic goals of the organisation.

Note:
The measurement issue is also closely related to the concept of controllability. We will deal with this aspect of performance measurement in more detail in topic 5.

*****

6. Summary

In this study unit, you have learnt

- to discuss the multiple and sometimes conflicting functions of a budget and the administration thereof
- how to compile different sub-budgets and master budgets that are derived from strategic organisational targets
- to appreciate the role of computerised budgeting
- how to use spreadsheet software in compiling sub-budgets
- to discuss the behavioural implications of the budgeted targets

Many entities use standard costing to predetermine costs. These can be used when compiling the budget as well as for control purposes. In the next topic, we will analyse variances and compare actual performance against the budget.

7. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer review questions 15.1 to 15.10 in the Drury textbook 8^{th} or 9^{th} edition covering the theory at the end of chapter 15, as well as review questions 16.11 to 16.17.

The solutions to these theory questions can be found on the page(s) indicated next to the specific question.

8. Online enrichment activity

Complete the online activities relating to the specified learning outcomes for chapters 15 and 16.

9. Self-assessment questions

After working through all the relevant sections in the textbook, as well as the guidance and activities provided by this study unit, you should now be able to attempt the following self-assessment questions.

Remember that all the learning outcomes mastered in MAC2601 still form part of the syllabus in MAC3701 (assumed prior knowledge), even if we do not add more to a specific topic, for example flexing the budget and preparing cash budgets.

QUESTION 6.1

The following information is available for Lotus (Pty) Ltd for the year ended 31 March 2014:

Trial balance at 31 March 2014

	Dr **R**	**Cr** **R**
Share capital		110 000
Retained income		22 500
Loan LTA Bank		80 000
Investment Aloe Ltd	50 000	
Furniture and equipment	120 000	
Vehicles	100 000	
Accumulated depreciation: Furniture and equipment		30 000
Accumulated depreciation : Vehicles		20 000
Inventory	5 000	
Debtors	40 000	
Creditors		40 300
Bank		
Receiver of revenue		12 200
	315 000	**315 000**

Additional information:

1. The authorised share capital consists of 15 000 shares at R10 each.
2. The loan from LTA Bank bears interest at 10% per annum payable in advance. No repayment is due within the next financial period.
3. Aloe Limited has declared a dividend of R4 000 payable on 31 May 2014.
4. Sales are estimated at R75 000 per month and purchases amount to an estimated R 28 000 per month.
5. Inventory on hand at the end of the next quarter is estimated at R8 500.

6. Depreciation on furniture and equipment is at 25% per annum on the straight line method and on vehicles at 20% on the straight line method.
7. Provision for taxation of R9 800 must be made.
8. Monthly expenses are as follows (cost per month):

Rental	R 6 000
Salaries and wages	R18 000
Telephone	R 580
Water and electricity	R 450

9. The following other expenses are payable during the next quarter (April to June 2014):

Administration expenses	R13 000
Travelling expenses	R 8 000
Other expenses	R 800

REQUIRED

Prepare the budgeted Statement of Profit or Loss and other comprehensive income (income statements) of Lotus (Pty) Ltd for the quarter April to June 2014.

SOLUTION TO SELF-ASSESSMENT QUESTION 6.1

LOTUS (PTY) LTD

Budgeted statement of profit or loss and other comprehensive income for the quarter ended 30 June 2014

	R
Revenue R(75 000 x 3)	225 000
Cost of sales R [5 000 + (28 000 x 3) - 8 500]	80 500
Gross profit	144 500
Other income – dividend Aloe Ltd	4 000
	148 500
Operating expenses	(111 390)
Interest on loan at LTA Bank R(80 000 x 10% x 3/12)	2 000
Rent R(6 000 x 3)	18 000
Salaries and wages R(18 000 x 3)	54 000
Telephone R(580 x 3)	1 740
Water and electricity R(450 x 3)	1 350
Depreciation: Furniture and equipment R(120 000 x 25% x 3/12)	7 500

Depreciation: Vehicles R(100 000 x 20% x 3/12)	5 000
Administrative expenses	13 000
Travelling expenses	8 000
Other expenses	800
Profit before tax	37 110
Income tax expense	9 800
Profit after tax	**27 310**

Note:
Dividends are receivable as Lotus (Pty) Ltd has an investment in Aloe Ltd and they will therefore receive dividends from Aloe Ltd.

Take note that a cash budget was not asked and therefore even though no repayment of interest is due on the loan from LTA Bank in the period under review, it still has to be accrued and taken into account in the budgeted statement of profit and loss. Depreciation expenses should therefore also be taken into account as we are not considering physical cash flow.

QUESTION 6.2

Answer question 15.8, excluding (e) in the Drury student manual, 8th edition or question 15.11, excluding (e) in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 6.2

Find the solution to question 15.8 at the back of the Drury student manual, 8th edition or question 15.11 in the 9th edition.

Note:
You learnt how to compile a cash budget in MAC2601. Remember that all the learning outcomes mastered in MAC2601 still form part of the syllabus in MAC3701 (assumed prior knowledge), even if we do not add more to a specific topic.

QUESTION 6.3

Answer question 15.10, task 1, in the Drury student manual, 8th edition or question 15.13, task 1, in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 6.3

Find the solution to question 15.10, task 1, at the back of the Drury student manual, 8th edition or question 15.13, task 1, in the 9th edition.

Note:

① **Errata**: In the production budget calculation, the closing stock of Holst is 266 and **NOT** 1 266. The total is correct. The calculation is done as follows:

Budget period of 13 weeks x 5 days per week = 65 days.
Sales of Holst = 1 235/65 days = 19 units per day.
Closing stock (equivalent to 14 days' sales) = 19 x 14 days = 266 units.

This mistake has been corrected in the Drury student manual 9th edition.

② In the production labour budget in hours, it is stated that the employees are only able to work at 95% efficiency compared to the standard of 100% efficiency. Therefore, the hours required and on which the wages paid are based should be increased. Another way of doing this calculation is as follows:

Calculated standard hours = 11 780
If this is only 95% efficiency, then 100% efficiency will be 11 780/95 x 100 = 12 400 hours.

*****

PART 2, TOPIC 4 – STANDARD COSTING

INTRODUCTION

In MAC2601, we introduced you to standard costing. This system of control is useful to managers who need to provide high quality goods or services at the lowest possible cost, because it enables them to identify inefficiencies in the production or service process and to determine whether the correct price was paid for the input materials.

In this topic, you will learn how to calculate **additional** variances for both variable and absorption costing systems and to identify causes for these additional variances. You will also learn to reconcile budgeted and actual profit and how to prepare a complete set of accounts for a standard costing system. You will calculate variances by incorporating the flexed budget approach where the actual units produced and sold differ from the budgeted units produced and sold. You will also learn whether standard costing can be applied to service organisations.

Topic 4 is made up of the following study units:

STUDY UNITS	TITLE
STUDY UNIT 7	STANDARD COSTING AND VARIANCE ANALYSIS
STUDY UNIT 8	STANDARD COSTING: FURTHER ASPECTS

LEARNING OUTCOMES

After studying this topic, you should be able to

- perform a detailed variance analysis in an **absorption** costing system where the **actual** sales and output units differ from the **budgeted** sales and production units
- identify the causes of the variances that arose within the context of one another and the scenario presented
- prepare a set of accounts with appropriate journal entries for a standard absorption costing system
- reconcile the actual absorption profit with the budgeted absorption profit
- determine when to investigate a variance further

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- understood and described the concept, aims and operations of an efficient standard costing system
- differentiated between budget and standard data
- established cost standards and compiled a standard cost card
- calculated selected variances using a standard costing system (where **the actual sales and production units = the budgeted sales and production units**) in combination with a **direct costing system**
- presented plausible reasons for variances
- reconciled budgeted and actual profit and analysed variances
- described the characteristics of an efficient standard costing system

Please refer to your second year guide if you want to refresh your knowledge.

For another perspective, you may also refer to the following subsections in your prescribed Drury textbook:

Chapter	**Subsection**
17	*Introduction*
17	*Operation of a standard costing system*
17	*Establishing cost standards*
17	*Variance analysis*
17	*Material variances*
17	*Material price variances*
17	*Wage rate variance*
17	*Variable overhead expenditure variance*
17	*Similarities between materials, labour and overhead variances*
17	*Fixed overhead expenditure or spending variance*
17	*Sales margin price variance*
17	*Reconciling budgeted profit and actual profit*
18	*Recording standard costs in the accounts*

Note:

The usage and efficiency variances in Drury are based on actual output units **differing** from budgeted output units. This incorporates the principle of the flexed budget, which will be covered later on in this topic. Please ignore these sections in Drury when revising the second year learning outcomes.

*****

Standard costing is covered in Drury, chapters 17 and 18.

STUDY UNIT 7 STANDARD COSTING AND VARIANCE ANALYSIS

1. Introduction

In this study unit, we will start off by briefly covering important aspects relating to the operation of standard costing systems. Then, you will learn how to calculate **additional** variances to those studied in MAC 2601.

This study unit is based on **selected sections** from the following chapters in your prescribed Drury textbook:

- Chapter 17
- Chapter 18

2. Operation and purposes of a standard costing system

Standard costing systems are mostly suited to manufacturing organisations where goods are manufactured or rendered in **repetitive scenarios**. The repetitive nature allows managers to set a standard for performance and price/cost.

Now study the following subsections in Drury and then attempt the activities below:

Chapter	Subsection
17	*Operation of a standard costing system*
17	*Purposes of standard costing*

Enrichment activity 7.1

Standard costing is still widely used in manufacturing organisations. Comment on whether you think it can be used in service organisations.

Solution to Enrichment activity 7.1

Although standard costing is best suited to manufacturing organisations, it may be applied to activities in service organisations where output can be measured and where clearly defined input-output relationships exist.

Activity 7.2

a. One of the purposes of standard costing is to act as a control device. Briefly explain how this is accomplished.

b. Despite changes in the environment in which business operates, standard costing and variance analysis may continue to be used in a number of different ways in the operation of a management accounting system. An example of its use would be as a control aid in each accounting period through the investigation of variances.

REQUIRED

Name and explain five applications (other than as a control aid each period) of standard costing and/or variance analysis in the operation of a management accounting system

[Source: Drury student manual, 8th edition, 2012: question 17.5]

Solution to Activity 7.2

a. Standard costing is a system that enables management to analyse deviations from the budget through the calculation and interpretation of variances. By doing this, managers can correct certain actions and control future costs more efficiently.

b. See ‘Purposes of standard costing’ in Chapter 17 of your Drury-textbook for the answer to this question. Additional purposes that could be added include monitoring variances through time to ascertain the need to change the targets or changing the standard to assist in the implementation of a continuous improvement philosophy.

[Source: Drury student manual, 8th edition, 2012: question 17.5]

It is important to remember that determining the **correct** standard has an important bearing on the motivational level of employees if the standard is to be used as an efficient control mechanism. There standards fall in three broad categories:

Basic cost standards are cost standards that **remain unchanged for long periods of time**. They enable us to compare variances from year to year. However, they are not very useful when methods of production, prices or other relevant factors change, as they do not represent current target costs. For this reason, we **seldom** use basic cost standards.

Ideal cost standards assume that **perfect operating conditions exist**. They involve the minimum costs that are possible under these perfect conditions. Ideal cost standards do not allow for normal idle time or normal spillage/spoilage and are therefore demoralising for employees.

Currently attainable cost standards involve costs that should be incurred under **efficient operating conditions,** taking into account normal spillage/spoilage, machine breakdowns and idle time. These standards are therefore difficult, but not impossible to achieve. Variances calculated using this type of standard will provide managers with the most meaningful information.

3. Variance analysis: actual output differs from budgeted output

If necessary, revise your MAC2601 tutorial matter for a basic discussion on variance analysis. It is very important that you understand the variances covered in MAC2601 and know how to calculate them, as this is assumed prior knowledge and forms the basis of what is taught in the rest of this topic.

You will remember that in terms of the **flexed budgeting approach**, we measure the performance of management against the budget reconstituted for the actual units produced and sold. We do not want to penalise (or reward) management for spending more (or less) than budgeted due to the numbers of units actually produced being more (or less) than those budgeted for.

We will therefore now calculate all the usage and efficiency variances based on the **standard costs allowed for the actual output** (and not for the budgeted output).

For <u>ACTUAL</u> volume of completed units produced						
		Allowed				**Allowed**
AQ x AP	–	AQ x SP	→	AQ x SP	–	SQ x SP
AH x AR		AH x SR		AH x SR		SH x SR
Price/Rate variance				**Usage/Efficiency** variance		
AQ x (SP – AP)				(AQ – SQ) x SP		
AH x (SR – AR)				(AH – SH) x SR		

Source: MAC2601, 2012 (adapted)

Most of the variances covered will be based on example 17.1 in your Drury textbook, 8th or 9th edition. It might be a good idea to copy that page and keep it handy for use with the rest of the study material.

Note:

In MAC2601, you learnt three methods for calculating variances/differences:

1. The schematic representation (differences between **baskets**)
2. Comparing **total amounts**, for example for the material usage variance (SQ x SP per input unit) less (AQ x SP per input unit), or (SQ – AQ) x SP per input unit
3. Comparing the **standard amounts per unit vs** the **actual amounts per unit**, for example (SQ per unit – AQ per unit) x SP per input unit x AQ of output (in units) of output

In this module we will ignore the basket method and focus on the formulas as per the approach followed in Drury. We do encourage you to still apply the 3rd method (per unit) as well, since it highlights where the problem (negative variance) or improvement (positive variance) has occurred.

*****

3.1 Further material variances

We will start off by examining a simple scenario where the familiar principles of price and usage variances are applied, but this time in the context where the actual output differs from the budgeted output.

Total, price and usage variances

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
17	*Material variances*
17	*Material price variances*
17	*Material usage variances*
17	*Total material variance*

Note:

The usage variance is calculated based on the standard cost allowed for the actual output of 9 000 units and not for the budgeted output of 10 000 units. We want to measure the production manager on the direct material quantities he/she **should have used to produce the actual output of 9 000 units**.

*****

Activity 7.3

a. Standard Ltd has a budgeted material cost of R375 000 for the production of 75 000 units per month. The standard for each unit is to use 2kg material. The standard cost of material is R2,50 per kg.

   Actual material cost in the month was R405 450 for 81 000 units and 159 000kg material was purchased and used.

   i. Calculate the material price variance.
   ii. Calculate the material quantity variance.

b. Provide possible reasons for the adverse material price variance and the favourable material usage variance calculated in the question above.

Solution to Activity 7.3

i. Material price variance = (standard price – actual price) x actual quantity
= (SP x AQ) – (AP x AQ)
= (R2,50 x 159 000kg) – R405 450
= R397 500 – R405 450
= R7 950 adverse

or

i. Material price variance = (standard price – actual price) x actual quantity
= (SP – AP) x AQ
= (R2,50 – [R405 450/159 000kg]) x 159 000kg
= (R2,50 – R2,55) x 159 000kg
= R0,05 x 159 000kg
= R7 950 adverse

ii. Material quantity variance
= (standard quantity allowed for actual production – actual quantity) x standard price
= (SQ for actual production – AQ) x SP
= [(2kg x 81 000 units) – 159 000kg] x R2,50
= [162 000kg – 159 000kg] x R2,50
= 3 000kg x R2,50
= R7 500 favourable

Note:
You will notice in this question that although the company budgeted for producing 75 000 units for the month, they actually produced 81 000 units. Therefore, when calculating the **material usage variance**, you need to base your calculations on the actual output of 81 000 units. The standard quantity of materials needed to produce 81 000 units is 81 000 x 2kg = 162 000kg.

The material quantity variance is also sometimes called the material usage variance.

*****

b. An adverse material price variance may be caused by the following:

- price increases by the existing supplier
- use of a different, more expensive supplier (investigate why the current supplier is not used)
- inefficiency of the purchasing department
- the use of more costly eco-friendly materials in the production process

A favourable material usage variance may be caused by the following:

- improvement in the quality of the material purchased resulting in less spillage/ wastage (i.e. more output)
- improvement in production methods (more output for each input)
- better trained workers (more output for each input)

Note:
It is important for you to differentiate between raw material and consumable inventory held at **standard cost** and those held at **actual cost**.

When material is purchased at actual cost and **recorded at standard cost**, the material price variance will arise at the time of purchase and will be reported immediately. This is also known as a purchase price variance.

When material is purchased and **recorded at actual cost**, the material price variance will only arise when the material is issued to the production process. This is also known as an issue price variance. Refer to your MAC2601 material to revise the journal entries for each method.

****

Joint price usage variance

Now study the following subsection in Drury:

Chapter	Subsection
17	*Joint price usage variance*

Note:
Be aware of the reason **why** a joint price usage variance may arise in practice. However, for the purposes of your studies, we will follow the default method of allocating the price usage variance to the materials price variance, to be accounted for by the purchasing manager. He/She will assume responsibility for the unfavourable R1 difference per unit purchased (regardless of the number of units purchased).

*****

Direct materials mix and yield variances

In any manufacturing process where more than one type of raw material is used, one of the basic requirements is that these raw materials must be combined in a specific proportion. The mix and yield variances therefore only arise when more than one type of material is used to manufacture a product and the combination results in different final output quantities. In certain circumstances, the mix and yield variances are therefore a further analysis of the usage variance.

Now study the following subsection in Drury and then attempt the activity:

Chapter	Subsection
18	*Direct materials mix and yield variances*

Note:
The fact that more than one material input is required to produce the final product does not automatically require or imply a mix and yield variance. Different proportions will inevitably affect the final output quantities and therefore the yield. This is mostly true for certain fluids and chemical compositions, for example, using less milk and more eggs in a dough mixture results in different quantities of acceptable dough output in kilograms. It would, for example, not apply in the following case: you cannot have an additional front wiper on a passenger sedan motor vehicle instead of the back passenger door. Apart from the fact that it would be ridiculous, it would not comply with the standard output (one complete motor vehicle).

Therefore, read the question carefully to see if the input materials should be combined in a **certain mixture or recipe**. Multiple material inputs do not automatically mean that both a mix and yield variance is required.

*****

Activity 7.4

a. Alpha Limited manufactures a single product by using a mixture of material Beta and material Gamma.

You are provided with the following information regarding the standard cost per unit:

		R
Material Beta	3 kg @ R10 per kg	30
Material Gamma	9 kg @ R15 per kg	135

Actual information for January 2014:

1. Number of units produced: 5 000
2. Materials:

Purchased	Beta:	20 000 kg for R209 000
	Gamma:	54 000 kg for R756 000
Issued	Beta:	18 500 kg
	Gamma:	45 500 kg

Calculate the material price, mix and yield variance.

b. Provide possible reasons for a favourable material mix variance and an adverse material yield variance.

Solution to Activity 7.4

a. Variance analysis:

Note:

A = Adverse or F = Favourable should always be clearly defined.

Material price variance	= (standard price – actual price) x actual quantity purchased	
Beta	= (R10 – R10,45) x 20 000	= R9 000 (A)
Gamma	= (R15 – R14) x 54 000	= R54 000 (F)

<u>Alternative:</u>

(SP – AP) x AQ purchased is mathematically the same as:

SP x AQ purchased – AP x AQ purchased

[AP x AQ purchased] is the same as the actual cost of purchases, which has been given in this question. This means you can calculate the material price variance in this question without calculating the actual price per kilogram of Beta or Gamma.

Therefore:

Beta	= R10 x 20 000 – R209 000
	= R200 000 – R209 000
	= R9 000 (A)
Gamma	= R15 x 54 000 – R756 000
	= R810 000 – R756 000
	= R54 000 (F)

Note:

In MAC3701, we use the actual quantity of material *purchased* in our calculation of the material price variance. This is the recommended method as per your text book.

Material mix variance = (actual quantity used in standard mix proportions – actual quantity used) x standard price

	Actual usage in standard mix proportions	Actual usage in actual proportions	Standard price	Mix variance R
Beta	64 000 ① x 3/12 ② = 16 000	18 500	R10	25 000 (A)
Gamma	64 000 ① x 9/12 ② = 48 000	45 500	R15	37 500 (F)
				12 500 (F)

① Total number of kilogram issued to production = 18 500 kg + 45 500 kg
= 64 000 kg

② Total kg required for 1 unit = 3 kg + 9 kg and ratios 3/12 or 9/12

The above layout is preferable when causes of variances have to be dealt with.

Note:
In MAC3701, we use the actual quantity of material *used* in our calculation of the material mix variance.

Alternative layout for the solution:

Actual usage (issued to production) in standard proportions:

	kg	**Standard price**	**R**
Beta	64 000 x 3/12 = 16 000	R10	160 000
Gamma	64 000 x 9/12 = 48 000	R15	720 000
			880 000

Actual usage (issued to production) in actual proportions:

	kg	**Standard price**	**R**
Beta	18 500 kg	R10	185 000
Gamma	45 500 kg	R15	682 500
			867 500

Mix variance = R880 000 – R867 500 = R12 500 (F)

Material yield variance = (actual yield – standard yield from actual input of material) x standard cost per unit of output

	Input allowed for *<u>actual output</u>* (Input allowed for actual yield)	**Actual usage in standard mix proportions**	**Difference at standard price**	**Yield variance R**
Beta	5 000 x 3kg = 15 000	16 000③	(1 000) x R10	10 000 (A)
Gamma	5 000 x 9kg = 45 000	48 000③	(3 000) x R15	45 000 (A)
				55 000 (A)

Note:
It is very important that you use the **input allowed for actual output** in your calculation above. The output is also called the "yield".

③ We have already arrived at these numbers in our material mix variance calculations.

This layout is better for control purposes, because the manager can see exactly which raw material's yield/usage was negative in cases where a favourable variance offsets an adverse variance.

<u>Alternative:</u>

Although the above layout is better for control purposes, the following method would also arrive at R55 000 (A):

(Actual yield – standard yield from actual input of material) x standard cost per unit of output
= (5 000 – 64 000/12) x R(135 + 30)
= (5 000 – 5 333,333) x R165
= R55 000 (A)

b. A favourable mix variance may be the result of substituting expensive materials with cheaper materials. There was a move towards using more of the cheaper input.

The input mixture used resulted in more spillage of input material or rejects of final products, causing an adverse yield variance. An adverse materials yield variance may be caused by the use of inferior quality input materials.

3.2 Labour variances

We will start off by examining a simple scenario where the familiar principles of rate and efficiency variances are applied, but this time in the context where the actual output differs from the budgeted output. The reality of labour being mostly a fixed cost in the South African context will be dealt with in postgraduate courses.

Total, rate and efficiency variances

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
17	*Wage rate variance*
17	*Labour efficiency variance*
17	*Total labour variance*

Note:
The efficiency variance is calculated based on the standard cost allowed for the actual output of 9 000 units and not for the budgeted output of 10 000 units. We want to measure the production manager on the direct labour hours he/she **should have used to produce the actual output of 9 000 units**.

*****

Activity 7.5

a. The following information relates to labour costs for the past month:

Budget	Labour rate	R10 per hour
	Production time	15 000 hours
	Time per unit	3 hours
	Production units	5 000 units
Actual	Wages paid	R176 000
	Production	5 500 units
	Total hours worked	14 000 hours

There was no idle time.

REQUIRED

Calculate the labour rate and labour efficiency variance

[Source: Drury student manual, 8th edition, 2012: 17.2]

b. Provide possible reasons for the adverse labour rate variance and the favourable efficiency variance calculated in the question above.

Solution to Activity 7.5

a. Labour rate variance = (standard price – actual price) x actual hours
= (SP – AP) x AH
= (SP x AH) – (AP x AH)
= (R10 x 14 000 hours) – R176 000
= R140 000 – R176 000
= R36 000 adverse

Labour efficiency = (standard hours allowed for actual production – actual hours) x standard price
= (SH allowed for actual production – AH) x SP
= [(3 hours x 5 500 units) – 14 000 hours] x R10
= [16 500 hours – 14 000 hours] x R10
= 2 500 hours x R10
= R25 000 favourable

[Source: Drury student manual, 8th edition, 2012: 17.2 adapted]

b. An adverse labour rate variance may be caused by the following:

- salary or wage increases (higher settlements than expected)
- labour union demands or negotiations (higher settlements than expected, or as a result of unplanned (wild cat) strikes)
- using higher skilled labour than budgeted for (higher skilled labour is paid more)
- incorrect standards

A favourable efficiency variance may be caused by the following:

- changes to the production process
- higher skilled labour
- using better quality material
- using new machinery with better throughput rates

Idle time variance

At this stage, it is important to differentiate between clock hours and work/operating/production hours. In practice, it is impossible for employees to work productively in the production line or to deliver services for 100% of the time that they are on the organisation's premises. Time off is allowed for tea or lunch breaks, having meetings, planned maintenance etc. Although employees are remunerated for this time, it is not productive time.

Key term: Clock hours

Clock hours refer to the time that the workers are physically present at work and are usually recorded by swiping a personnel card or by other means of clocking in. Remuneration is based on the clock hours.

Key term: Clock hour rate/tariff

This is the standard (budgeted) or actual rate/tariff paid to employees for each clock hour.

Key term: Work hours

Work/Operating/Productive hours refer to the time that the employee is productive. This is usually recorded on job cards.

Key term: Idle time

Idle time is the difference between the clock hours and the work/operating/productive hours.

Key term: Standard work/productive hour rate/tariff

This is the standard clock hour rate/tariff adjusted for the standard (budgeted) idle time allowed. Standard workhour rate = standard clock hour rate / (1 – standard idle time %).

Key term: Standard hours

Standard hours are the **actual** clock hours after allowing for the standard or normal allowed idle time percentage, in other words, clock hours x (1 – standard idle time %).

Key term: Idle time variance

The idle time variance is the difference between the standard productive hours and the actual productive hours.

= (actual productive hours – standard productive hours) x standard work hour rate

Alternatively:

The idle time variance is the difference between the actual idle time and the standard or normal idle time allowed.

Note:

When a question provides information on clock hours, working hours (operating or productive hours) and standard hours, you should split the efficiency variance into an idle time variance and an efficiency variance.

The standard clock hour rate (rate paid to workers) should be converted to a standard work hour rate.

*****

Example:

If employees are paid a standard **clock hour rate** of R30 for each hour clocked and 10% is allowed for idle time, it translates into a standard **work hour rate** of R30 / 90% = R33,33 per **work** hour. This expresses the labour rate for the time that the worker is **actually working** in the production or service delivery process.

Suppose the standard clock hours required per unit is 6 clock hours.

The standard labour cost per unit would then be 6 x R30 per clock hour = R180 per unit

or:

Standard work hours per unit = 6 x 90% = 5,4 work hours

The standard labour cost per unit would then be 5,4 x R33,33 per work hour = R180 per unit (small rounding)

Note:

Standard **clock** hours per unit x standard **clock** hour rate	=	Standard **work** hours per unit x standard **work** hour rate

The idle time variance is calculated as the difference between standard and actual productive hours, in other words, how productive the workers have been:

*****

Actual clock hours x standard clock hour rate (from the labour rate variance)
= [actual clock hours x (1 – standard idle time %)] x [clock hour rate/(1 – standard idle time %)] = standard work hours x standard work hour rate
↕ **Idle time variance**
Actual work hours x standard work hour rate
↕ **Efficiency variance**
Actual output x standard hours x standard work hour rate (or actual output x standard cost per unit)

Alternative – difference between idle/unproductive hours

[(Actual clock hours x standard idle time % allowance) – (actual clock hours – actual productive hours)] x **standard work hour rate**

= (standard (**allowed**) idle hours – actual idle hours) x **standard work hour rate**

Note:

The efficiency variance is now computed with the actual work/productive hours and no longer with the actual clock hours.

*****

Example

Early Bird Farms exports pre-packed frozen ostrich meat to the European market. Ostriches are bought from the local ostrich farms, slaughtered at their abattoir and then plucked and skinned. Thereafter, the carcasses are cut and packed. They make use of a standard costing system to control costs.

The following standards have been set for labour in the cleaning section of the abattoir:

Labour rate:	R18 per clock hour
Expected output:	100 meat packs are packed in 8 hours
Idle time provision:	20% of clock hours

The actual results for September were as follows:

Labour cost:	R15 400 for 880 clock hours
Actual output:	10 120 meat packs

The factory foreman indicated that productive hours were 15% less than the hours clocked during the month of September.

REQUIRED

Calculate all relevant labour variances and provide reasons for these variances.

Solution

Labour rate variance
= (standard wage rate per hour – actual wage rate) x actual labour hours worked
= [R18 – (R15 400 ÷ 880)] x 880
= (R18 – R17,50) x 880
= R440, favourable
Idle time variance
= (actual productive hours – standard hours) x standard work hour rate
= (748⑤ – 704⑦) hours x R22,50②
= R990, favourable

Alternatively:
= (allowed idle hours – actual idle hours) x standard work hour rate
= (176⑥ – 132④) hours x R22,50②
= R990, favourable

Labour efficiency variance
= (standard quantity of labour hours for actual production – actual labour hours) x standard productive hour rate
= [(0,064③ x 10 120) – 748⑤] hours x R22,50②
= (647,68 – 748) hours x R22,50
= R2 257,20, adverse

Alternatively:

= Actual production @ standard cost – actual work hours x standard production hour rate

= (10 120 x R1,44①) – (748⑤ x R22,50②)

= R14 572,80 – R16 830

= R2 257,20, adverse

Calculations:

① Standard labour cost per meat pack = (8 hours x R18) ÷ 100 braai packs
= R1,44

② R18,00 is stated as the standard clock hour rate with an allowance of 20% for idle time.
Therefore, the standard production hour rate = R18/0,8 = R22,50

③ Standard clock hours per meat pack = 8 hours ÷ 100 braai packs
= 0,08 hours

Standard productive hours per meat pack = 0,08 x (1 – 20%)
= 0,064 hours

④ Actual production hours were 15% less than actual hours clocked.
Actual idle time = 880 x 15%
= 132 hours

⑤ Actual productive hours = 880 – 132
= 748 hours

⑥ Allowed idle time = actual clock hours x allowed idle time %
= 880 x 20%
= 176 hours

⑦ Standard hours = actual clock hours x (1 – allowed idle time %)
= 880 x 80%
= 704 hours

Reasons for variances

Labour was cheaper than expected, but the efficiency variance indicates that the workers were not as efficient as anticipated. The reason might be that less skilled workers with less efficient working skills were used at a cheaper rate.

The favourable idle time shows that although 20% is allowed for idle time, these workers were only idle for 15%. They were working more, but not as efficient as expected.

Activity 7.6

a. Solve review problem 17.15 in Drury textbook, 8th or 9th edition.

b. Provide two possible reasons for the adverse idle time variance calculated above.

Solution to Activity 7.6

a. Find the solution to review problem 17.15 at the back of Drury textbook, 8th or 9th edition.

Note:

This scenario has a zero percent allowance for idle time in the standard. Therefore, the standard clock hour rate is equal to the standard work hour rate. The total idle time can be attributed to the difference between the actual clock hours and the actual work hours.

The 5 500 total unproductive hours used to calculate the idle time variance is calculated as follows:

Actual clock hours = (actual labour hours paid) – actual productive hours
= 61 500 – 56 000
= 5 500

*****

b. Two possible reasons for the adverse idle time variance calculated above are:
- unforeseen or unscheduled machine breakdowns/downtime
- labour disputes, such as strikes

3.3 Variable overhead variances

We will start off by examining a simple scenario where the familiar principles of expenditure and efficiency variances are applied, but this time in the context where the actual output differs from the budgeted output.

Total, expenditure and efficiency variances

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
17	*Variable overhead variances*
17	*Variable overhead expenditure variance*
17	*Variable overhead efficiency variance*

Note:

① The variable overhead efficiency variance is calculated based on the standard labour hours allowed for the actual output of 9 000 units and not on the budgeted labour hours for an output of 10 000 units. We want to measure the production manager on the variable overheads he/she **should have used based on 27 000 direct labour hours.**

② Where direct labour hours are used as an allocation base, the variable overhead efficiency variance will be based on the same number of hours as in the labour efficiency variance.

③ Note that the discussions in these sections of Drury are based on variable overheads that are recovered based on **direct labour hours**. The following activity is based on variable overheads that are recovered based on **units produced.**

****

Activity 7.7

Use the information provided in review problem IM17.1 in Drury textbook, 8th or 9th edition.

REQUIRED

Ignore the "REQUIRED" in the textbook and answer the questions below:

a. Calculate the total, expenditure and efficiency variance for variable manufacturing overheads.

b. Provide possible reasons for the variable overhead expenditure variance.

Solution to Activity 7.7

a. Variable overhead expenditure variance
= (allowed variable overheads for actual input volume – actual variable overhead cost)
= (18 500 x R3) – R58 800
= R3 300, adverse

Alternative:

Actual variable overhead cost per unit
= R58 800 / 18 500
= R3,18 (rounded)
Variable overhead expenditure variance
= (SR – AR) x AU
= (R3 – R3,18) x 18 500 units
= R3 300 (rounded)

An efficiency variance is intended to indicate the variance in **input quantities or hours** actually used and that which should have been used to achieve the actual output units under efficient operating conditions. In this case, because JB Ltd is allocating overheads based on the **output** units, there is no efficiency variance (efficiency variance is zero).

The total variable overhead variance is therefore R3 300.

b. Variable overhead expenditure variances may occur due to expenses being different (in this case higher) because of unforeseen cost increases. Each expense item needs to be investigated to establish the reason. The actual cost per unit was R3,18.

3.4 Sales variances in an absorption costing system

In MAC2601, we assumed that the actual units sold were equal to the budgeted units. We will now investigate how to analyse sales revenue when the actual quantities sold are different to those budgeted for. This will have a direct impact on the contribution (direct costing system) and profit (absorption costing system) for the period. This section also relies on your knowledge of **flexible budgeting**.

Sales variances arising when one type of product is manufactured and sold

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
17	*Sales variances*
17	*Total sales margin variance*
17	*Sales margin price variance*
17	*Sales margin volume variance*
17	*Difficulties in interpreting sales margin variances*

The above discussions in your Drury textbook, 8th or 9th edition, as well as example 17.2, are based on a **variable costing** system. You will remember from MAC2601 that when we use an absorption costing system, we allocate the fixed production overheads to inventory by means of a fixed production overhead recovery or allocation rate.

Standard selling price per unit

Less: Standard variable costs per unit (material, labour and production overhead) ①

= standard **contribution margin** per unit

Less: Standard **fixed** production overhead cost per unit (using the recovery rate) ②

= standard **profit margin** per unit

The sales **margin** volume variances are expressed in standard unit **contribution** margins for a **variable** costing system and standard unit **profit** margins for an **absorption** costing system. This is multiplied in both cases by the difference between the actual units sold and the budgeted units to be sold.

Note:

We do not calculate separate volume variances for costs. Changes in the costs arising from the difference between budgeted units to be produced and actual units produced are in effect netted off **in** the sales **margin volume** variance (see ① and ② above). Also note the shaded box on the right of the next diagram.

****

Figure 7.1 Variances where actual output differs from budgeted output

For the ACTUAL volume of completed units produced or sold									BUDGETED volume produced or sold
		Allowed				**Allowed**			
AQ x AP	–	AQ x SP	→	AQ x SP	–	SQ x SP	→	SQ x SP (=AV x SC)	– (material) BV x SC
AH x AR		AH x SR		AH x SR		SH x SR		SH x SR (=AV x SC)	BV x SC (lab and o/h)

Price/Rate variance	Usage/Efficiency variance	Volume variance
AQ x (SP – AP)	(AQ – SQ) x SP	(BV – AV) x SC for material
AH x (SR – AR)	(AH – SH) x SR	(BV – AV) x SC for labour and o/h
		(AV – BV) x SP for sales

Source: MAC2601, 2012 (adapted)

Activity 7.8

a. Solve review problem 17.16 part (a) and (b) in Drury textbook, 8th or 9th edition.

b. Calculate the sales volume contribution variance for October.

c. Provide possible reasons for the sales variances calculated above.

Solution to Activity 7.8

a. Find the solution to review problem 17.16 part (a) and (b) at the back of Drury textbook, 8th or 9th edition.

Note:
In order to calculate the sales volume **profit** variance (part b) for an **absorption costing** system, you first need to calculate the fixed overhead recovery rate per unit and the standard (budgeted) profit per unit.

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Fixed overhead rate per unit = budgeted fixed overheads ÷ budgeted production (units)
= R34 800 ÷ 8 700 units
= R4

Standard (budgeted) profit per unit = R26 – R10 – R4 = R12

b. Sales volume contribution variance
= (actual sales volume – budgeted sales volume) x standard **contribution** margin
= (8 200 – 8 700) x R(26 – 10)
= R8 000 adverse

c. The favourable **sales price variance** is due to the actual selling price being higher than the budgeted selling price. You will have to investigate market conditions further to establish why the organisation managed to charge higher prices (maybe imported substitute products are getting too expensive).

The adverse **sales volume profit (and contribution) variance** may be due to changes in the marketing strategy of the organisation or its competitors. It may also be due to the increased selling price which dampened demand.

Variances arising when more than one type of product is manufactured and sold

Where more than one type of product is sold, the **sales volume variance** is subdivided into a **mix** and **quantity variance**. This is similar to the **raw material usage variance** which is subdivided into a **mix** and a **yield variance** where more than one type of raw material is used in a mixture to manufacture a product.

Now study the following subsection in Drury and then attempt the activity:

Chapter	Subsection
18	*Sales mix and sales quantity variances*

Please ignore the last paragraph of this subsection referring to learning note 18.1. This will only be covered in your postgraduate MAC modules.

Activity 7.9

BRK Co operates an **absorption costing system** and sells three products, B, R and K which are substitutes for each other. The following standard selling price and cost data relate to these three products:

Product	*Selling price per unit*	*Direct material per unit*	*Direct labour per unit*
B	R14,00	3,00 kg at R1,80 per kg	0,5 hrs at R6,50 per hour
R	R15,00	1,25 kg at R3,28 per kg	0,8 hrs at R6,50 per hour
K	R18,00	1,94 kg at R2,50 per kg	0,7 hrs at R6,50 per hour

Budgeted fixed production overhead for the last period was R81 000. This was absorbed on a machine hour basis. The standard machine hours for each product and the budgeted levels of production and sales for each product for the last period are as follows:

Product	*B*	*R*	*K*
Standard machine hours per unit	0,3 hrs	0,6 hrs	0,8 hrs
Budgeted production and sales (units)	10 000	13 000	9 000

Actual volumes and selling prices for the three products in the last period were as follows:

Product	*B*	*R*	*K*
Actual selling price per unit	R14,50	R15,50	R19,00
Actual production and sales (units)	9 500	13 500	8 500

REQUIRED

a. Calculate the following variances for overall sales for the last period:

i. sales price variance;

ii. sales volume profit variance;

iii. sales mix profit variance;

b. Discuss the significance of the sales mix profit variance and comment on whether useful information would be obtained by calculating mix variances for each of these three products.

[Source: Drury textbook, 8th edition, 2012: 18.15 adapted]

Solution to Activity 7.9

a. The company uses a standard costing system. Therefore sales variances will be expressed in standard profit margins rather than standard contribution margins. The calculations of the standard profit margins per unit are as follows:

Budgeted machine hours = (10 000 × 0,3) + (13 000 × 0,6) + (9 000 × 0,8) = 18 000 hours

Overhead absorption rate = 81 000/18 000 = R4,50 per machine hour

Product	**B (R)**	**R (R)**	**K (R)**
Direct material	5,40 (3 x 1,80)	4,10 (1,25 x 3,28)	4,85 (1,94 x 2,50)
Direct labour	3,25 (0,5 x 6,50)	5,20 (0,8 x 6,50)	4,55 (0,7 x 6,50)
Fixed production overhead	1,35 (0,3 x 4,50)	2,70 (0,6 x 4,50)	3,60 (0,8 x 4,50)
Standard cost	10	12	13
Selling price	14	15	18
Standard profit	4	3	5

① Budgeted sales quantity in standard mix at standard profit margins

Product	**Quantity**	**Standard profit**	**R**
B	10 000	4	40 000
R	13 000	3	39 000
K	9 000	5	45 000
	32 000		124 000

② Actual sales quantity in actual mix at actual profit margins (i.e. actual selling price less standard cost)

Product	**Quantity**	**Actual selling price less standard cost**	**R**
B	9 500	(14,50 – 10)	42 750
R	13 500	(15,50 – 12)	47 250
K	8 500	(19 – 13)	51 000
	31 500		141 000

③ Actual sales quantity in actual mix at standard profit margins

Product	**Quantity**	**Standard profit**	**R**
B	9 500	4	38 000
R	13 500	3	40 500
K	8 500	5	42 500
	31 500		121 000

④Actual sales quantity in standard mix at standard profit margins

Product	**Quantity**	**Standard profit**	**R**
B	9 843,750 (10/32)	4	39 375
R	12 796,875 (13/32)	3	38 390
K	8 859,375 (9/32)	5	44 297
	31 500		122 062

Sales margin price variance (② – ③)		20 000F
Sales margin mix variance (③ – ④)	1 062A	
Sales margin quantity variance (④ – ①)	1 938A	
Sales margin volume variance (③ – ①)		3 000A
Total sales margin variance (② – ①)		17 000F

b. The sales margin mix variance explains how much of sales volume margin variance is due to a change in sales mix. For example, the adverse sales margin mix of R1 062 calculated in (a) indicates that the actual sales mix contained a greater proportion of low margin products and a lower proportion of high margin products than the planned budgeted proportions. The following schedule shows the impact of the change in sales mix:

Product	**Standard mix**	**Actual mix**	**Difference**	**Standard profit**	**R**
B	9 844	9 500	(344)	R4	1 376A
R	12 797	13 500	703	R3	2 109F
K	8 859	8 500	(359)	R5	1 795A
	31 500	31 500			1 062A

It can be seen that more of the lowest margin product (product R) than the budgeted mix were sold. In contrast, the actual sales mix contained a lower proportion of the higher margin products.

The sales margin mix variance is of significance only when there is an identifiable relationship between the products and these relationships are incorporated into the planning process. Where relationships between products are not expected, the mix variance does not provide meaningful information, since it incorrectly suggests that a possible cause of the sales margin variance arises from a change in the mix.

[Source: Drury textbook, 8th edition, 2012: 18.15]

Note:

When attempting a question like this, you should first determine whether the company uses a variable or an absorption costing system.

In this case, the company uses an **absorption costing system**. Therefore, your first step should be to calculate the fixed overhead rate per unit and the budgeted standard profit margin per unit.

****

Below are **additional** calculations explaining how the total variances in the solution were arrived at.

(a)(i) Calculation of the **sales price variance** per product:

(Actual selling price – standard (budgeted) selling price) x actual sales volume

Product	**Actual selling price (R)**	**Standard selling price (R)**	**Difference in unit price (R)**	**Actual sales volume (units)**	**Sales price variance (R)**	
	①	②	③= ① –②	④	③x④	
B	14,50	14,00	0,50	9 500	4 750	(f)
R	15,50	15,00	0,50	13 500	6 750	(f)
K	19,00	18,00	1,00	8 500	8 500	(f)
					20 000	(f)

(a)(ii) Calculation of the **sales margin volume** variance per product:

(Actual sales volume – budgeted sales volume) x standard profit

Product	**Actual sales volume (units)**	**Budgeted sales volume (units)**	**Difference in volume (units)**	**Standard profit (R)**	**Sales margin volume variance (R)**	
	①	②	③= ① –②	④	③x④	
B	9 500	10 000	(500)	4	(2 000)	(a)
R	13 500	13 000	500	3	1 500	(f)
K	8 500	9 000	(500)	5	(2 500)	(a)
	31 500	32 000			(3 000)	(a)

(a)(iii) Calculation of the **sales margin mix** variance:

(Actual sales quantity – actual sales quantity in budgeted proportions) x standard profit

Product	**Actual sales volume (units)**	**Actual sales volume in budgeted proportions (units)**	**Difference in volume (units)**	**Stan-dard Profit (R)**	**Sales margin mix variance (R)**	
	①	②	③ = ① - ②	④	③x④	
B	9 500	31 500 x 10/32 = 9 843,750	(343,750)	4	(1 375,000)	(a)
R	13 500	31 500 x 13/32 = 12 796,875	703,125	3	2 109,375	(f)
K	8 500	31 500 x 9/32 = 8 859,375	(359,375)	5	(1 796,875)	(a)
	31 500				(1 062,500)	(a)

Note:

Did you notice the move from the higher profit products (B and K) to the lower profit product R? The increase in the volume of the lower profit product could not make up for the profits forfeited on the other two products.

Notice that the outcomes of the sales mix variance is opposite to that of the material mix variance. A proportionate move towards the more expensive product in the sales mix results in a positive mix variance for that product. By contrast, a proportionate move towards the more expensive material in an input mixture results in an adverse material mix variance for that material.

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(a)(iv) Calculation of the **sales quantity** variance

(Actual sales quantity in budgeted proportion – budgeted sales quantity) x standard profit

Product	**Actual sales volume in budgeted proportions (units)**	**Budgeted sales volume (units)**	**Difference in volume (units)**	**Standard profit (R)**	**Sales quantity profit variance (R)**	
	①	②	③ = ① - ②	④	③x④	
B	9 843,750	10 000	(156,250)	4	(625,000)	(a)
R	12 796,875	13 000	(203,125)	3	(609,375)	(a)
K	8 859,375	9 000	(140,625)	5	(703,125)	(a)
					(1 937,500)	(a)

Note:

The calculations above are more suitable for analysis and control than for merely reporting the difference between two grand totals. You should rather follow this approach.

*****

3.5 Fixed overhead variances in an absorption costing system

In this section, we will compare the treatment of the fixed overhead variances in a variable costing system with their treatment in an absorption costing system.

Variable costing/direct costing system

In MAC2601, you studied the fixed manufacturing overhead expenditure variance. This is the **only** variance that occurs in a variable/direct costing system in respect of fixed overheads. This is because fixed overheads are deducted in full from contribution in the income statement and are not allocated to the manufactured products.

If you want to refresh your knowledge of this variance, you may refer to the following section in your prescribed Drury textbook:

Chapter	Subsection
17	*Fixed overhead expenditure or spending variance*

Revision activity 7.10

A company operates a standard **marginal** costing system. Last month actual fixed overhead expenditure was 2 per cent below budget and the fixed overhead expenditure variance was R1 250.

REQUIRED

What was the actual fixed overhead expenditure for last month?

[Source: Drury student manual, 8th edition, 2012: 17.4]

Solution to Revision activity 7.10

Budgeted overhead – actual overhead = R1 250
Actual overhead = 0,98 x budgeted overhead
Budgeted overhead – (0,98 x budgeted overhead) = R1 250
Budgeted overhead = R1 250/0,02 = R62 500
Actual overhead = R62 500 – R1 250 = R61 250

[Source: Drury student manual, 8th edition, 2012: 17.4]

Note:

Alternative solution:

Let the budgeted fixed overheads = x

Fixed overhead expenditure variance = budgeted fixed overheads – actual fixed overheads

R1 250	= x – (x -2%x)
R1 250	= x – x + 2/100 x
R1 250	= 2/100 x
x	= R62 500

Actual fixed overheads = R62 500 x 0,98 = R61 250

*****

Absorption costing system

We will now explore **additional** variances that occur when an organisation uses an absorption costing approach. We can then calculate a fixed overhead **expenditure** and **volume** variance. The expenditure variance is the same as that calculated for the variable costing system.

The volume variance arises due to the fact that fixed overheads are allocated to products based on predetermined fixed overhead recovery rates. The volume variance can also be made up of the **volume capacity variance** and the **volume efficiency variance.**

Now study the following subsections in Drury and then attempt the activity below:

Chapter	Subsection
17	*Standard absorption costing*
17	*Volume variance*
17	*Volume efficiency variance*
17	*Volume capacity variance*

Exhibit 17.5 in your Drury textbook, 8th edition or Figure 17.6 in your Drury textbook, 9th edition illustrates the fixed overhead variances and sub-variances that we can calculate for an absorption costing system.

Activity 7.11

A company making use of a standard absorption costing system provides you with the following information relating to the month of September:

The standard direct labour cost per unit is R9 (@ R12 per hour)

Manufacturing overheads are allocated to products based on direct labour hours. The company has budgeted to operate at the budgeted average long run capacity. The budget for total manufacturing overheads at different production levels is as follows:

Labour hours	**R**
14 000 (average long run capacity)	66 500
13 000	65 400

Actual results for September were as follows:

1. Manufacturing overheads incurred

- Variable	R17 000
- Fixed	R48 640

2. Direct labour

Wages paid @ R13 per hour	R179 400

3. Number of **units** produced	20 000

REQUIRED

a. Calculate all the possible fixed manufacturing overhead variances.

b. Provide possible reasons for the variances calculated above.

Rates should be calculated to four decimal places.
Units should be rounded down to the nearest full unit.

Solution to Activity 7.11

a. Calculation of fixed overhead variances

Fixed overhead expenditure variance
= budgeted fixed overheads – actual fixed overheads
= ① R51 100 – R48 640
= R2 460, favourable (f)

Fixed overhead volume capacity variance
= (actual hours of input – budgeted hours of input) x standard fixed overhead rate
= (②13 800 – 14 000) x ③R3,65
= R730, unfavourable (u) or adverse (a)

Fixed overhead volume efficiency variance = (standard quantity of input hours for actual production – actual input hours) x standard fixed overhead rate
= [(0,75 hours x 20 000 units) – ② 13 800 hours] x ③ R3,65
= (15 000 – 13 800) x R3,65
= R4 380, favourable (f)

Note:
Budgeted/Standard time per unit = R9/R12 = 0,75 hour
This means the standard time required to manufacture one unit is 45 minutes (75% x 60).

Actual time per unit = ②13 800 hours / 20 000 units
= 0,69 hour

This is an improvement of (0,75 – 0,69) / 0,75 = 8% in labour efficiency.

Alternative efficiency variance:
(0,75 – 0,69) hours x 20 000 x R3,65
R4 380 (f)

Fixed overhead volume variance = volume capacity variance + volume efficiency variance
= R730 (u) + R4 380 (f)
= R3 650 (f)

Or:

Fixed overhead volume variance = (actual production **units** – budgeted production **units**) x standard fixed overhead cost per **unit**

= [20 000 – (14 000 ÷ 0,75)] x R2,7375

= (20 000 – 18 666) x R2,7375

= R3 651,83 (f) (small rounding difference)

Note:

① When we calculate the fixed overhead volume variance, we work with budgeted and actual **output units** and cost per unit. When we calculate the **volume capacity** and **volume efficiency** variances, we work with **direct labour hours (or another allocation base)** and the cost per labour hour.

② The fixed overhead volume variance is **part of the sales margin volume variance**, as discussed in section 3.4. Remember that the sales **margin** volume variances are expressed in standard unit **contribution** margins for a **variable** costing system and standard unit **profit** margins for an **absorption** costing system. This is multiplied in both cases by the difference between the actual units sold and the budgeted units to be sold.

*****

Calculations

①	**Hours**	**Rand**
High	14 000	66 500
Low	13 000	65 400
	1 000	1 100

Variable cost per hour = 1 100/1 000 = R1,10 per hour

Total fixed cost = R66 500 – (14 000 x R1,10) = R51 100

Or

= R65 400 – (R13 000 x R1,10) = R51 100

② Actual direct labour hours = R179 400 / R13 per hour

= 13 800 hours

③ Fixed overhead recovery rate = budgeted fixed overheads ÷ budgeted standard hours

= R51 100 / 14 000

= R3,65 per direct labour hour

④ Standard fixed overhead cost per unit = R9/R12 x R3,65
= R2,7375

b. The favourable **fixed overhead expenditure variance** calculated above may be due to a variety of causes. The individual items of expenditure must be compared to ascertain the reasons for this variance.

The favourable **fixed overhead volume variance** arose due to the fact that the actual production was greater than the budgeted production. Here, the fixed overhead charged to production is more than the budgeted cost.

The **fixed overhead volume efficiency variance** measures labour efficiency. Since this variance is favourable, it shows that the labour force is working at a higher level than the prescribed level of efficiency.

The **fixed overhead volume capacity variance** is adverse. This indicates a failure to utilise available capacity. This may be caused by machine breakdowns, material shortages or poor production scheduling.

4. Summary

In this study unit, you have learnt

- how a standard costing system operates
- what the purposes of standard costing are
- what the three types of cost standards are
- how to do detailed variance analyses in an **absorption** costing system where the actual sales and output **units differ** from the budgeted sales and production units
- how to identify the causes of the variances that arose within the context of one another and the scenario presented

In study unit 8 you will learn how to prepare a set of accounts for a standard costing system, as well as how to reconcile actual profit with budgeted profit.

5. Self-assessment theory review questions

After working through the relevant sections in Drury and this study unit, you should now be able to answer the review questions in your Drury textbook, 8th or 9th edition, covering the theory at the end of chapter 17 (excluding review question 17.3) and at the end of chapter 18 (answer only 18.1 and 18.2).

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

6. Online enrichment activity

Complete the online activities that relate to the specified learning outcomes for chapters 17 and 18.

7. Self-assessment questions

QUESTION 7.1

a. Outline the uses of standard costing and discuss the reasons why standards have to be reviewed.
b. Standard costs are a detailed financial expression of organisational objectives. What non-financial objectives might organisations have? In your answer, identify any stakeholder group that may have a non-financial interest.

[Source: Drury student manual, 8th edition, 2012: 17.6]

SOLUTION TO QUESTION 7.1

a. An explanation of the different uses of standard costing is provided in '*Purposes of standard costing*' in Chapter 17 of the Drury-textbook. Once standards have been set they cannot be assumed to be valid targets over long periods of time. They should periodically be reviewed to enable the benefits of standard costing to continue. In this respect, standards must change with the changing practices of an organisation. Some organisations adopt a continuous improvement philosophy which reflects improvement in methods and more efficient usage of resources. Under these circumstances, standards need to be changed to reflect the planned improvements. The various purposes for which standards are used will be undermined if they are not continually reviewed. Staff will also pay little attention to standards if they do not reflect the current circumstances.

b. An organisation may have non-financial objectives relating to:
   - The welfare of employees (e.g. health and safety, the provision of adequate social facilities)
   - The environment (e.g. avoiding pollution);
   - Customer satisfaction (e.g. product/service quality, reliability, on-time delivery and a high quality after-sales service);
   - Support for community services;
   - Meeting statutory and regulatory requirements.

   Various stakeholders have a non-financial interest in organisations. They include employees, customers, suppliers, competitors, government, regulatory authorities, tax authorities and special interest groups (e.g. environmental protection groups).

[Source: Drury student manual, 8th edition, 2012: 17.6]

Note:

It is important for organisations not to monitor their financial performance in isolation, that is, to focus only on the financial value of variances to the budget. Non-financial performance measures are also important. The latter includes key performance indicators (KPIs) for environment, society and governance aspects of the business to ensure its long term sustainability.

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QUESTION 7.2

Answer question 17.12 (a), (b) and (c) in the Drury student manual, 8th edition or question 17.20 (a), (b) and (c) in the 9th edition.

SOLUTION TO QUESTION 7.2

Find the solution to question 17.12 (a), (b) and (c) at the back of the Drury student manual, 8th edition or question 17.20 (a), (b) and (c) in the 9th edition.

QUESTION 7.3

The standard variable cost for manufacturing one bag of Dogz Choice, a popular vet endorsed dog food, is as follows:

	R
12 kg Well @ R5 per kg	60,00
8 kg Gro @ R15 per kg	120,00
2,5 clock hours @ R21,60 per clock hour	54,00
Selling price	320

Additional information

1. Actual purchases of raw materials and issues to production for the month of June were as follows:

	Purchases (kg)	**Purchases (R)**	**Issued (kg)**
Well	12 000	59 500	6 100
Gro	5 000	81 000	3 950

   There was no opening inventory at the beginning of June. Well and Gro are used in a scientific mixture to enhance dog health.

2. Labourers clocked 1 300 hours, but the actual productive hours were only 80% of the clocked hours. Normal productivity is set at 90%. Labourers were paid R30 000 for the month.
3. 500 bags of Dogz Choice were manufactured during the month of June.
4. Although the budget intended for 480 bags of Dogz Choice to be sold, only 450 bags were sold.

REQUIRED

Calculate the following variances:

a. direct materials mix variance
b. idle time variance
c. sales margin volume variance

SOLUTION TO QUESTION 7.3

a. Calculation of the direct materials mix variance

(Actual quantity in standard mix proportions – actual quantity used) x standard price

Actual usage in standard proportions

	Actual quantity in standard mix proportion	Standard cost (R)	Total cost (R)	Actual quantity issued	Total cost (R)	Diff In quantity	Mix variance (R)
Well	① 6 030	5	30 150	6 100	30 500	(70)	(350) (a)
Gro	② 4 020	15	60 300	3 950	59 250	70	1 050 (f)
	10 050		**90 450**	**10 050**	**89 750**	**-**	**700 (f)**

① 10 050 x 12/20

② 10 050 x 8/20

The actual mix was less expensive than the standard mix, because less of the expensive Gro was used.

b. Calculation of the idle time variance

Normal productivity is set at 90%; therefore, allowance for idle time is 10%.

Therefore, the standard production hour rate = R21,60/0,9
= R24

Actual idle time = 1 300 x 20%
= 260 hours

Budgeted idle time = actual clock hours x allowed idle time %
= 1 300 x 10%
= 130 hours

Idle time variance = (standard unproductive hours – actual unproductive hours) x standard work hour rate
= (130 – 260) hours x R24
= R3 120, unfavourable

The labourers were less productive than normal.

c. Calculation of the sales volume variance

Since no information was provided regarding the fixed cost, we can only calculate the sales volume variance based on contribution margin.

Sales margin volume variance = (actual sales volume – budgeted sales volume) x standard contribution
= (450 – 480) x R86③
= R2 580, adverse

③

	R
Selling price	320
Less variable costs:	
12 kg Well @ R5 per kg	60
8 kg Gro @ R15 per kg	120
2,5 clock hours @ R21,60 per clock hour	54
Contribution per bag	86

Note:
The sales margin volume variance is computed based on the actual and budgeted **sales** units, and not on production output. Differences between the production output and the sales units will be accommodated via the movement to/from inventory, valued at the standard cost per unit.

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STUDY UNIT 8 STANDARD COSTING: FURTHER ASPECTS

1. Introduction

In the previous study unit, we covered the calculation of standard costing variances. In this study unit, we will focus on the reconciliation of budgeted profits with actual profits for an absorption costing system, the recording of standard costs in the accounts, as well as the investigation of variances.

This study unit is based on **selected sections** from the following chapters in your prescribed Drury textbook:

- Chapter 17
- Chapter 18

2. Reconciliation of budgeted and actual profit

In MAC2601, you learned how to reconcile budgeted and actual profits for a **variable costing** system. To learn how this works for an **absorption costing system**, study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
17	*Reconciliation of budgeted and actual profit for a standard absorption costing system*

Use the following format when answering questions requiring you to reconcile budgeted and actual profits for an **absorption costing** system:

	(R)
Budgeted profit (budgeted number of units sold x standard profit)	**XXX**
Add/Less: Sales margin volume variance (based on standard profit):	X
o Mix	
o Quantity	
Standard profit (actual number of units x standard profit)	**<u>XXX</u>**
Add/Less: Sales margin price variance	X
Direct cost variances	
• Direct material variances:	
o Price	
o Mix	
o Yield/Usage	
• Direct labour variances:	
o Rate	
o Idle	
o Efficiency	
Manufacturing overhead variances	
• Variable overhead variances	
o Expenditure	
o Efficiency	
• Fixed overhead variances	
o Expenditure	
o Volume	
▪ Capacity	
▪ Efficiency	
Actual profit	**<u>XXX</u>**

Note:

If the organisation uses a **variable costing system**, we calculate budgeted and standard profits by using **standard contribution** instead of standard profit.

*****

Activity 8.1

KHL manufactures a single product and operates a budgetary control system that reports performance using variances on a monthly basis. The company has an agreement with a local supplier and calls off raw materials as and when required. Consequently there is no inventory of raw materials.

The following details have been extracted from the budget working papers for 2011:

	Annual Activity (units)		
	50 000	**70 000**	**90 000**
	R'000	**R'000**	**R'000**
Sales revenue	3 200	4 480	5 760
Direct materials (3 kgs per unit)	600	840	1 080
Direct labour (2 hours per unit)	1 000	1400	1 800
Variable overhead (2 hours per unit)	400	560	720
Fixed overhead (2 hours per unit)*	600	600	600

*The fixed overhead absorption rate of R5 per hour was based on an annual budget of 60 000 units of the product being produced at a constant monthly rate throughout the year, with the fixed overhead cost being incurred in equal monthly amounts.

The following actual performance relates to February 2011:

	R	**R**
Sales revenue (5 700 units)		330 600
Direct materials (18 600kgs)	70 680	
Direct labour (11 500 hours)	128 800	
Variable overhead (11 500 hours)	47 150	
Fixed overhead absorbed	60 000	
	306 630	
Finished goods inventory adjustment	15 000	291 630
Gross profit		38 970
Fixed overhead over-absorption		3 000
Profit		41 970

For February 2011 budgeted sales were 6 000 units, the selling price variance was R34 200 adverse and the sales volume profit variance was R4 200 adverse. The actual fixed overhead incurred was R57 000.

Budgeted profit for February 2011 was R84 000.

REQUIRED

Prepare a statement for February 2011 that reconciles the budgeted profit of R84 000 with the actual profit of R41 970.

You should show the variances in as much detail as possible given the data provided.

[Source: Drury textbook, 8th edition, 2012: 17.17]

Solution to Activity 8.1

Budgeted fixed overhead rate per unit of output = R10 (2 hours at R5 per hour)

Since the actual fixed overheads absorbed were R60 000 actual output must have been 6 000 units (R60 000/R10).

Variance analysis

The sales price and sales volume variances are given in the question. The workings for the cost variances are as follows:

Direct material price	= (18 600 × R4) − R70 680	= R3 720 favourable
Direct material usage	= [(6 000 × 3) − 18 600] × R4	= R2 400 adverse
Direct labour rate	= (11 500 × R10) − R128 800	= R13 800 adverse
Direct labour efficiency	= [(6 000 × 2) − 11 500] × R10	= R5 000 favourable
Variable overhead expenditure	= (11 500 × R4) − R47 150	= R1 150 adverse
Variable overhead efficiency	= [(6 000 × 2) − 11 500] × R4	= R2 000 favourable
Fixed overhead expenditure	= R50 000 − R57 000	= R7 000 adverse
Fixed overhead volume	= (6 000 − 5 000) × R10	= R10 000 favourable

Note that the price variances are calculated as follows:

(SP − AP) AQ giving:

(SP × AQ) − actual cost.

SP for materials is calculated by dividing the budgeted cost of resources (R600 000) by the budgeted activity level (50 000 units) divided by the SQ per unit of output (3 kg) giving a SP of R4 per kilogram. The SPs for labour and overheads are calculated using the same approach.

Reconciliation statement			**R**
Budgeted profit			**84 000**
Sales volume variance			4 200 (A)
Standard profit on actual sales			79 800
Selling price variance			34 200 (A)
			45 600
	Adverse	Favourable	
Direct material price		3 720	
Direct material usage	2 400		
Direct labour rate	13 800		
Direct labour efficiency		5 000	
Variable overhead expenditure	1 150		
Variable overhead efficiency		2 000	
Fixed overhead expenditure	7 000		
Fixed overhead volume		10 000	
Totals	24 350	20 720	3 630 (A)
Actual profit			**41 970**

[Source: Drury textbook, 8th edition, 2012: 17.17]

The following comments relate to the solution provided in Drury:

- Your first step to answering this question would be to calculate the number of units actually produced. The actual performance shows that R60 000 has been absorbed in fixed overheads. Since the fixed overhead absorption rate is given as R5 per hour, we can use this information to calculate the number of units actually produced during February 2011.

- To calculate the direct material, labour and variable overhead cost per unit, you may use the information provided for any of the annual activities. Since the unit cost is the same at each activity level, you will get the same answer, irrespective of the activity level you choose to use.

- The budgeted fixed overheads for February 2011 are calculated by dividing the annual fixed overheads of R600 000 by 12 to get R50 000. This amount was used to calculate the fixed overhead expenditure variance.

Is it important to ensure that the budgeted and actual amounts correspond to the same period. Therefore, if the actual amounts are provided per month and the budgeted amounts per year, you will have to convert the yearly amounts to monthly amounts.

3. Recording standard costs in the accounts

In MAC2601, you studied the calculation for each variance covered in that module and learnt how to record it in the accounts. It would be a good idea for you to revise these sections in your MAC2601 study guide.

In this section, you will now learn how to prepare the accounting entries for the variances introduced in MAC3701.

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
18	*Recording standard costs in the accounts*

Note:

① This subsection is once again based on example 17.1 in Drury, 8th or 9th edition. It might be a good idea to copy that page and keep it handy when studying this section.

② Example 17.1 deals with a **standard absorption costing** system.

③ You will remember from MAC2601 and study unit 7 that raw material and consumable inventory can be held either at **standard** or **actual cost**. You need to be able to prepare the journal entries for both options. Example 17.1 uses a system that values all inventories at **standard cost.**

If the question does not indicate how raw material and consumables are valued, you may assume that these inventories are also kept at standard.

④ Sales variances are **NOT** recorded in the general ledger; they are merely calculated for management information purposes when reconciling the actual and budgeted results. Cost of sales variances are recorded because inventory is valued at standard and this gives rise to variances.

⑤ Adverse variances appear as debit balances, and favourable variances appear as credit balances.

*****

Revision Activity 8.2

Solve review problem 18.13 in Drury textbook, 8th edition or 18.14 in the 9th edition.

Solution to revision Activity 8.2

Find the solution to review problem 18.13 at the back of Drury textbook, 8th edition or 18.14 in the 9th edition.

Activity 8.3

Use the information and calculations for the labour variances example in study unit 7 (Early Bird Farms).

REQUIRED

Prepare the ledger accounts for these transactions.

Solution to Activity 8.3

Dr			**Cr**
	Wages and contributions payable		
	R		**R**
		Actual labour cost for September	15 400*(1)*

Dr			Cr
Wage control account			
	R		**R**
Actual labour cost for September	15 400 *(1)*	Actual number of clock hours worked x standard rate = 880 hours x R18 per hour	15 840 *(2)*
(Difference in rates for actual hours worked) = 880 hours x (R18 – R17,50)	440 (f) *(4)*		
	15 840		**15 840**

Dr			Cr
Production account			
	R		**R**
Actual number of clock hours worked x standard rate = 880 hours x R18 per hour	15 840 *(2)*	Standard number of productive hours allowed x standard work hour rate =(0,064 x 10 120) x R22,50	14 572,80 *(3)*
(Allowed idle hours – actual idle hours) x standard work hour rate = (176 – 132) hours x R22,50	990 (f) *(6)*	Difference in the number of hours for actual production at standard production hour rate = R22,50 per hour x (647,68 hours - 748 hours)	2 257,20 (u) *(5)*
	16 830		**16 830**

Dr			Cr
Completed goods or WIP (if incomplete)			
	R		**R**
(Standard number of productive hours allowed x standard work hour rate) =(0,064 x 10 120) x R22,50	14 572,80 *(3)*		

Dr			Cr
Labour rate variance			
	R		**R**
		(Difference in rates for actual hours worked) = 880 hours x (R18 – R17,50)	440 (f) *(4)*

Dr			Cr
Labour efficiency variance			
	R		**R**
Difference in the number of hours for actual production at standard production hour rate = R22,50 per hour x (647,68 hours - 748 hours)	2 257,20 (u) *(5)*		

Dr			Cr
Idle time variance			
	R		**R**
		(Allowed idle hours – actual idle hours) x standard work hour rate = (176 – 132) hours x R22,50	990 (f) *(6)*

The labour rate and idle time variances are favourable (see calculations in the example); the account has therefore been credited. The labour efficiency variance is adverse; the account has therefore been debited.

Note:

In exhibit 18.1, Drury, 8th or 9th edition, generates all the cost variances in the various control accounts. Unisa prefers to add an additional step or account to the accounting process, namely the production account. Input costs are therefore debited to the Production Account as the actual volume of inputs multiplied by the standard cost per input unit, from where the usage/efficiency variances are allocated from. This aids the control function of the standard costing system, as the production manager should primarily take responsibility for the efficient usage of resources allocated to the production process. On the other hand, the materials and human resource managers should take responsibility for the actual costs incurred in sourcing the materials and labourers (price/rate/tariff variance).

Completed units are transferred from the production account to the completed goods account at full standard cost per unit. If any units are incomplete at the end of the period, they are transferred to the WIP account at standard cost, based on the percentage completion of each input and applying process costing principles.

*****

Activity 8.4

Use the information and calculations for material mix and yield variances in example 18.1 in Drury, 8th or 9th edition. In this example, the purchase price variance has already been accounted for (entry *(1)*) and the material inventory accounts are kept at standard price per litre. Refer to your MAC2601 guide for the accounting entries relating to the purchase price variance. We will only deal with the accounting entries for issues from the stores (at standard cost per input unit, e.g. kg or litre) and the variances that arise where a mixture is used to produce the output.

REQUIRED

Prepare the ledger accounts for these transactions.

Solution to Activity 8.4

Material cost per completed unit of product A

Material	**Cost per 10 litres of input R**	**Cost per one litre of final output R (input cost ÷ 9)**
X	35	3,88888
Y	15	1,66667
Z	4	0,44444
Total	54	6,00000

Note:
Only 9 litres of output (final product of A) are generated from 10 litres of input.

*****

Dr			**Cr**
		Stores ledger control account	
	R		**R**
		(Actual quantity x standard price)	
		Material X (53 000 x R7)	371 000 *(2)*
		Material Y (28 000 x R5)	140 000 *(2)*
		Material Z (19 000 x R2)	38 000 *(2)*
			549 000

Dr			Cr
WIP product A control account			
	R		**R**
(Actual quantity x standard price)		(Standard quantity x standard price)	
Material X (53 000 x R7)	371 000 *(2)*	Material X (92 700 x R3,88888)	360 500 *(3)*
Material Y (28 000 x R5)	140 000 *(2)*	Material Y (92 700 x R1,66667)	154 500 *(3)*
Material Z (19 000 x R2)	38 000 *(2)*	Material Z (92 700 x R0,44444)	41 200 *(3)*
Mix variance – Material Y = (R150 000 – R140 000)	10 000 (f) *(4)*	Mix variance – Material X = (R350 000 – R371 000)	21 000 (u) *(4)*
Mix variance – Material Z = (R40 000 – R38 000)	2 000 (f) *(4)*		
Yield variance – Material X = (R360 500 – R350 000)	10 500 (f) *(5)*		
Yield variance – Material Y = (R154 500 – R150 000)	4 500 (f) *(5)*		
Yield variance – Material Z = (R41 200 – R40 000)	1 200 (f) *(5)*		
	577 200		**577 200**

Dr			Cr
Completed goods product A control account			
	R		**R**
(Standard quantity x standard price)			
Material X (92 700 x R3,88888)	360 500 *(3)*		
Material Y (92 700 x R1,66667)	154 500 *(3)*		
Material Z (92 700 x R0,44444)	41 200 *(3)*		
	556 200		

Dr			Cr
Direct materials mix variance			
	R		**R**
Mix variance – Material X = (R350 000 – R371 000)	21 000 (u) *(4)*	Mix variance – Material Y = (R150 000 – R140 000)	10 000 (f) *(4)*
		Mix variance – Material Z = (R40 000 – R38 000)	2 000 (f) *(4)*
		To profit and loss	9 000 (u) *(6)*
	21 000		**21 000**

Dr			Cr
Direct materials yield variance			
	R		**R**
To profit and loss	16 200 (f) *(7)*	Yield variance – Material X = (R360 500 – R350 000)	10 500 (f) *(5)*
		Yield variance – Material Y = (R154 500 – R150 000)	4 500 (f) *(5)*
		Yield variance – Material Z = (R41 200 – R40 000)	1 200 (f) *(5)*
	16 200		**16 200**

Activity 8.5

Use the information and calculations for the fixed manufacturing overhead variances in activity 7.11 in study unit 7.

REQUIRED

Prepare the ledger accounts for these transactions.

Solution to Activity 8.5

Dr			Cr
Fixed factory overhead control account			
	R		**R**
Actual fixed overheads incurred	48 640 *(1)*	Production account (13 800 hours x R3,65)	50 370 *(2)*
Fixed overhead expenditure variance	2 460 *(3)*	Fixed overhead volume capacity variance	730 *(4)*
	51 100		**51 100**

Dr			Cr
Production account			
	R		**R**
Fixed overhead control account	50 370 *(2)*	WIP (20 000 units x R2,7375)	54 750 *(6)*
Fixed overhead volume efficiency variance	4 380 *(5)*		
	54 750		**54 750**

Dr			Cr
WIP account			
	R		**R**
Production account	54 750 *(6)*		
	54 750		

Dr			Cr
Expense creditors			
	R		**R**
		Actual fixed overheads incurred	48 640 *(1)*

Dr			Cr
Fixed overhead expenditure variance			
	R		**R**
		Fixed factory overhead control account	2 460 *(3)*

Dr			Cr
Fixed overhead volume capacity variance			
	R		**R**
Fixed factory overhead control account	730 *(4)*		

Dr			Cr
Fixed overhead volume efficiency variance			
	R		**R**
		Production account	4 380 *(5)*

The fixed overhead expenditure variance and fixed overhead volume efficiency variance are favourable (see calculations in the activity); the account has therefore been credited. The fixed overhead volume capacity variance is adverse; the account has therefore been debited.

4. The investigation of variances

Standard costing is introduced in Drury at the beginning of chapter 17 as a **financial control system** that enables deviations from the budget to be analysed in detail, thus enabling costs to be controlled more efficiently. This brings us to the investigation of variances as part of this system of control.

Now study the following subsections in Drury and then attempt the activity:

Chapter	Subsection
18	*The investigation of variances*

Please ignore the subsection titled *Statistical investigation models*. This will only be covered in your postgraduate MAC modules.

Activity 8.6

a. Outline the factors a management accountant should consider when deciding whether or not to investigate variances revealed in standard costing and budgetary control systems.
b. Indicate briefly what action the management accountant can take to improve the chances of achieving positive results from investigating variances.

[Source: Drury student manual, 8th edition, 2012: 18.1]

Solution to Activity 8.6

a. The management accountant should consider the following factors when deciding whether or not to investigate variances:

i) *The size of the variances*: This may be expressed in terms of percentage variation from standard or budget. Alternatively, statistical techniques can be used to determine the probability of the variance occurring when it is under control. The size of the variance indicates the likelihood that the variance is due to an assignable cause.

ii) *Costs and benefits of investigation:* The management accountant should assess whether the costs of investigation are less than the benefits that are expected to result from the investigation.

iii) *Nature of the standard:* Are expected or ideal standards used? If ideal standards are used then investigation of the variances is unlikely to result in the variances being eliminated.

iv) *Cumulative variances:* A variance showing an increase in size over time may justify an investigation even when the variance for the particular period is not significant. Alternatively, a variance that is significant for a particular period but that is decreasing over time may be under control.

v) *Validity of standard or budget:* The validity of the standard will help the accountant to gauge the significance of the variance. A price variance in times of rapidly rising prices is unlikely to be due to an assignable cause.

b. The management accountant can take the following action to improve the chances of achieving positive results from investigating variances:

i) *Speedy identification and reporting of variances:* Significant delays between the occurrence of a variance and its notification to managers will limit the degree of control that managers can achieve. The sooner a variance is identified, the sooner it can be investigated and acted upon.

ii) *Analysis of variances:* The accountant should provide clues as to the possible reasons for the variances by pinpointing where the variances have arisen. For example, the accountant might identify the reason for a direct material variance as being due to excessive usage of a certain material in a particular process. This should assist the responsibility manager in quickly identifying the cause of the excessive usage.

iii) *Statistical procedures:* Statistical procedures and quality control charts should be used so as to determine the probability that variances are due to an assignable cause. If managers are frequently required to investigate variances that are due to random variations then it is unlikely that they will give detailed attention to the investigation process. However, if the majority of variances reported are significant then managers will attach greater importance to the investigation process.

iv) *Develop a team effort approach:* The accountant should be seen by managers as supportive within the control process. If a team effort approach is developed then it is likely that managers will be more actively involved in the investigation process.

[Source: Drury student manual, 8th edition, 2012: 18.1]

5. Summary

In this study unit, you have learnt to

- prepare a set of accounts for a standard absorption costing system by passing appropriate journal entries
- reconcile actual absorption profit with budgeted absorption profit
- determine when a variance should be investigated

Implementing a standard costing system is one way to control behaviour. In study unit 9 you will learn about divisional financial performance measures.

6. Self-assessment theory review questions

After working through the relevant sections in Drury and this study unit, you should now be able to answer review questions 18.4, 18.5 and 18.6 in Drury, 8th or 9th edition, covering the theory at the end of chapter 18.

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

7. Online enrichment activity

Complete the online activities for chapters 17 and 18 relating to the specified learning outcomes.

8. Self-assessment questions

QUESTION 8.1

Answer question 17.7 in the Drury student manual, 8th edition or question 17.5 in the 9th edition.

SOLUTION TO QUESTION 8.1

Find the solution to question 17.7 at the back of the Drury student manual, 8th edition or question 17.5 in the 9th edition.

QUESTION 8.2

JK Plc operates a chain of fast-food restaurants. The company uses a **standard marginal costing system** to monitor the costs incurred in its outlets. The standard cost of one of its most popular meals is as follows:

		R per meal
Ingredients	(1,08 units)	1,18
Labour	(1,5 minutes)	0,30
Variable conversion costs	(1,5 minutes)	0,06
The standard selling price of this meal is		2,14

In one of its outlets, which has budgeted sales and production activity level of 50 000 such meals, the number of such meals that were produced and sold during April was 49 700. The actual cost data were as follows:

		R
Ingredients	(55 000 units)	58 450
Labour	(1 200 hours)	13 600
Variable conversion costs	(1 200 hours)	3 250
The standard selling price of this meal is		103 935

REQUIRED

a. Calculate
   i. The total budgeted contribution for April.
   ii. The total actual contribution for April.

b. Present a statement that reconciles the budgeted and actual contribution for April. Show all variances to the nearest R1 and in as much detail as possible.

c. Explain why a marginal costing approach to variance analysis is more appropriate in environments such as that of JK plc, where there are a number of different items being produced and sold.

[Source: Drury student manual, 8th edition, 2012: 17.8]

SOLUTION TO QUESTION 8.2

a. Budgeted contribution = Standard unit contribution (R2,14 – R1,54 = R0,06) x 50 000
= R30 000

Actual contribution = R103 935 – (R58 450 + R13 600 + R3 250) = R28 635

b. Sales margin price = (Actual price – standard price) x Actual sales volume
= Actual sales – (Actual sales volume x standard price)
= R103 935 – (49 700 x R2,14)
= R2 423 A (note that the same answer would be obtained using contribution margins in the above formula)

Sales margin volume = (Actual volume – Budgeted volume) x Standard unit contribution
= (R49 700 – 50 000) x R0,60 = R180 A

Ingredients price = (SP – AP)AQ = (AQ x SP) – (AQ x AP)
= (55 000 x R1,18/1,08 = R60 093) – R58 450 = R1 643 F

Ingredients usage = (SQ – AQ)SP
= (49 700 x 1,08 = 53 676 – 55 000) R1,18/1,08 = R1 447A

Wage rate = (SP – AP)AH = (AH x SP) – (AH x AP)
= (1 200 x R12① = R14 400) – R13 600 = R800F

Labour efficiency = (SH – AH)SP
= (49 700 x 1,5 min = 1 242,5 hours – 1 200 ure) x R12
= R510G

Variable conversion price = (SP – AP)AH = (AH x SP) – (AH x AP)
= 1 200 x R2,40② = R2 880 – R3 250 = R370A

Variable conversion efficiency = (SH – AH)SP
= (49 700 x 1,5 min = 1 242,5 hours – 1 200 hours) x R2,40
= R102F

Notes:

① Standard price paid for labour = R0,30/1,5 minutes = R0,20 per minute = R12 per hour

② Standard variable conversion price = R0,06/1,5 minutes = R0,04 per minute = R2,40 per hour

Reconciliation statement				**R**
Budgeted contribution				30 000
Sales volume contribution variance				180 A
Standard contribution on actual sales				29 820
Sales price variance				2 423 A
				27 397
Cost variances		A	F	
Ingredients	Price		1 643	
	Usage	1 447		
Labour	Rate		800	
	Efficiency		510	
Conversion cost	Expenditure	370		
	Efficiency		102	
		1 817	3 055	1 238 F
Actual contribution				28 635

c. The answer should point out that in any environment fixed overhead volume variances are not particularly helpful for cost control (see '*Volume variance'* in Chapter 17 of your Drury-textbook for an explanation of this point). Therefore, a marginal costing variance analysis approach is preferable for most types of environment.

[Source: Drury student manual, 8th edition, 2012: 17.8]

Note:

In this question, variable overheads are recovered based on **direct labour hours**.

Therefore, the variable overhead expenditure variance is equal to the difference between the budgeted flexed variable overheads (BFVO) for the actual direct labour hours of input and the actual variable overheads (AVO) costs incurred.

BFVO – AVO

= (1 200 hours x standard rate) – R3 250

= (1 200 x R2,40) – R3 250 = R370 A

QUESTION 8.3

Answer question 18.5 in the Drury student manual, 8th edition or question 18.1 in the 9th edition.

SOLUTION TO QUESTION 8.3

Find the solution to question 18.5 at the back of the Drury student manual, 8th edition or question 18.1 in the 9th edition.

PART 2, TOPIC 5 – PERFORMANCE MANAGEMENT IN DECENTRALISED ORGANISATIONS

INTRODUCTION

Larger organisations often expand and diversify their product range or service offering to such a wide variety of products and/or services that it becomes difficult for top management to control the operations providing these products and/or services directly. In this topic, you will learn about techniques to manage and control such organisations and to evaluate their performance as well as those of the managers at different levels.

LEARNING OUTCOMES

After studying this topic, you should be able to

- determine appropriate responsibility centres for control purposes at different levels in the organisation
- differentiate between functional and divisional organisational structures and prepare organisational structures (organograms) for both
- identify and explain the advantages and disadvantages of divisionalisation and the prerequisites for a successful divisional control structure
- describe the controllability principle and its impact on performance measurement
- distinguish between the economic performance of the division and that of the manager
- compute return on investment and residual income and identify the advantages and disadvantages of each
- identify and compute the impact of factors, such as asset base and depreciation, on the performance of the divisions and/or managers
- compute and explain the effect of performance measurement on capital investment decisions
- identify and explain the approach (excluding balanced scorecard) that can be used to reduce the dysfunctional consequences of short-term financial performance measures

ASSUMED PRIOR KNOWLEDGE

Most of the learning outcomes covered in this topic were not covered in previous modules. It is therefore important that you pay careful attention when working through the contents of this topic.

Topic 5 is made up of the following study unit:

STUDY UNIT	TITLE
STUDY UNIT 9	DIVISIONAL FINANCIAL PERFORMANCE MEASURES

STUDY UNIT 9 DIVISIONAL FINANCIAL PERFORMANCE MEASURES

1. Introduction

Organisations have increasingly become more complex as technological and logistical advances made diversification of products, supply of input material, etc available on a global basis. Before we proceed to the theory in the textbook, do the following activity to see how companies in South Africa structure their business operations.

Enrichment activity 9.1

Refer to the following websites to obtain an understanding of the organisational structure of some of the larger South African organisations:

Company name	Website	Where to find information on website
SASOL	www.sasol.com	▪ Investor centre tab. ▪ Integrated annual report and financial statements. ▪ Open the integrated annual report. ▪ Refer to the group structure section.
SANLAM	www.sanlam.co.za	▪ Businesses tab. Page down on this page and you will see that the business is subdivided into smaller divisions.
BHP Billiton	www.bhpbilliton.com	▪ Businesses tab.

In this study unit, you will focus on the background and theory of divisional organisational structures, divisional performance measurement, controllability and the performance measurement of the divisions and their managers.

This study unit is based on **selected sections** from the following chapters in your prescribed Drury textbook:

- Chapter 16
- Chapter 19
- Chapter 21

2. Background and theory of divisional structures

In the budgeting topic in MAC2601, you were briefly introduced to the concept of controllable and uncontrollable factors and learnt about the four different types of responsibility centres. The sections you are going to study next will explain the background and theory to you for implementing different organisational structures.

Now study the following subsections in Drury, chapters 16 and 19, and then attempt the activities:

Chapter	Subsection
16	*Responsibility centres*
16	*The nature of management accounting control systems*
19	*Divisional organisational structures*

Enrichment activity 9.2

Answer the question(s) posed in Real World Views 16.3 in your Drury-textbook 8th edition or Real World Views 16.4 in Drury-textbook 9th edition.

Solution to Enrichment activity 9.2

Find the solution to the question(s) in Real World View online via your CourseMate account.

Activity 9.3

You are the financial manager of a pharmaceutical company, PHARMA, that sells the following products and services:

i. clinic services
ii. dispensary
iii. nutritional products
iv. toiletries
v. cosmetics

The company's supply chain operates across the following functions:

i. marketing and sales
ii. operations
iii. information technology
iv. human resources
v. customer services

REQUIRED

a. Explain the difference between a functional and divisional organisational structure.

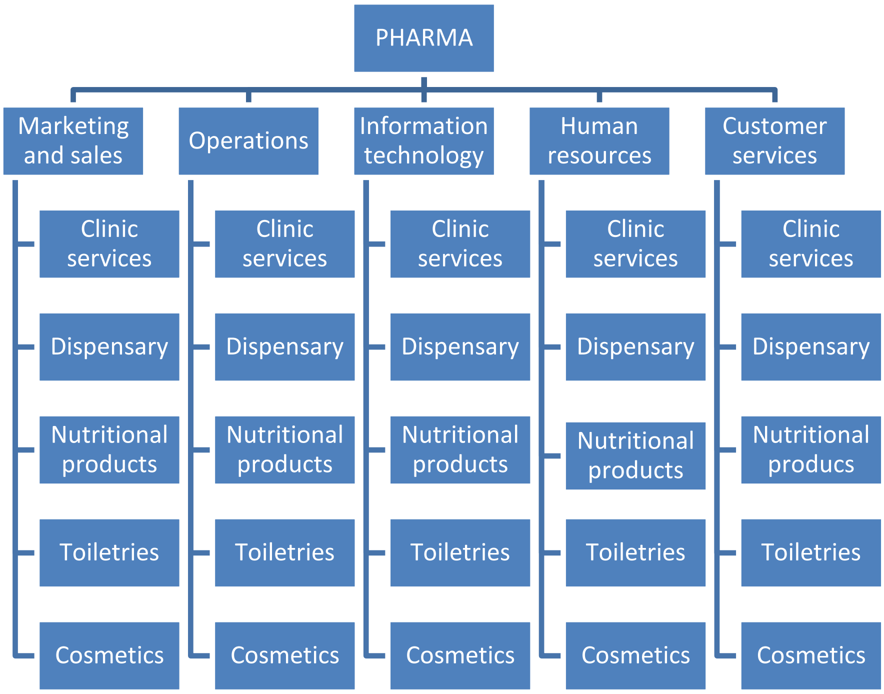
b. Prepare an organogram of a functional organisational structure for PHARMA.

c. Prepare an organogram of a divisional organisational structure for PHARMA.

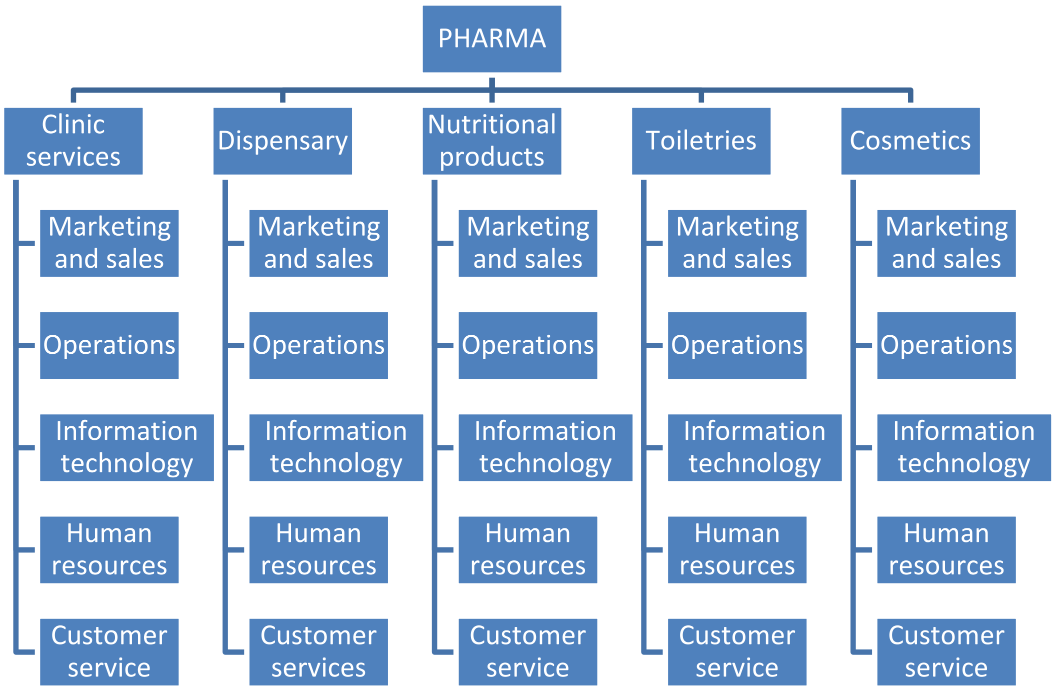
Solution to Activity 9.3

a. In a functional organisational structure, the groups within the structure are based on similar job functions. Each functional area services each product/service provided by the organisation. In a divisional organisational structure, divisions represent unique products, services, customers or geographical locations. Each division has its own functional structure.

b. Functional organogram



c. Divisional organogram



Did you notice that, in some cases, it is more effective to manage a company on a divisional basis rather than on a functional basis? It is therefore important that the management team make the right decisions regarding the type of organisational structure as well as the responsibility centres that need to be included in the elected organisational structure.

The creation of divisions allows for the operation of a responsibility accounting costing system. There are number of responsibility centres that can be used within a system of responsibility accounting.

Below is a table that summarises the relationship between responsibility centre, controllability and performance measures.

Type of responsibility centre	Manager has control over	Principal performance measures
Cost centre	• Controllable costs	Variance analysis Efficiency measures
Revenue centre	• Revenues only	Revenues
Profit centre	• Controllable costs • Sales prices (including transfer prices)	Profit
Investment centre	• Controllable cost • Sales prices (including transfer prices) • Investment in non-current assets and working capital	Return on investment (ROI) Residual income (RI) Other financial measures

[Source: BPP adapted]

Now study the following subsections in Drury, chapter 19, and attempt the activity:

Chapter	Subsection
19	*Advantages and disadvantages of divisionalisation*
19	*Prerequisites for successful divisionalisation*

Enrichment activity 9.4

Answer the question(s) posed in Real World View 19.1 in the Drury-textbook 8th or 9th edition.

Solution to Enrichment activity 9.4

Find the solution to the question(s) in Real World View online via your CourseMate account.

3. Controllability and divisional performance measurement

Having worked through the background and theory of divisional structures and understanding what a divisional structure is, we will delve into the factors that should be considered when you evaluate divisions and divisional managers on whether they have reached their profit targets.

Now study the following subsection in Drury, chapter 16 and the additional guidance, and then attempt the activities:

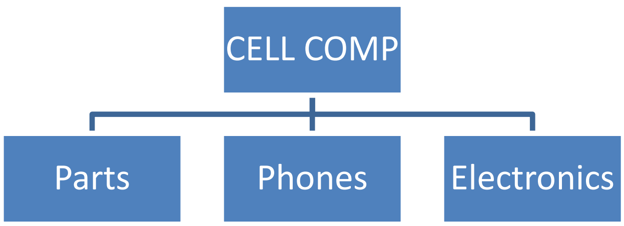
Chapter	Subsection
16	*The controllability principle*

When looking at the performance of a division and/or the division's manager, you need to make sure you understand what factors the manager can control (controllable factors) and what factors the manager cannot control (uncontrollable factors) that will impact the performance of his/her division.
Imagine yourself working for a business where your salary and bonus are determined by the performance of your production department. It will be unfair if you are held responsible for factors which impact the performance of your department but are beyond your control.

Suppose your production department experienced a lot of downtime due to electricity problems encountered by your service provider. You cannot control the electricity cuts by your service provider and therefore cannot be held responsible for a decrease in manufacturing output during the period when the problem occurred.

However, you can control an effective start-up once the electricity is back on and maximise your output during this time. You can also investigate alternative electricity resources, for example a generator, and prepare a costing analysis of the cost price versus the loss of income due to the decrease in sales as well as penalties that might be payable to customers.

Activity 9.5



Cell Comp is a large corporate company which manufactures cell phones and other electronics. The company is divided into three divisions. The parts division manufactures all the parts used by the phones division, where the phones are assembled and tested. The company's strategic policy states that the phones division should first buy the parts from the parts division at a market-related price that is determined at the beginning of each year, before purchasing parts from an outside company. The agreed market-related purchase price for one of the parts with product code A100 was determined at R100 per unit at the beginning of the year.

Phones CC, a competitor also producing product A100, has lost a big client and is currently selling the extra product at a discounted price of R75 per unit.

REQUIRED

When determining the performance of the phones division, do you think it is fair to hold the purchasing manager responsible for the "extra cost" of buying the units from the parts division and not at the lower price available in the market? Explain your reasoning.

Solution to Activity 9.5

No, it will not be fair to hold the manager responsible. The company policy states that the phones division should first buy their parts from the parts division at a market-related price, as agreed at the beginning of each financial year. The manager can therefore not contract with Phones CC to buy the product at a discounted price. The fact that the manager has to buy the more expensive product is not controllable and therefore he/she should not be penalised.

Controllability is a very important concept when we evaluate the performance of individuals and responsibility centres. You should always read the question carefully to gather what aspect of each activity is controlled by whom.

Care must be taken to distinguish between controllable cost and uncontrollable costs. The **controllability principle** is that managers of responsibility centres should only be held accountable for cost over which they have some influence.

Now study the following subsections in Drury, chapter 19, and then attempt the activities:

Chapter	Subsection
19	*Distinguish between the managerial and economic performance of the division*
19	*Alternative divisional profit measures*

Note:

The term **managerial performance** is used to refer to assessing the performance of the manager (person) at the profit centre and investment centre level in the organisation. The performance measure should only include controllable items.

The term **economic performance** is used to refer to the performance of the division in comparison to other divisions in the organisation and those of competitors. It might include non-controllable and allocated costs.

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You need to make the link between the various levels of profits, as set out in the table below, and the managerial and economic performance measures of a division.

Table 9.1 – Various levels of divisional profit measures

	R	
Total sales revenue	xxx	
Less: Controllable cost	xxx	
1. Controllable profit	**xxx**	**Manager's performance**
Less: Non-controllable avoidable cost	xxx	
2. Divisional profit contribution	**xxx**	**Division's economic performance**
Less: Allocated corporate expenses	xxx	
3. Divisional net profit before interest and tax	**xxx**	**Comparison to similar organisations**

Source: Author, 2012

Note:

When adding each division's level (c) profit and the net unallocated head office costs, it would equate to the organisation's consolidated profit before interest and tax (PBIT).

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Activity 9.6

EEB Consulting Ltd is a company providing consulting services. The company consists of two divisions: Tax Consulting Services (Tax) and Financial Management Consulting Services (FM).

The financial results for the divisions for the year ended 31 December 20X1 is set out below:

	Tax	**FM**
	R'000	**R'000**
Net profit	50 000	35 500

The net profit was determined before the following divisional expenses were taken into account:

	Tax	**FM**
	R '000	**R'000**
Internal audit services – charged	1 500	1 000
Legal fees – charged	5 500	2 000
Head office costs – allocated	7 500	5 000

Additional information

- Internal audit services form part of head office. The group executive committee (GEC) approves an annual internal audit plan that includes internal audit services for head office and all the divisions. The costs are allocated to the divisions based on the actual hours spent to complete the assignments included in the internal audit plan.
- The head office has a legal department that provides services to the two divisions. The divisions decide when they need the assistance of the legal department, and the fees are allocated according to a standard price per hour.
- Head office costs allocated to the divisions are administrative fees based on the gross income of the divisions.

REQUIRED

Determine the controllable profit, divisional profit contribution and the profit before tax for the two divisions by populating the above figures in the format provided by
Table 9.1 above.

Solution to Activity 9.6

		Tax R'000	FM R'000	
Net profit before other expenses		50 000	35 500	
Less: Controllable cost				
	Legal fees	5 500	2 000	①
(a)	**Controllable profit**	**44 500**	**33 500**	
Less: Non-controllable avoidable cost				
	Internal audit services	1 500	1 000	②
(b)	**Divisional profit contribution**	**43 000**	**32 500**	
Less: Allocated corporate expenses				
	Head office costs	7 500	5 000	③
(c)	**Divisional net profit before interest and tax**	**35 500**	**27 500**	

Explanations

① The divisional managers have control over the legal costs, as the decision whether the services are needed or not are controlled by the management of the division and may in fact occur as a result of their actions, for example, non-compliance with an agreement.

② The divisional managers do not have control over these costs, as the internal audit plan is approved by the GEC. The costs are also avoidable when the division is closed down.

③ The division would have incurred these costs if it was a separate company. Therefore, the costs are included in the calculation of the divisional net profit before interest and tax.

Note:

In later relevant costing study units, you will learn more about avoidable and unavoidable central or head office support costs in scenarios where management is considering closing down divisions.

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Enrichment activity 9.7

Answer the questions posed in Real World View 19.2 in your Drury textbook 8th or 9th edition.

Solution to Enrichment activity 9.7

Find the solution to the questions in Real World View online via your CourseMate account.

It is also important for you to understand that the performance of a **functional** organisational structure is not determined on the same basis as the performance of a **divisional** organisational structure.

- In a functional organisation you would have different performance measurements for the different functions based on whether they are cost centres or income responsibility centres. This is augmented with non-financial performance measures. Say, for instance, one of the functions of an organisation is a client services department. This department will typically be measured against its cost structure, the number of calls handled on a daily basis and the number of outstanding calls at the end of each month. We will continue our discussion of non-financial performance measures later.

- If you consider the performance measurement of a divisional organisation, you will typically look at the profit of each division. Divisions are structured as profit and investment responsibility centres.

Make sure you understand which profit measures to use when evaluating the manager versus the division. In determining the profit, you should apply the controllability principle again.

4. Relative financial measures of divisional performance

In the previous section, we focused on an **absolute** performance measure (one figure in isolation), namely the divisional profit (at different levels of control). You will appreciate that if two divisions both earned a profit of R1m each, your assessment of each performance will differ if you knew that one division generated R1m of profit with controllable net assets of R10m, while the other division generated R1m of profit with controllable net assets of R20m. Relating the profit earned to the net assets employed to generate the profit converts the measurement to a **relative** performance measure.

Now study the following subsections in Drury, chapter 19, and attempt the activities:

Chapter	Subsection
19	*Return on investment (ROI)*
19	*Residual income (RI)*
19	*Determining which asset base should be included in the investment base.*

Note:

① Other performance measures, such as economic value added (EVA) and market value added (MVA), as well as the balanced scorecard will be covered in later MAC modules.

② The concept of EVA is a further refinement of residual income. When studying the section on asset base, you should substitute "EVA" with "residual income", that is, read "residual income" instead of "EVA".

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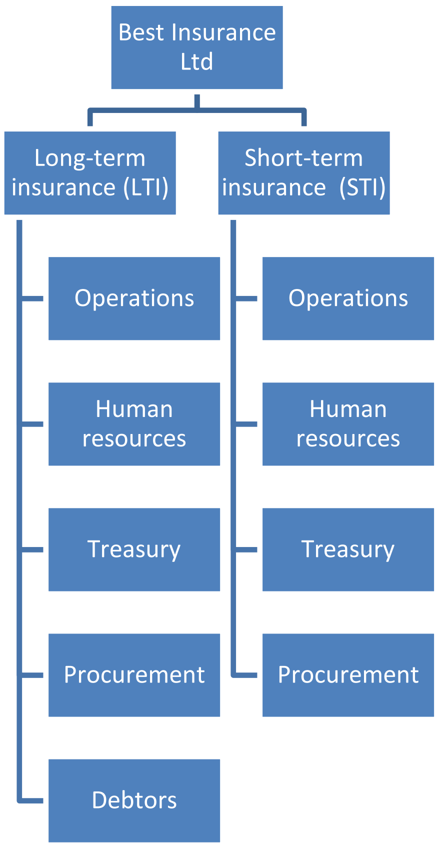
Activity 9.8

Best Insurance Ltd is a company that provides both long-term and short-term insurance products to its customers. The company has two separate divisions for the two different products offered.



The management teams of the two divisions are responsible for the functions that are included in their divisional structures (see organogram above):

- The treasury function is responsible for cash management and for the financing agreements of the division.
- The procurement function is responsible for the procurement and sales of non-current assets.
- The debtor's function of LTI is responsible for the credit management (granting of credit and collection) of the division.

Head office is currently responsible for the credit management (granting of credit and collection) of STI. Head office also delivers IT services to the different divisions at the request of divisional management. In addition, head office determines the transfer price and the tax implications of these services.

The financial results for the divisions for the year ended 31 December 20X1 is set out below:

	LTI	**STI**
	R'000	**R'000**
Sales	250 000	170 000
Gross income	75 000	47 500

Gross income was determined before the following income and expenses were taken into account:

	LTI	**STI**
	R'000	**R'000**
Interest paid on long-term loan	5 000	750
Interest paid on the bank overdraft	200	
Interest received on bank account		150
Bad debts (accounts receivable)	350	170
Discount allowed on debtors	50	8
Discount received from creditors	70	10
Other sundry expenses (management can control all the sundry expenses)	50 500	32 000
Depreciation on fixed assets	2 500	1 000
IT services	3 500	1 500
Allocated head office expenses	3 300	1 700

The following is applicable to the assets and liabilities balances of the two divisions:

	LTI	STI
	R'000	**R'000**
Non-current assets	87 500	42 000
Net current assets	13 500	12 000
• Current assets:	35 000	21 000
Debtors	35 000	14 500
Cash on hand		6 500
• Current liabilities:	21 500	9 000
Creditors	20 000	9 000
Bank overdraft	1 500	
Long-term loan	50 000	5 000

Additional information

- The required return on controllable investment is 17,5% for LTI and 20% for STI.
- The costs of IT services are allocated to the divisions based on actual time used and standard transfer prices.
- Head office costs allocated to the divisions involve administrative fees based on gross income.

REQUIRED

a. Classify the responsibility centre type for each division.

b. Calculate the following for each of the two divisions:

   i. controllable profit
   ii. divisional profit contribution
   iii. divisional net profit before tax
   iv. controllable investments
   v. return on investment (ROI)
   vi. residual income (RI)

Solution to Activity 9.8

a. Both divisions can be classified as investment centres as they have control over most of their assets in addition to operational decisions.

b. Various divisional performance measures

	LTI R'000		STI R'000	
Gross income	75 000		47 500	
Add: Controllable income	70		160	
Interest received on bank account	-		150	①
Discount received from creditors	70		10	
Less: Controllable costs	62 100		35 250	
Interest paid on long-term loan	5 000	①	750	①
Interest paid on bank overdraft	200	①	-	
Bad debts	350		-	②
Discount allowed on debtors	50		-	②
Other sundry expenses	50 500		32 000	
Depreciation on non-current assets	2 500		1 000	
IT services	3 500	③	1 500	③
Allocated head office expenses	-	④	-	④
i. Controllable profit	**12 970**		**12 410**	
Less: Non-controllable avoidable costs	-		178	
Bad debts	-		170	②
Discount allowed on debtors	-		8	②
ii. Divisional profit contribution	**12 970**		**12 232**	
Less: Allocated corporate expenses	3 300		1700	
Allocated head office expenses	3 300	④	1 700	④
iii. Divisional net profit before tax	**9 670**		**10 532**	

iv. Controllable investments

	LTI		STI	
	R'000		R'000	
Non-current assets	87 500		42 000	
Debtors	35 000		-	②
Cash on hand	-		6 500	①
Creditors	(20 000)		(9 000)	
Bank overdraft	(1 500)	①		
Long-term loan	(50 000)	①	(5 000)	①
Controllable investments	**51 000**		**34 500**	

Explanations

① The treasury function has control over the financing structures and cash management. Therefore, the interest on the long-term loan and bank overdrafts are included in the controllable profit figures and the balance of the long-term loans and bank overdraft are deducted from the controllable investments balances. The interest earned on cash balances are also controllable and are therefore included in the controllable profit and added to the controllable investments.

② The credit management of STI is the responsibility of head office. Therefore, the management team of STI does not have any control over the bad debt on debtors, discount allowed on debtors as well as the outstanding balance on debtors at year end.

You will note that these costs were deducted as part of the non-controllable avoidable cost when we calculated the divisional profit contribution. The reason for this is that the management of STI does not have control over these costs, because they are attributable to the division. If the division were to close down, head office would not incur these expenses.

③ IT services are rendered to the two divisions at the request of management for a standard tariff. Due to the fact that the management team of each division can decide on the services needed (quantity or volume), they are in control of the expense, and the costs are allocated at a standard tariff. Head office will carry the expenditure variance (the difference between the standard tariff and the actual tariff), as they determine the cost structure of the IT services support department.

④ The head office expenses are allocated to the divisions based on gross income. The divisions cannot control these costs; therefore they are excluded from the controllable profit calculation.

However, the expenses are included in the calculation of the divisional net profit before taxes, as the division would have incurred these costs if it were a separate company.

v. Return on investment (ROI)

		LTI	STI
		R'000	**R'000**
Return on investment	=	controllable profit / controllable investment	controllable profit / controllable investment
	=	12 970 / 51 000	12 410 / 34 500
	=	**25,43%**	**35,97%**

vi. Residual income (RI)

	LTI		STI	
	R'000		**R'000**	
Controllable profit	12 970		12 410	
Less: Cost of capital of controllable investments	8 925	①	6 900	②
Residual income	**4 045**		**5 510**	

Calculation

① 17,5% x R51 000 = R8 925

② 20% x R34 500 = R6 900

Activity 9.9

Solve review problem 19.16 (a) and (b) in the Drury textbook, 8th or 9th edition.

Solution to Activity 9.9

Find the solution to review problem 19.16 at the back of Drury textbook, 8th or 9th edition.

You will find some more activities to practice the calculation of ROI and RI in the following section.

Please ensure you understand the advantages and disadvantages of ROI and RI and know when to use a particular method. The asset base used in both measures **also** relates to the controllability concept.

5. The impact of non-current assets on financial performance measures

Both ROI and RI is calculated using the net controllable assets. Non-current assets are usually the biggest constituent of net controllable assets. Manipulating this figure gives management the opportunity to influence the calculation of their performance measurement (assuming they have control over the investment and depreciation method decisions).

Now study the following subsections in Drury, chapter 19, and attempt the activities:

Chapter	Subsection
19	*The impact of depreciation*
19	*The effect of performance measurement on capital investment decisions*

Note:
As mentioned before, the concept of EVA is a further refinement of RI. When studying these sections, you should substitute "EVA" with "RI", that is, read "RI" instead of "EVA".

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Activity 9.10

Solve review problem 19.18 (a) in the Drury textbook, 8th edition or 19.19 (a) in the 9th edition.

Solution to Activity 9.10

Find the solution to review problem 19.18 (a) at the back of Drury textbook, 8th edition or 19.19 (a) in the 9th edition.

Applying the correct performance measure is important when one considers the impact of possible future capital budgeting decisions and the effect of depreciating existing assets. Managers may make investment decisions that are in their own interest, but not in the interest of the organisation. In that case, goal congruency is not achieved.

6. Including non-financial performance measures

When the budget is compiled, performance targets are set for the next financial year (short term). Managers are usually rewarded for meeting the ROI or RI target. However, these short-term targets should always be aligned to the medium and long-term strategies of the organisation. Various techniques can be employed to overcome the problem of only focussing on the short-term financial objectives to the detriment of the organisation's long-term sustainable growth.

Now study the following subsections in Drury, chapters 19 and 21 and the additional guidance before you attempt the activities:

Chapter	Subsection
19	*Addressing the dysfunctional consequences of short-term financial measures*
21	*Non-financial measures of quality and customer satisfaction (excluding Control charts)*

You learnt in MAC2601 that quantitative (financial) and qualitative (non-financial) factors will play a role when management makes a decision. In MAC2602, you learnt about the influence stakeholders other than the owners of the organisation can have on its strategic direction and action.

You should consider these non-financial (qualitative) factors when you look at the performance of the individual managers, the divisions and the organisation as a whole. These non-financial or qualitative factors usually relate to the impact that management's decisions have on the rest of the business, existing customers, society, the environment and corporate governance.

Examples of non-financial measures that will impact the performance of the organisation, its divisions and the relevant managers are

- downtime of the plant (for the manufacturing manager)
- percentage of existing clients retained and new clients obtained (for the marketing manager)
- percentage of uncollected debtors written off (bad debts) as an expense (for the credit manager)
- the actual output of the product in comparison to the budgeted output (for the production manager)

Examples of economic, social and governmental factors include

- the goals and objectives of the organisation (long-term and budgeted)
- the responsibility the organisation has towards the public and/or its employees
- the environmental impact of the division, for example CO^2 emissions
- the effect a decision has on future profits (for example: Will accepting an order at a lower price than usual create the expectation that these lower prices will be applicable to future orders as well? or: Will these lower prices create the impression that the product quality has been compromised?)
- relationships with customers or suppliers
- the consideration of other potential alternatives to the decision at hand
- socially responsible investment decisions

Activity 9.11

Refer to the background information provided in Activity 9.8

REQUIRED

Evaluate the financial performance of the two divisions as calculated in the solution to Activity 9.8 and then provide four possible non-performance measures that this organisation can use.

Solution to Activity 9.11

From a purely financial perspective, it seems that STI is performing better in both ROI and RI.

However, the following non-financial performance measures (which might influence the long-term sustainability of the business) should also be considered:

- number of claims received
- turnaround time for the processing of the claims
- number of new customers
- retention of old customers
- socially responsible investment of the premiums received
- employment equity statistics

Activity 9.12

Solve review problem 19.16 (c) in the Drury textbook, 8th or 9th edition.

Solution to Activity 9.12

Find the solution to review problem 19.16 (c) at the back of Drury, 8th or 9th edition.

It is important to link the performance of managers and divisions to the long-term strategies of the organisation if you want to avoid suboptimum short-term decisions. You should read widely to increase your awareness of the operating environment of different sectors of the economy so that you would be able to identify suitable non-financial performance measures.

Note:

① It is also important to understand that the transfer price between different divisions in the same company will impact the performance of all the divisions involved. This will be discussed in study unit 12.

② Although the balanced scorecard is covered in later MAC modules, please take note of the importance of incorporating non-financial measures when determining the performance of the manager, division and organisation.

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7. Summary

In this study unit, you have learnt how to

- determine appropriate responsibility centres for control purposes at different levels in the organisation
- differentiate between functional and divisional organisational structures and prepare organisational structures (organograms) for both
- identify and explain the advantages and disadvantages of divisionalisation and the prerequisites for a successful divisional control structure
- describe the controllability principle and its impact on performance measurement
- distinguish between the economic performance of the division and that of the manager
- compute ROI and RI and identify the advantages and disadvantages of each

- identify and compute the impact of factors, such as asset base and depreciation, on the performance of divisions and/or managers
- compute and explain the effect of performance measurement on capital investment decisions
- identify and explain the approach (excluding balanced scorecard) that can be used to reduce the dysfunctional consequences of short-term financial performance measures

It is important that you understand the principle of divisionalisation before you move on to study unit 12, where we will look at transfer pricing between different divisions of the company.

8. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer the review questions in the Drury textbook, 8th or 9th edition covering the theory at the end of chapter 16 (refer only to review questions 16.8 to 16.11) and at the end of chapter 19 (exclude the part of the question referring to EVA in questions 19.9 and 19.10 and exclude questions 19.11 and 19.13).

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

9. Online enrichment activity

Complete the online activities for chapters 16 and 19 relating to the learning outcomes specified (excluding EVA).

10. Self-assessment questions

After working through all the relevant sections in the textbook and the guidance and activities provided in this study unit, you should now be able to attempt the following self-assessment questions. Please note that any reference to EVA should be ignored (or read as RI) as this will only be covered in later MAC modules.

QUESTION 9.1

Solve review problem 16.25 (a) and (b) in the Drury textbook, 8th edition or 16.26 (a) and (b) in the 9th edition.

SOLUTION TO SELF-ASSESSMENT QUESTION 9.1

Find the solution to review problem 16.25 (a) and (b) at the back of Drury textbook, 8th edition or 16.26 (a) and (b) in the 9th edition.

QUESTION 9.2

Linamix is the chemicals division of a large industrial corporation. George Elton, the divisional general manager, is about to purchase new plant in order to manufacture a new product. He can buy either the Aromatic or the Zoman plant, each of which have the same capacity and expected four year life, but which differ in their capital costs and expected net cash flows, as shown below:

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	Aromatic	Zoman
Initial capital investment	R6 400 000	R5 200 000
Net cash flows (before tax)		
2012	R2 400 000	R2 600 000
2013	R2 400 000	R2 200 000
2014	R2 400 000	R1 500 000
2015	R2 400 000	R1 000 000
Net present value (@16% p.a)	R315 634	R189 615

In the above calculations it has been assumed that the plant will be installed and paid for by the end of December 2011, and that the net cash flows accrue at the end of each calendar year. Neither plant is expected to have residual value after decommissioning costs.

Like all other divisional managers in the corporation, Elton is expected to generate a before tax return on his divisional investment in excess of 16 percent p.a., which he is currently just managing to achieve. Anything less than a 16 percent return would make him ineligible for a performance bonus and reduce his pension when he retires in early 2014. In calculating divisional returns, divisional assets are value at net book values at the beginning of the year. Depreciation is charged on a straight line basis.

REQUIRED

a. Explain, with appropriate calculations, why neither return on investment nor residual income would motivate Elton to invest in the process showing the higher net present value. To what extent can the use of alternative accounting techniques assist in reconciling the conflict between using accounting-based performance measures and discounted cash flow investment appraisal techniques?

b. Managers tend to use post-tax cash flows to evaluate investment opportunities, but to evaluate divisional and managerial performance on the basis of pre-tax profits. Explain why this is so and discuss the potential problems that can arise, including suggestions as to how such problems can be overcome.

c. Discuss what steps can be taken to avoid dysfunctional behaviour which is motivated by accounting-based performance targets.

[Source: Drury textbook, 8th edition, 2012: 19.17]

SOLUTION TO SELF-ASSESSMENT QUESTION 9.2

a. The annual ROI and residual income calculation for each plant are as follows:

	2012	2013	2014	2015	Total
Aromatic	Rm	Rm	Rm	Rm	Rm
1) Net cash flow	2.4	2.4	2.4	2.4	9.6
2) Depreciation	1.6	1.6	1.6	1.6	
3) Profit	0.8	0.8	0.8	0.8	3.2
4) Cost of Capital (16% of [6])	(1.02)	(0.77)	(0.51)	(0.26)	
5) Residual income	(0.22)	0.03	0.29	0.54	
6) Opening value of asset	6.4	4.8	3.2	1.6	
7) ROI (Row 3/Row 6)	12.5%	16.67%	25%	50%	
Zoman					
1) Net Cash flow	2.6	2.2	1.5	1.0	7.3
2) Depreciation	1.3	1.3	1.3	1.3	
3) Profit	1.3	0.9	0.2	(0.3)	2.1
4) Cost of Capital (16% of [6])	(0.83)	(0.62)	(0.42)	(0.21)	
5) Residual income	0.47	0.28	(0.22)	(0.51)	
6) Opening value of asset	5.2	3.9	2.6	1.3	
7) ROI	25%	23%	7.7%	(23%)	

The answer should indicate:

i. Over the whole life of the project both ROI and residual income (RI) favour the Aromatic plant. The average ROI and RI figures are 25% and R0,16 million (R0,64m/4) for the Aromatic plant and 20% and R0,005 million (R0,02m/4) for the Zoman plant. The ROI calculation are based on expressing the average profits as a percentage of the average investment (defined as one-half of the initial capital investment).

ii. An explanation that Mr Elton will favour the Zoman plant because it yields a higher ROI and RI over the first two years. Mr Elton will probably focus on a two-year time horizon because of his personal circumstances, since choosing the Aromatic plant is likely to result in him losing his bonus. Therefore he will choose the plant with the lower NPV and there will be a lack of goal congruence.

iii. Suggestions as to how alternative accounting techniques can assists in reconciling the conflict between accounting performance measures and DCF techniques:

    1. Avoiding short-term evaluations and evaluating performance at the end of the project's life. Thus bonuses would be awarded with hindsight.
    2. Use alternative asset valuations other than historic cost (e.g. replacement cost).
    3. Choose alternative depreciation methods that are most consistent with NPV calculations (e.g. annuity depreciation).
    4. Incorporate a range of variables (both financial and non-financial when evaluating managerial performance) that give a better indication of future results that can be expected from current actions.

b. Managers may use the pre-tax profits to evaluate divisional performance because it is assumed that taxation is non-controllable. Taxation payable is based on total group profits and present and past capital expenditure rather than individual divisional profitability. After tax cash flows are used to appraise capital investment because the focus is on decision-making and accepting those projects that earn return in excess of the investors' opportunity cost of capital. To do this IRRs and NPVs should be based on after-tax cash flows.

The following potential problems can arise:

i. Managers may ignore the taxation impact at the decision-making stage because it is not considered when evaluating their performance.
ii. Confusion and demotivation can occur when different criteria are used for decision-making and performance evaluation.

Possible solutions include evaluating divisional profitability after taxes or evaluating performance based on a comparison of budgeted and actual cash flows. Adopting the latter approach is an attempt to ensure that the same criteria is used for decision-making and performance evaluation.

c. Steps that can be taken to avoid dysfunctional behaviour include:
   i. Not placing too much emphasis on short-term performance measures and placing greater emphasis on the long term by adopting a profit conscious style of evaluation.
   ii. Focusing on controllable residual income or economic value-added combined with asset valuations derived from depreciation models that are consistent with NPV calculation. Alternatively, performance evaluation might be based on a comparison of budgeted and actual cash flows.
   iii. Supplementing financial performance measures with non-financial measures when evaluating performance. (see '*addressing the dysfunctional consequences of short-term financial measures*' in Chapter 19).

[Source: Drury textbook, 8th edition, 2012: 19.17]

QUESTION 9.3

Solve review problem 19.19 (a) in the 8th edition or 19.20 (a) in the 9th edition of the Drury textbook. Ignore the requirement to calculate EVA.

SOLUTION TO SELF-ASSESSMENT QUESTION 9.3

Find the solution to review problem 19.19 (a) in the 8th edition or 19.20 (a) in the 9th edition at the back of Drury textbook. Ignore the calculations and comments relating to EVA.

PART 3, TOPIC 6 – RELEVANT DECISION MAKING IN VARIOUS SCENARIOS

INTRODUCTION

Decision making is one of the basic functions of a manager. Managers are constantly faced with decisions such as whether to accept a special order, what mix of products to produce, when to replace equipment etc. To make these decisions, managers need to choose between alternatives by comparing the costs and benefits of each. Cash inflows and outflows that differ between alternatives are known as **relevant incomes/costs**. When making decisions, it is very important for managers to distinguish between relevant and irrelevant data as this can save huge amounts of time, effort and resources.

In MAC2601, you learnt about the basic concepts underlying relevancy and were exposed to some basic decision making involving special orders. In this topic, you will learn how to analyse data provided in order to make more advanced decisions.

Relevant costing is covered in Drury, chapters 9 and 25, although subsections in chapters 1, 2, 3, 10 and 11 also form part of this topic.

LEARNING OUTCOMES

After studying this topic, you should be able to

- make preliminary recommendations, supported by appropriate calculations, based on the following advanced scenarios:
  - special pricing (special orders)
  - product mix when capacity constraints exist
  - replacement of equipment
  - outsourcing (make or buy)
  - discontinuation of products, product lines or divisions
- discuss qualitative issues for each decision, including but not limited to environmental, social and governance aspects

- solve the allocation of resources by applying linear programming where two products are produced and two or more constraints are present
- solve the optimum production output by means of the graphical or simultaneous equation method
- calculate the maximum price to be paid for additional supplies of the limited resources per input unit
- describe the different uses of linear programming

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- identified the characteristics that make information relevant
- distinguished between relevant and irrelevant information with regard to a specific decision
- identified qualitative factors that may affect decision making in a specific scenario
- calculated relevant incremental cash flows in a given scenario
- identified the preconditions for a special price
- determined an appropriate price for a special order
- defined and identified limiting factors in a given scenario
- identified the need for calculating contribution per unit of the limiting factor
- calculated contribution of the limiting factor per unit in a given scenario
- determined the optimal allocation of available resources and the optimal product mix

Please refer to your MAC2601 study guide if you want to refresh your knowledge.

For another perspective, you may also refer to the following subsections in your prescribed Drury textbook:

Chapter	Subsection
2	*Relevant and irrelevant costs and revenues*
2	*Avoidable and unavoidable costs*
2	*Sunk costs*
2	*Opportunity costs*
2	*Incremental and marginal costs*
9	*Identifying relevant costs and revenues*
9	*Special pricing decisions (**up to** "Evaluation of a longer-term order")*
9	*Product mix decisions when capacity constraints exist*
9	*Determining the relevant costs of direct materials*
9	*Determining the relevant costs of direct labour*

THIS TOPIC CONSISTS OF THE FOLLOWING STUDY UNITS:

STUDY UNIT	TITLE
STUDY UNIT 10	ADVANCED DECISION-MAKING SCENARIOS
STUDY UNIT 11	BASIC LINEAR PROGRAMMING

STUDY UNIT 10 ADVANCED DECISION-MAKING SCENARIOS

1. Introduction

We will begin this study unit on decision making by looking at the users of accounting and costing information are as well as the six stages of the decision-making process. We will then do some revision activities to reinforce the key concepts before moving on to the advanced scenarios.

Study the following background subsections in Drury and then attempt the activity:

Chapter	Subsection
1	*The users of accounting information*
1	*Differences between management accounting and financial accounting*
1	*The decision-making process*

Activity 10.1

Answer review questions 1.1 to 1.3 in Drury textbook, 8th or 9th edition at the end of chapter 1.

Solution to Activity 10.1

Find the solutions to the questions on the page(s) indicated next to each question.

Reflection

Do you think the six stages in the decision-making process are also applicable to decisions you make in your life? Consider, for instance, your decision to buy a new car or a home. What about decisions regarding your career, lifestyle and health?

*****

In MAC2601, we introduced you to the terminology and basic concepts relating to relevant costing as well as important quantitative and qualitative factors management need to consider when making decisions. It is imperative that you fully understand these concepts in order to apply them to the advanced scenarios covered in this module. Please consult Drury or your MAC2601 study guide in this regard.

Revision activity 10.2

Solve review problem 2.24 in your Drury textbook, 8th edition or 2.25 in the 9th edition.

Solution to Revision activity 10.2

Find the solution to review problem 2.24 at the back of your Drury textbook 8th edition or 2.25 in the 9th edition.

Sometimes overhead costs, such as rates and taxes, depreciation and insurance are assigned to product costs (for example, where the organisation uses activity-based costing (ABC)). These costs may or may not be relevant to the decision at hand.

Study the following subsection in Drury relating to this situation:

Chapter	Subsection
3	*Extracting relevant costs for decision-making*

Note:
You should be extremely careful when deciding whether to include or exclude production or other fixed costs in a particular scenario. Because ABC improves the traceability of costs, it will help you to identify potential relevant costs relating to a decision.

When determining short-term special prices, fixed costs are usually not incremental and are therefore excluded. However, any longer-term pricing decisions should include fixed costs in order for the business to be profitable. The discontinuation of products and product lines is especially tricky when it comes to fixed costs. We will discuss these in more detail later on.

*****

2. Importance of qualitative (non-financial) aspects

The first responsibility of the management accountant or financial manager is to provide the financial information on which decisions will be based. However, our role does not end here. You should also consider other factors or issues that could arise as a result of the decision. In MAC2602, you learnt that businesses could no longer operate with the sole objective of maximising profits. Businesses and organisations operate within the context of society and the natural environment and should also be governed properly. To be sustainable in the long term, organisations should consider all stakeholders. They should also identify and manage business and other risks appropriately.

Now study the following subsection in Drury and attempt the activity:

Chapter	Subsection
9	*Importance of qualitative/non-financial factors*

Activity 10.3

An organisation is currently considering outsourcing the production of one of its product lines as its own technology is becoming outdated and it is too expensive to import new equipment. In respect of the fixed costs, management have indicated that 10 people will have to be retrenched if the production is outsourced.

REQUIRED

Describe four qualitative factors that management should consider with regard to the decision to outsource one of the product lines.

Solution to Activity 10.3

1. The morale of the remaining employees may be affected negatively after ten colleagues have been retrenched, especially the morale of those working closely with them. This may have a negative effect on the output of the remaining employees.
2. Labour law requires that trade unions be consulted before making a final decision on retrenching employees. This may lead to labour unrest on the premises, which could disrupt production.
3. It is crucial that the organisation to which the product line will be outsourced is reliable. If they do not deliver to customers timeously, the organisation could lose these customers' goodwill and future business.
4. The quality standards of the organisation to which the product line will be outsourced should be similar to the organisation's own; otherwise, the organisation could lose customers' goodwill and future business.
5. The new supplier should have the same ethical and environmental practices as the organisation.
6. After retrenching the employees, the reputation of the organisation in the market place should be managed carefully.
7. The human resources department should engage the affected employees in a process of counselling.

When considering different options, you should always identify what the risks are to the business, the employees, society and the natural environment.

In the next section, we will examine how to do financial analyses for different advanced scenarios.

3. Advanced scenarios

In this module, we will cover decision-making in the following five advanced scenarios:

- special selling prices (special orders) relating to the **long term**
- product mix when capacity constraints exist
- replacement of equipment
- outsourcing (make or buy)
- discontinuation

We will now look at each scenario individually.

3.1 Special pricing decisions (setting prices)

In MAC2601, you were introduced to special pricing decisions (special orders) relating to the **short term**. In this study unit, we will look at special pricing decisions relating to the **long term**.

Revise what a special pricing decision is and how to determine whether it will be more profitable for the organisation to accept or decline the order in the **short term** by studying the following subsection in Drury up to "Evaluation of a longer-term order" now:

Chapter	Subsection
9	*Special pricing decisions*

You will notice that you can follow one of two approaches in your solution:

- **The comprehensive approach.** The total costs of each alternative are calculated. Both relevant and irrelevant revenues and costs are shown in different columns for each alternative.

- **The incremental approach.** Only relevant costs and revenues are shown, in other words, only revenues and costs that differ between the alternatives. Only one column of figures is presented.

Example 9.1 in your Drury textbook, 8th or 9th edition illustrates that both approaches will result in the same answer.

Notes:

① Please be careful, however, when answering questions. The question may require you to follow a specific approach.

② When including irrelevant costs in the comprehensive approach, be sure to include the same amount for all options considered. Otherwise, leave it out (for all options) as there is no difference in the cash inflow or outflow between the options.

③ We recommend the comprehensive approach, as students can easily get confused when following the incremental approach. If you want to follow the incremental approach, you must be very sure that you know which scenario forms the base to which all other options are compared.

At this stage, it becomes necessary for the organisation to consider what price they should determine for a special order. As special orders are once-off orders, we only need to cover the incremental costs of the special order. Any price obtained above these costs will contribute to the recovery of the fixed costs of the organisation. Now study the following subsections in Drury relating to these pricing decisions:

Chapter	Subsection
10	*A price-setting firm facing short-run pricing decisions*
10	*A price-taking firm facing short-run product mix decisions*

In the short term, the cash outflow relating to fixed costs cannot be altered, as it is already committed. Therefore, it is usually irrelevant for short-term decisions. However, an organisation may have more control over the cash outflow relating to fixed costs in the **long term**. For example, management can make decisions and take steps to reduce the infrastructure of the organisation, leading to a reduction in fixed costs. Thus, the relevant costs will differ from those calculated in the short term. In the long term, **any cost** that is subject to change may become relevant.

Now study the following subsection in Drury from "Evaluation of a longer-term order" relating to the long term and then attempt the activity below:

Chapter	Subsection
9	*Special pricing decisions*

Activity 10.4

The production manager of your organisation has approached you for some costing advice on project X, a one-off order from overseas that he intends to tender for. The costs associated with the project are as follows:

	R
Material A	4 000
Material B	8 000
Direct labour	6 000
Supervision	2 000
Overheads	12 000
	32 000

You ascertain the following:
(i) Material A is in stock and the above was the cost. There is now no other use for material A, other than the above project, within the factory and it would cost R1 750 to dispose of. Material B would have to be ordered at the cost shown above.

(ii) Direct labour costs of R6 000 relate to workers that will be transferred to this project from another project. Extra labour will need to be recruited to the other project at a cost of R7 000.

(iii) Supervision costs have been charged to the project on the basis of 33⅓% of labour costs and will be carried out by existing staff within their normal duties.

(iv) Overheads have been charged to the project at the rate of 200% on direct labour.

(v) The company is currently operating at a point above break-even.

(vi) The project will need the utilisation of machinery that will have no other use to the company after the project has finished. The machinery will have to be purchased at a cost of R10 000 and then disposed of for R5 250 at the end of the project.

The production manager tells you that the overseas customer is prepared to pay up to a maximum of R30 000 for the project, and a competitor is prepared to accept the order at that price. He also informs you the minimum that he can charge is R40 000 as the above costs show R32 000, and this does not take into consideration the cost of the machine and profit to be taken on the project.

REQUIRED:

a. Cost the project for the production manager, clearly stating how you have arrived at your figures, and giving reasons for the exclusion of other figures.

b. Write a report to the production manager stating whether the organisation should go ahead with the tender for the project, the reasons why and the price, bearing in mind that the competitor is prepared to undertake the project for R30 000.

   Note: The project should only be undertaken if it shows a profit.

c. State four non-monetary factors that should be taken into account before tendering for this project.

d. What would be your advice if you were told that the organisation was operating below break-even point? Give reasons for your advice.

[Source: Drury student manual, 8th edition, 2012: 9.4]

Solution to Activity 10.4

a. Relevant costs of the project:

	R
Material A ①	(1 750)
Material B ②	8 000
Direct labour ③	7 000
Net cost of machinery ④	4 750
Relevant costs	**18 000**
Contract price	30 000
Contribution	**12 000**

Notes:

① There is a saving of disposal costs of R1 750 if material A is used.

② The actual cost of material B represents the incremental cost.

③ The hiring of the labour on the other contract represents the additional cash flows of undertaking this contract.

④ The net cost of purchasing the machinery represents the additional cash flows associated with the contract.

⑤ Supervision and overheads will still continue even if the contract is not accepted, and are therefore irrelevant.

b. The report should indicate that the costs given in the question do not represent incremental cash flows arising from undertaking the contract. As the company is operating at an activity level in excess of break-even point, any sales revenue in excess of R18 000 incremental costs will provide an additional contribution which will result in an increase in profits. Assuming that the company has spare capacity, and that a competitor is prepared to accept the order at R30 000, then a tender price slightly below R30 000 would be appropriate.

c. Before accepting the contract the following non-monetary factors should be considered:

i. Is there sufficient spare capacity to undertake the project?
ii. Is the overseas customer credit worthy?
iii. Has the workforce the necessary skills to undertake the project?
iv. Is the contract likely to result in repeat business with the customer?

d. If the company were operating below the break-even point, acceptance of the order would provide a further contribution towards fixed costs and reduce the existing loss. In the short term it is better to accept the order and reduce the total loss but if, in the long run, there are not enough orders to generate sufficient contributions to cover total fixed costs, then the company will not survive.

[Source: Drury student manual, 8th edition, 2012: 9.4]

3.2 Product mix decisions when capacity constraints exist

Most organisations sell a range of products or deliver a range of services. This means that management should know which products or services are more profitable in order for them to channel their resources towards those products or services. In MAC2601, you learnt about limiting factors and how to allocate the available resources to production in order for the organisation to maximise its contribution.

You will recall that two conditions need to be satisfied for a resource to be considered as a limiting factor, namely

- the availability of that resource is limited (either because it is scarce or because of a physical constraint, such as machine capacity or storage space)
- the scarcity or constraint prevents the organisation from manufacturing (or buying, in the case of retailers) the full product range for which there is a demand in the market

You will recall the following matrix from MAC2601 that provides an approach to follow in situations with limiting factors:

<table>
<tr><td colspan="6">Establish sales demand (in units) of all products or services</td></tr>
<tr><td colspan="6">Establish extent of available resources (= feasible output)</td></tr>
<tr><td colspan="4">Feasible production output < demand</td><td colspan="2">Feasible production output > demand</td></tr>
<tr><td colspan="4">Establish which factor or resource is limiting the output.</td><td>Demand unlimited</td><td>Demand limited</td></tr>
<tr><td></td><td colspan="3">How extensive is the organisation's product range?</td><td>Only produce product with highest contribution per unit.</td><td>Produce products in descending order of contribution per unit.</td></tr>
<tr><td>Number of limitations</td><td>One product</td><td>Two products</td><td>Multiple products</td><td></td><td></td></tr>
<tr><td>One limitation</td><td>Limit output to resource supply.</td><td>Rank according to contribution per limiting factor.</td><td>Rank according to contribution per limiting factor.</td><td></td><td></td></tr>
<tr><td>More than one limitation</td><td>Limit output to resource with highest constraint.</td><td>① Linear programming:
- graphical approach
- simultaneous equations</td><td>② Simplex tableau</td><td></td><td></td></tr>
</table>

Figure 11.3.1 Matrix: methods for resource allocation with limiting factors
Source: MAC2601, 2012

Notes:

① Linear programming will be covered in study unit 11.

② The simplex tableau is not part of the undergraduate learning outcomes.

*****

Now study the following subsection in Drury and then attempt the activity below:

Chapter	Subsection
9	*Product mix decisions when capacity constraints exist*

Activity 10.5

Solve review problem 9.15 in your Drury textbook, 8th or 9th edition.

Solution to Activity 10.5

Find the solution to review problem 9.15 at the back of Drury textbook, 8th or 9th edition.

The test for limiting factors required in part (a) of this question can also be done as follows:

Product	Raw materials			Labour		
	Maximum demand (units)	**Kg per unit**	**Total number of kilograms required**	**Maximum demand (units)**	**Hours per unit**	**Total number of hours required**
X	4 000	5	20 000	4 000	12/12 = 1	4 000
Y	5 500	4	22 000	5 500	9/12 = 0,75	4 125
Z	7 000	6	42 000	7 000	18/12 = 1,5	10 500
Required			84 000			18 625
Available			90 000			18 000
Surplus/(Shortage)			**6 000**			**(625)**

Therefore, only labour is a limiting factor.

3.3 Decisions on replacement of equipment

When management is faced with a decision on whether to replace or keep existing equipment, the recorded value (carrying value) of the equipment is irrelevant. We are only interested in **future** cash flows.

Now study the following subsection in Drury and then attempt the activity below:

Chapter	Subsection
9	*Replacement of equipment - The irrelevance of past costs*

Activity 10.6

Mr Ndlovu is considering whether or not to purchase a high-speed meat-mincing machine in order to replace the current meat-mincing machine. You are provided with the following information regarding the two machines:

	Current meat mincer	**High-speed meat mincer**
Original cost price	R20 000	R30 000
Accumulated depreciation to date	R8 000	-
Current resale value	R7 500	-
Estimated variable operating costs per annum	R14 000	R7 000
Electricity and other fixed cash operating costs per annum	6 000	6 000
Remaining useful life	5 years	5 years

REQUIRED

Advise Mr Ndlovu whether or not to purchase the high-speed meat-mincing machine. You may assume that both machines will produce the same required kilograms of mince to be sold at similar prices.

Solution to Activity 10.6

	(1) Retain current mincer R	(2) Buy high-speed mincer R	(2) – (1) Difference in relevant costs/ (benefits) R
Variable operating costs: R14 000; R7 000 for 5 years	(70 000)	(35 000)	35 000
Fixed cash operating costs① R6 000 for 5 years	(30 000)	(30 000)	-
Book value of current mincer: R20 000 – R8 000 = R12 000 Lump sum write-off②	-	-	-
Resale value of old machine ③	(7 500)	-	7 500
Initial purchase price of new machine		(30 000)	(30 000)
Total cost	**(107 500)**	**(95 000)**	**12 500**

Recommendation

Based on the calculations above, Mr Ndlovu should purchase the high-speed mincer as this would lead to a R12 500 (⑤) saving in costs over the following five years.

Notes:

① All **future cash flows** are included. However, you could have opted to leave this out, as there is no difference between the alternatives for this cash-flow item. The latter is the correct interpretation of relevant costs. The above solution shows the two approaches (the total costs for each alternative OR only the relevant costs – last column). If the question is silent on the approach you should follow, both are acceptable, although we recommend the multiple column approach, as students tend to get confused when working with net figures only, especially when comparing outflows.

② **Accounting values** such as book value and depreciation is **always irrelevant,** as it does not represent a change in cash flow. We are only interested in future cash flows that differ between alternatives.

③ This is an **opportunity cost** as the proceeds of selling the current machine is foregone in order to keep operating it. Opportunity costs are always relevant as they represent foregone cash inflows (in effect the same as an outflow).

④ The sales values (should they have been given) would not have been relevant as there is no difference in the inflows for the two alternatives. They could be left out. See also note①.

⑤ This is a rough calculation. A more accurate calculation would have involved incorporating the time value of money in respect of the operating cash flows for years one to five as you learnt in MAC2602 (capital budgeting).

*****

3.4 Outsourcing (make or buy decisions)

In some instances, management have to decide whether to continue to manufacture a part internally or to purchase it from an external supplier. This decision is known as an **outsourcing/make or buy decision.**

Now study the following subsection in Drury and then attempt the activity below:

Chapter	Subsection
9	*Outsourcing and make or buy decisions*

Activity 10.7

The management of Springer Plc is considering next year's production and purchase budgets. One of the components produced by the company, which is incorporated into another product before being sold, has a budgeted manufacturing cost as follows:

	R
Direct material	14
Direct labour (4 hours at R12 per hour)	48
Variable overhead (4 hours at R2 per hour)	8
Fixed overhead (4 hours at R5 per hour)	20
Total cost	**90 per unit**

Trigger Plc has offered to supply the above component at a guaranteed price of R86 per unit.

REQUIRED:

a. Considering cost criteria only, advise management whether the above component should be purchased from Trigger Plc. Any calculations should be shown and assumptions made, or aspects which may require further investigation should be clearly stated

b. Explain how your advice would be affected by each of the two *separate* situations shown below:

i. As a result of recent government legislation if Springer Plc continues to manufacture this component, the company will incur additional inspection and testing expenses of R56 000 per annum, which are not included in the above budgeted manufacturing costs.

ii. Additional labour cannot be recruited, and if the above component is not manufactured by Springer Plc the direct labour released will be employed in increasing the production of an existing product which is sold for R90, and which has a budgeted manufacturing cost as follows:

	R
Direct material	10
Direct labour (8 hours at R12 per hour)	96
Variable overhead (8 hours at R2 per hour)	16
Fixed overhead (8 hours at R5 per hour)	40
Total cost	**162 per unit**

All calculations should be shown.

c. The production director of Springer Plc recently said:

'We must continue to manufacture the component as only one year ago we purchased some special grinding equipment to be used exclusively by this component. The equipment cost R100 000, it cannot be resold or used elsewhere and if we cease production of this component we will have to write off the written down book value which is R80 000'.

Draft a brief reply to the production director commenting on his statement.

[Source: Drury student manual, 8th edition, 2012: 9.5]

Solution to Activity 10.7

a.	**R**
Purchase price of component from supplier	86
Additional cost of manufacturing (variable cost only)	70
Saving if component is manufactured	**16**

The component should be manufactured provided the following assumptions are correct:

i. Direct labour represents the *additional* labour cost of producing the component.

ii. The company will not incur any additional fixed overheads if the component is manufactured.

iii. There are no scarce resources. Therefore, the manufacture of the component will not restrict the production of other more profitable products.

b. Advice on the two *separate* situations:

i. Additional fixed costs of R56 000 will be incurred, but there will be a saving in purchasing costs of R16 per unit produced. The break-even point is 3 500 units (fixed costs of R56 000/ R16 per unit saving). If the quantity of components manufactured per year is less than 3 500 units, then it will be cheaper to purchase from the outside supplier.

ii. The contribution per unit sold from the existing product is R40 and each unit produced uses eight scarce labour hours. The contribution per labour hour is R5. Therefore, if the component is manufactured, four scarce labour hours will be used, resulting in a lost contribution of R20. Hence the relevant cost of manufacturing the components is R90, consisting of R70 incremental cost plus a lost contribution of R20. The component should be purchased from the supplier.

c. The book value of the equipment is a sunk cost, and is not relevant to the decision whether the company should purchase or continue to manufacture the components. If we cease production now, the written-down value will be written off in a lump sum, whereas if we continue production, the written-down value will be written off over a period of years. Future cash outflows on the equipment will not be affected by the decision to purchase, or continue to manufacture the components. For an illustration of the irrelevance of the written down value of assets for decision-making purposes see '*Replacement of equipment – the irrelevance of past cost'* in Chapter 13.

[Source: Drury student manual, 8th edition, 2012: 9.5]

Notes:

① In these decisions, it is particularly important that the organisation considers both the relevant costs and the **qualitative factors** relating to the decision. (See point 2 above as well as the subsection "Importance of qualitative/non-financial factors" in Drury.)

② Sometimes the inverse decision needs to be made: should we rather manufacture the item ourselves than buy it from an outside supplier? The principles of incremental cash flows still apply.

③ When the make or buy decision is made in a divisionalised company, the transfer price will play a very important role in the buying division's decision on whether to buy externally or internally from another division. You will learn more about this in study unit 12.

④ The principles of make or buy are also applicable to the decision whether or not to process joint products further or to sell them at the split-off point. As long as the incremental cash proceeds from further processing exceed the incremental cash costs of further processing, the organisation should decide to process further and not sell at the split-off point. Please refer to study unit 5.

*****

3.5 Discontinuation decisions

A market segment in an organisation may consist of a product, product range, division, geographical area etc. In quantitative terms, we should consider a market segment that does not render a sufficient return on capital and is unable to become more profitable for discontinuation. We should also consider a market segment for discontinuation in the case of changes in technology or changes to the long-term goals of the organisation.

Now study the following subsection in Drury and then attempt the activities below:

Chapter	Subsection
9	*Discontinuation decisions*
10	*A price-taking firm facing long-run product mix decisions*

Activity 10.8

Answer the two questions posed in Real World Views 9.4 in your Drury textbook, 8th or 9th edition.

Solution to Activity 10.8

Find the solution to Real World Views 9.4 online via your CourseMate account.

Activity 10.9

Blackarm Ltd makes three products and is reviewing the profitability of its product line. You are given the following budgeted data about the firm for the coming year.

Product	**A**	**B**	**C**
Sales (in units)	**100 000**	**120 000**	**80 000**
	R	**R**	**R**
Revenue	1 500 000	1 440 000	880 000
Costs:			
Material	500 000	480 000	240 000
Labour	400 000	320 000	160 000
Overhead	650 000	600 000	360 000
	1 550 000	1 400 000	760 000
Profit/(Loss)	**(50 000)**	**40 000**	**120 000**

The company is concerned about the loss on product A. It is considering ceasing production of it and switching the spare capacity of 100 000 units to product C.

You are told:

i. All production is sold.
ii. 25% of the labour cost for each product is fixed in nature.

iii. Fixed administration overheads of R900 000 in total have been apportioned to each product on the basis of units sold and are included in the overhead costs above. All other overhead costs are variable in nature.

iv. Ceasing production of product A would eliminate the fixed labour charge associated with it and one-sixth of the fixed administration overhead apportioned to product A.

v. Increasing the production of product C by 100 000 units would mean that the fixed labour cost associated with product C would double, the variable labour cost would rise by 20% and its selling price would have to be decreased by R1.50 in order to achieve increased sales.

REQUIRED

a. Prepare a marginal cost statement for a unit of each product on the basis of:
   i. the original budget;
   ii. if product A is deleted.

b. Prepare a statement showing the total contribution and profit for each product group on the basis of:
   i. the original budget;
   ii. if product A is deleted.

c. Using your results from (a) and (b) advise whether product A should be deleted from the product range, giving reasons for your decision.

[Source: Drury student manual, 8th edition, 2012: 9.6]

Solution to Activity 10.9

a.

i. Product	**A**	**B**	**C**
	R	**R**	**R**
Selling price	15	12	11
Less variable cost:			
Material	(5)	(4)	(3)
Labour	(3)	(2)	(1,5)
Variable overhead ①	(3,5)	(2)	(1,5)
Contribution	3,5	4	5

Note:

① Fixed overheads are apportioned to products on the basis of sales volume and the remaining overheads are variable with output.

ii. Product	**B**	**C**
	R	**R**
Selling price	12	9,50
Less variable cost:		
Material	(4)	(3)
Labour	(2)	(1,80)
Variable overhead ①	(2)	(1,50)
Contribution	4	3,2

b.

i. Product	**A**	**B**	**C**	**Total**
Total contribution [a]	350 000	480 000	400 000	1 230 000
Less fixed costs:				
Labour				(220 000)
Fixed administration				(900 000)
Profit				110 000

ii. Product	**B**	**C**	**Total**
Total contribution [a]	480 000	576 000	1 056 000
Less fixed costs:			
Labour [b]			(160 000)
Fixed administration [c]			(850 000)
Profit			46 000

Notes:

a. product B = 120 000 units x R4 contribution

product C = 18 000 units x R3,2 contribution

b. (25% x R320 000 for B) plus (25% x R160 000 x 2 for C)

c. Fixed administration costs will decline by 1/6 of the amount apportioned to product A (100/300 x R900 000). Fixed overheads will decline from R900 000 to R850 000.

c. Product A should not be eliminated even though a loss is reported for this product. If Product A is eliminated the majority of fixed cost allocated to it will still continue and will be borne by the remaining products. Product A generates a contribution of R350 000 towards fixed cost but the capacity released can be used to obtain an additional contribution from product C of R176 000 (R576 000 - R400 000). This will result in a net loss in contribution of R174 000. However, fixed cost savings of R110 000 (R50 000 administration apportioned to product A plus R100 000 labour for A less an extra R40 000 labour for product C) can be obtained if product A is abandoned. Therefore there will be a net loss in contribution of R64 000 (R174 000 - R110 000) and profits will decline from R110 000 to R64 000.

[Source: Drury student manual, 8th edition, 2012: 9.6]

Notes:

① We cannot over emphasise the **role of fixed costs** in this decision. You should know how much fixed costs will be eliminated at each level in the organisation if the product or product range is discontinued. If the product or product range still makes a contribution towards joint costs at the next level, discontinuation should not proceed.

② From a marketing perspective, we should also consider those customers that buy a **basket of products** from us. Customers might decide to switch their whole basket of products to the competition resulting in further losses in contribution from remaining products.

*****

4. Summary

In this study unit you learnt to

- make preliminary recommendations supported by appropriate calculations based on the following advanced scenarios:
  - special pricing (special orders)
  - product mix when capacity constraints exist
  - replacement of equipment
  - outsourcing (make or buy)
  - discontinuation of products or product lines
- discuss qualitative issues for each decision including, but not limited to, environmental, social and governance aspects

In the next study unit you will learn how to optimise output decisions in situations where two products are produced with the help of linear programming principles.

5. Self-assessment theory review questions

After working through the relevant sections in Drury and this study unit, you should now be able to answer review questions 9.1 to 9.12 in your Drury textbook, 8th or 9th edition covering the theory at the end of chapter 9.

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

6. Online enrichment activity

Complete the online activities for chapter 9 relating to the specified learning outcomes.

7. Self-assessment questions

Note:
Since students often struggle with relevant costing, we have added additional self-assessment questions at the end of this study unit. Remember, the more you practice, the better you will become.

*****

Remember: the objective is to increase net cash inflows or decrease net cash outflows.

QUESTION 10.1

Solve review problem 9.16 in your Drury textbook, 8th or 9th edition.

SOLUTION TO QUESTION 10.1

Find the solution to review problem 9.16 at the back of your Drury textbook, 8th or 9th edition. This should be read with "Determining the relevant costs of direct labour" in Drury (covered in MAC2601).

QUESTION 10.2

Solve review problem 9.17 in your Drury textbook, 8th or 9th edition.

SOLUTION TO QUESTION 10.2

Find the solution to review problem 9.17 at the back of your Drury textbook, 8th or 9th edition. This should be read with "Determining the relevant costs of direct materials" in Drury (covered in MAC2601).

QUESTION 10.3

Solve review problem 9.18 in your Drury textbook, 8th or 9th edition.

SOLUTION TO QUESTION 10.3

Find the solution to review problem 9.18 at the back of your Drury textbook, 8th or 9th edition.

Alternatively, the total relevant skilled labour cost of the contract can be calculated as follows:

	R
Hourly wage rate (90 hours x R8 per hour)	720
Lost contribution	
R20 ÷ 8 = 2,5 hours per unit	
90 hours ÷ 2,5 = 36 units can be produced in 90 hours	
36 x R25 lost contribution =	900
	1 620

QUESTION 10.4

Solve review problem 9.19 in your Drury textbook, 8th or 9th edition.

SOLUTION TO QUESTION 10.4

Find the solution to review problem 9.19 at the back of your Drury textbook, 8th or 9th edition.

QUESTION 10.5

WZ is a manufacturing company with two factories. The company's West factory currently produces a number of products. Four of these products use differing quantities of the same resources. Details of these four products and their resource requirements are as follows:

Product	**J**	**K**	**L**	**M**
	R/unit	**R/unit**	**R/unit**	**R/unit**
Selling price	56	40	78	96
Direct labour (R8 per hour)	20	16	24	20
Direct material A (R3 per litre)	6	3	0	9
Direct material B (R5 per kg)	10	0	15	20
Variable O/H (see ①)				
Labour related	1,25	1	1,50	1,25
Machine related	1,25	2	0,75	1
Total variable cost	38,50	22	41,25	51,25
Other data:				
Machine hours per unit	5	8	3	4
Maximum demand per week	1 000	3 500	2 800	4 500

Notes:

1. An analyses of the variable overhead shows that some of it is caused by the number of labour hours and the remainder is caused by the number of machine hours.

2. Currently WZ purchases a component P from an external supplier for R35 per component. A single unit of this component is used in producing N, the company's only other product. Product N is produced in WZ's other factory and does not use any of the resources identified above. Product N currently yields a positive contribution. WZ could manufacture the component in its West factory, but to do so would require: 1 hour of direct labour, 0,5 machine hours, and 2kgs of direct material B. WZ purchases 500 components per week. WZ could not produce the component in its other factory.

3. The purchasing director has recently advised you that the availability of direct material A and B is to be restricted to 21 000 litres and 24 000 kgs per week respectively. This restriction is unlikely to change for at least 10 weeks. No restrictions are expected on any other resources.

4. WZ does not hold inventory of either finished goods or raw materials.

5. WZ has already signed a contract, which must be fulfilled, to deliver the following units of its products each week for the next 10 weeks:

Product	**Contract**
J	100
K	200
L	150
M	250

These quantities are in addition to the maximum demand identified above.

REQUIRED

a. Calculate whether WZ should continue to purchase the component P or whether it should manufacture it internally during the next 10 weeks.

b. Prepare a statement to show the optimum weekly usage of the West factory's available resources.

Note: you are NOT required to use linear programming
(i) Assuming no other changes, calculate the purchase price of the component P at which your advice in part (a) would change.

(ii) Explain two non-financial factors that should be considered before deciding whether or not to manufacture the component internally.

c. If you were to solve part (b) above using linear programming state the following:

- Objective function
- The inequality for the material A constraint
- The inequality for the material B constraint

[Source: Drury textbook, 8th edition, 2012: 9.23]

SOLUTION TO QUESTION 10.5

a. If all of the resources required to produce component P are readily available the relevant costs will be as follows:

	R/unit
Direct labour hour (1 hour @ R8/hour)	8,00
Direct material B (2kgs @ R5/kg)	10,00
Variable overhead ①:	
Direct labour (1 hour@ R0,50/hour)	0,50
Machine hours(0,5 hours @R0,25/hour)	0,125
	18,625

①: Product J requires 2,5 labour hours (R20/R8) so the labour related variable overhead rate is R0,50 per hour (R1,25/2,5 hours). Product J also requires 1,5 machine hours giving a machine related variable overhead rate of R0,25 per hour (R1,25/5 machine hours).

Assuming that all of the above resources are readily available the relevant cost of producing component P is less than the purchase price so the component should be produced internally. However, both materials A and B will be in scarce supply over the next 10 weeks so it is necessary to examine how this will influence the optimum production programme of WZ.

The following schedule compares the kg required to meet the planned production programme compared with availability of materials:

Resource	**Available**	**Total**	**J**	**K**	**L**	**M**	**P**
Direct material A	21 000	20 150	2 200	3 700	0	14 250	0
Direct material B	24 000	31 050	2 200	0	8 850	19 000	1 000

Note that the above schedule is based on the maximum weekly demand plus existing contractual commitments. Material B is binding constraint so the optimal production programme should be determined based on the ranking per unit of limiting factor (kg of material B).

	J	L	M	P
	R	**R**	**R**	**R**
Selling price/buying cost	56	78	96	35
Direct labour	20	24	20	8
Material A	6	0	9	0
Material B	10	15	20	10
Overhead:				
Labour	1,25	1,50	1,25	0,50
Machinery	1,25	0,75	1	0,125
Contribution	**17,50**	**36,75**	**44,75**	**16,375**
Contribution/ kg of material B	8,75	12,25	11,19	8,19
Rank	**3**	**1**	**2**	**4**

Note that product K is not included in the above ranking because it does not use material B. Therefore product K can be produced to meet maximum demand. Since the component is the lowest ranked usage of material B then WZ should continue to purchase the component so that the available resources can be used to manufacture products, L, M and J.

b. The allocation of scarce resources is as follows:

Production		**Kg used**	**Balance of Kg unused**
Contractual commitment for:	J	200	
	L	450	
	M	1 000	22 350
Maximum production of L (2800 units)		8 400	13 950
Balance to M (3 487,5 units)		22 350	----

c. (i) For component P to be produced internally it will be necessary to reduce production of M, which currently yields a contribution of R11,19 per kg. To justify production of component P the purchase price will have to exceed the variable cost of R18,1625 plus the opportunity costs of scarce resources (2kg at R11,19 per kg) giving a purchase cost of R41. In other words, if you refer to the ranking of the scarce materials shown in part (b) the purchase price of P would have to be R41 to yield the same contribution per scarce factor of M.

(ii) Other factors to be considered include:

- The quality of the component produced internally compared with external supplies;
- The ability to resume supplies with the supplier when the constraint no longer applies.

d. Objective function: Maximise C = 17,5J + 36,75L + 44,75M subject to:

2J +1K + 0L + 3M < 21 000 (Material A constraint)

2J + 0K + 3L + 4M < 24 000 (Material B constraint)

[Source: Drury textbook, 8th edition, 2012: 9.23]

QUESTION 10.6

A market gardener is planning his production for next season, and has asked you as a cost accountant, to recommend the optimal mix of vegetable production for the coming year. He has given you the following data relating to the current year:

Products	**Potatoes**	**Turnips**	**Parsnips**	**Carrots**
Area occupied (acres)	25	20	30	25
Yield per acre (tonnes)	10	8	9	12
Selling price per tonne (R)	100	125	150	135
Variable cost per acre (R):				
Fertilisers	30	25	45	40
Seeds	15	20	30	25
Pesticides	25	15	20	25
Direct wages	400	450	500	570

Fixed overhead per annum is R54 000

The land that is being used for the production of carrots and parsnips can be used for either crop, but not for potatoes or turnips. The land being used for potatoes and turnips can be used for either crop, but not for carrots or parsnips. In order to provide an adequate market service, the gardener must produce each year at least 40 tonnes each of potatoes and turnips and 36 tonnes each of parsnips and carrots.

a. You are required to present a statement to show:

i. the profit for the current year;

ii. the profit for the production mix that you would recommend.

b. Assuming that the land could be cultivated in such a way that any of the above crops could be produced and there was no market commitment, you are required to:

i. advise the market gardener on which crop he should concentrate his production;

ii. calculate the profit if he were to do so;

iii. calculate in rands the break-even point of sales

[Source: Drury textbook, 8th edition, 2012: 9.24]

SOLUTION TO QUESTION 10.6

a. Preliminary calculations

Variable costs are quoted per acre, but selling prices are quoted per tonne. Therefore, it is necessary to calculate the planned sales revenue per acre. The calculation of the selling price and contribution per acre is as follows:

Products	**Potatoes**	**Turnips**	**Parsnips**	**Carrots**
Yield per acre (tonnes)	10	8	9	12
Selling price per tonne (R)	100	125	150	135
Sales revenue per acre	**1 000**	**1 000**	**1 350**	**1 620**
Variable cost per acre (R):	470	510	595	660
Contribution per acre(R)	**530**	**490**	**755**	**960**

(i) Profit statement for the year

Products	**Potatoes**	**Turnips**	**Parsnips**	**Carrots**	**Total**
Acres	25	20	30	25	
Contribution per acre(R)	530	490	755	960	
Total contribution (R)	**13 250**	**9 800**	**22 650**	**24 000**	**69 700**
Less: fixed overheads					54 000
Profit					**15 700**

(ii) Profit statement for recommended mix

	Area A (45 acres)		Area B (55 acres)		
Products	**Potatoes**	**Turnips**	**Parsnips**	**Carrots**	**Total**
Contribution per acre(R)	530	490	755	960	
Ranking	1	2	2	1	
Minimum sales requirements in acres ①		5	4		
Acres allocated ②	40			51	
Recommended mix (acres)	40	5	4	51	
Total contribution (R)	**21 200**	**2 450**	**3 020**	**48 960**	**75 630**
Less: fixed overheads					54 000
Profit					**21 630**

① The minimum sales requirement for turnips is 40 tonnes, and this will require the allocation of 5 acres (40 tonnes/ 8 tonnes yield per acre). The minimum sales requirement for parsnips is 36 tonnes, requiring the allocation of 4 acres (36 tonnes/ 9 tonnes yield per acre).

② Allocation of available acres to products on basis of a ranking that assumes that acres are the key factor.

b. (i) Production should be concentrated on carrots, which have the highest contribution per acre (R960).

(ii)

	R
Contribution from 100 acres of carrots (100 X R960)	96 000
Less: Fixed overhead	54 000
Profit from carrots	**42 000**

(iii) Break-even point in acres for carrots

$$\text{Formulae} = \frac{\text{Fixed costs}}{\text{Contribution per acre}}$$

$$= \frac{R54\ 000}{R960}$$

$$= 56{,}25 \text{ acres}$$

Contribution in sales value for carrots = R91 125 (56,25 acres at R1 620 sales revenue per acre). **[Source: Drury textbook, 8th edition, 2012: 9.24]**

QUESTION 10.7

Answer question 9.7 in the Drury student manual, 8th edition or question 9.8 in the 9th edition.

SOLUTION TO QUESTION 10.7

Find the solution to question 9.7 at the back of the Drury student manual, 8th edition or question 9.8 in the 9th edition.

STUDY UNIT 11 BASIC LINEAR PROGRAMMING

1. Introduction

In study unit 10, you learnt how to apply relevant costing principles to determine the optimum production programme/scheduling when there was only **one** scarce resource or limiting factor. In this study unit, we will introduce you to linear programming, which is a mathematical technique you can use to determine the optimum production programme when there are **more than one** scarce resource or limiting factor.

This study unit is based on **selected sections** from chapter 25 in your prescribed Drury textbook.

2. Determining the optimum production programme when more than one scarce resource or limiting factor exist

In instances where more than one scarce resource exist, linear programming techniques can be applied to determine the optimum production programme. In this module, we will be dealing only with situations where **two** products are produced.

Where more than two products are produced, we can also determine the optimum production programme using the simplex tableau. SAICA does not prescribe this method.

Now study the following subsections in Drury and then attempt the activities below:

Chapter	Subsection
25	*Linear programming*
25	*Graphical method (up to the end of the simultaneous equations)*

To summarise, when formulating the linear programming model, you need to include

- the objective function
- an equation for each constraint (e.g. material, labour hours, machining time available)
- maximum and minimum sales limitations

Note:

We must regard sales limitations as a constraint, since it serves no purpose for an organisation to produce goods for which there is no market.

*****

Activity 11.1

a. A company uses linear programming to establish an optimal production plan in order to maximize profit. The company finds that the next year materials and labour are likely to be in short supply.

Details of the company's products are as follows:

	A	**B**
	R	**R**
Materials (at R2 per kg)	6	8
Labour (at R12 per hour)	60	36
Variable overheads (at R1 per hour)	5	3
Variable cost	71	47
Selling price	80	70
Contribution	9	23

There are only 30 000kg of material and 36 000 labour hours available. The company also has an agreement to supply 1 000 units of product A which must be met.

REQUIRED

a. Formulate the objective function and constraint equations for this problem.

b. Plot the constraints on a suitable graph and determine the optimal production plan.

[Source: Drury student manual, 8th edition, 2012: 25.1]

c. Solve review problem 25.10 in Drury textbook, 8th or 9th edition.

Note:

The questions above differ from each other in that the objective in question a. is to **maximise profit**, while in question c. it is to **minimise costs**.

When **minimising costs**, you should look for the points in the feasible region **closest** to the origin. When **maximising profit,** you should look for the point **furthest** away from that origin that the contribution line touches.

Solution to Activity 11.1

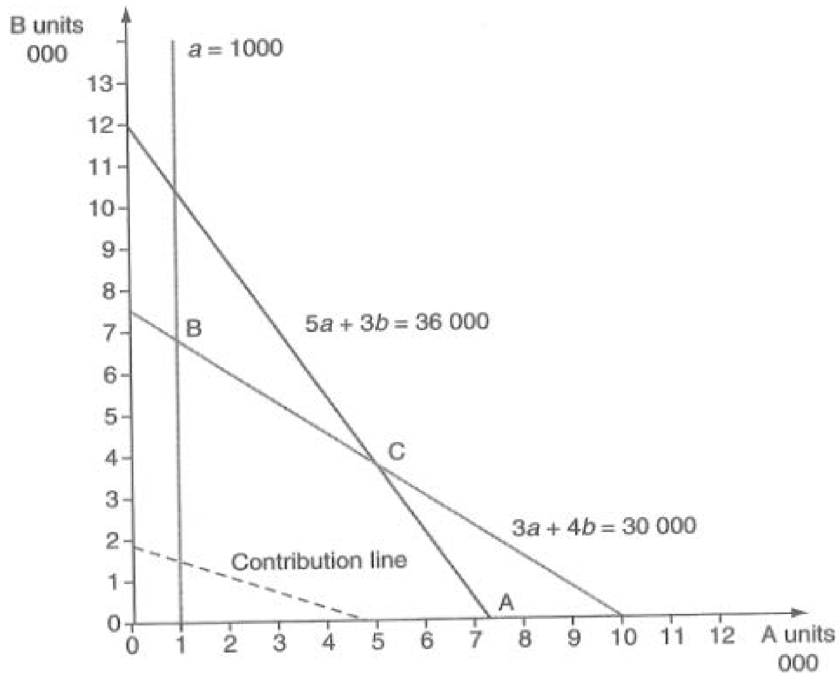
a. Objective is to maximise profit:

Let *a* = the number of units of A to be produced.

Let *b* = the number of units of B to be produced.

Objective function:	9a + 23b
Constraints:	
Non-negativity	b ≥ 0
Minimum requirement of A	a ≥ 1 000
Materials	3a + 4b ≤ 30 000
Labour	5a + 3b ≤ 36 000

b.



[Source: Drury student manual, 8th edition, 2012: 25.1]

c. Find the solution to review problem 25.10 at the back of Drury textbook, 8th or 9th edition.

Additional guidance on completing the graph

Based on question 25.1 (b)

To plot the constraints on a graph, we need to calculate the intersection on the x and the y-axes. We do this by assuming that each available resource is used solely for the one product.

(The output for the other product is nil.) It is useful to draw a table indicating these intersections. Then draw a straight line connecting the intersection on the x and the y-axes.

	Y-axis	X-axis
	B (let A=0)	**A (let B=0)**
Material ①	7 500	10 000
Labour ②	12 000	7 200
Sales		1 000
Contribution line ③	1 800	4 600
Or ④	4 000	10 222

① $3A + 4B \leq 30\ 000$

When A = 0, B = 7 500, and when B = 0, A = 10 000

② $5A + 3B \leq 36\ 000$

When A = 0, B = 12 000, and when B = 0, A = 7 200

③ As mentioned in the solution where we had to determine the contribution line, we randomly select a total contribution, which is R41 400 in this instance.

Therefore $9A + 23B = R41\ 400$

When A = 0, B = 1 800, and when B = 0, A = 4 600

④ If it is difficult for you to guess a random contribution, you may follow this alternative approach: Look at your graph (or the intersection table) and select a number of units for one of the products that are **lower than all of the resource intersections**. For example, suppose the resource intersections on the y-axis for product B are 7 500 and 12 000 units respectively. If we randomly select to produce only 4 000 units of product B, the total contribution will be 4 000 x R23 = R92 000. To achieve the same total contribution by only selling product A, we will need to sell R92 000 ÷ R9 = 10 222 units of A.

Therefore $9A + 23B = R92\ 000$

When A = 0, B = 4 000, and when B = 0, A = 10 222

⑤ Did you notice that the incline or gradient for the contribution line is the same for both levels of contribution in ③ and ④, namely 1:2,5555 (product B:product A)? This ratio is the same as the contribution of A:B. The contribution line (or variable cost line) will be moved further away from (maximising contribution) or closer to the intersection (minimising variable costs) of the x and y-axes within the feasible production area.

Using simultaneous equations to determine the optimum production output

It may be difficult to determine the exact number of units to produce by merely looking at the graph, unless you used finely marked graph paper. Then it may be a good idea to use simultaneous equations.

The contribution line has indicated that the optimum output will be at the intersection of the materials line and the minimum sales line of product A, which is named **point B**. Using simultaneous equations, we solve product A and B at point B as follows:

3A	+ 4B	= 30 000	①
A		= 1 000	②
3A		= 3 000	③ (② x 3)
	4B	= 27 000	④ (① - ③)
	B	= 6 750	

Therefore, we must produce 1 000 units of A and 6 750 units of B in order to maximise profit. You could also have substituted the value of A into equation ①.

Total contribution	= R9 (1 000) + R23 (6 750)
	= R9 000 + R155 250
	= R164 250

Note:

The feasible production output area is **BCA**. You can check your answer algebraically by calculating the total contribution at each of the other two corners of the feasible area. Firstly, we calculate the total contribution where the other two constraint lines intersect at **point C**.

5A	+ 3B	= 36 000	①
3A	+ 4B	= 30 000	②
15A	+ 9B	= 108 000	③ (① x 3)
15A	+ 20B	= 150 000	④ (② x 5)
	11 B	= 42 000	④ - ③
	B	= 3 818,18	
		≈ 3 818	

Substitute B = 3 818 into ①

5A	+ 3 (3 818)	= 36 000
5A	+ 11 454	= 36 000
A		= 4 909,20
		≈ 4 909

Total contribution	= R9 (4 909) + R23 (3 818)
	= R44 181 + R87 814
	= R131 995

Lastly, calculate the contribution generated at **point A**, where the labour constraint intersects with the x-axis. From the intersection table, you read this off as 7 200 units of product A (and zero units of product B, as it lies on the x-axis). Therefore, 7 200 x R9 = R64 800.

To summarise:

Point	**Contribution R**		**Output of A**	**Output of B**
A	64 800		7 200	-
C	131 995		4 909	3 818
B	**164 250**	**(highest)**	1 000	6 750

Note:

If the company had not entered into an agreement to supply at least 1 000 units of product A, it could have improved its contribution even more by manufacturing only product B. The output is determined where the material constraint line intersects the y-axis. Reading off the intersection table, we see that this is 7 500 units of product B generating a contribution of 7 500 x R23 = R172 500.

*****

Did you notice that you can determine the optimum production output level without using graph paper by means of simultaneous equations? However, using graph paper is more time efficient, as one can visually determine which of the intersections of the feasible area will generate the highest contribution (or involve the lowest cost) and then solve only that particular intersection.

3. Situations where it is possible to acquire additional resources (shadow prices)

Sometimes it is possible to acquire additional scarce resources at a higher price than that which is normally paid. In such instances, managers need to determine whether the increase in contribution makes it worthwhile acquiring these additional resources.

Now study the following subsections in Drury (from the end of the simultaneous equations) and then attempt the activity below:

Chapter	Subsection
25	*Graphical method*

Activity 11.2

Brass Ltd produces two products, the Masso and the Russo. Budgeted data relating to these products on a unit basis for August are as follows:

	Masso	**Russo**
	R	**R**
Selling price	150	100
Materials	80	30
Salesmen's commission	30	20

Each unit of product incurs costs of machining and assembly. The total capacity available in August is budgeted to be 700 hours of machining and 1 000 hours of assembly, the cost of this capacity being fixed at R7 000 and R10 000 respectively for the month, whatever the level of usage made of it. The number of hours required in each of these departments to complete one unit of output is as follows:

	Masso	**Russo**
Machining	1,0	2,0
Assembly	2,5	2,0

Under the terms of special controls recently introduced by the government in accordance with EEC requirements, selling prices are fixed and the maximum permitted output of either product in August is 400 units (i.e. Brass Ltd may produce a maximum of 800 units of product). At the present controlled selling prices the demand for the products exceeds this considerably.

REQUIRED

a. Calculate Brass Ltd's optimal production plan for August, and the profit earned.

b. Calculate the value to Brass Ltd of an independent marginal increase in the available capacity for each of machining and assembly, assuming that the capacity of the other department is not altered and the output maxima continue to apply.

c. State the principal assumptions underlying your calculations in (a) above, and to assess their general significance.

[Source: Drury textbook 8th edition, 2012: 25.11]

Solution to Activity 11.2

a. Let *M* = number of units of Masso produced and sold.
   Let *R* = number of units of Russo produced and sold.

   The linear programming model is as follows:

   Maximise Z = 40M + 50R (production contributions) subject to:

M + 2R	≤	700	(machining capacity)
2,5M + 2R	≤	1 000	(assembly capacity)
M	≤	400	(maximum output of Masso constraint)
R	≤	400	(maximum output of Russo constraint)
M	≥	0	
R	≥	0	

The constraints are plotted on the graph as follows:

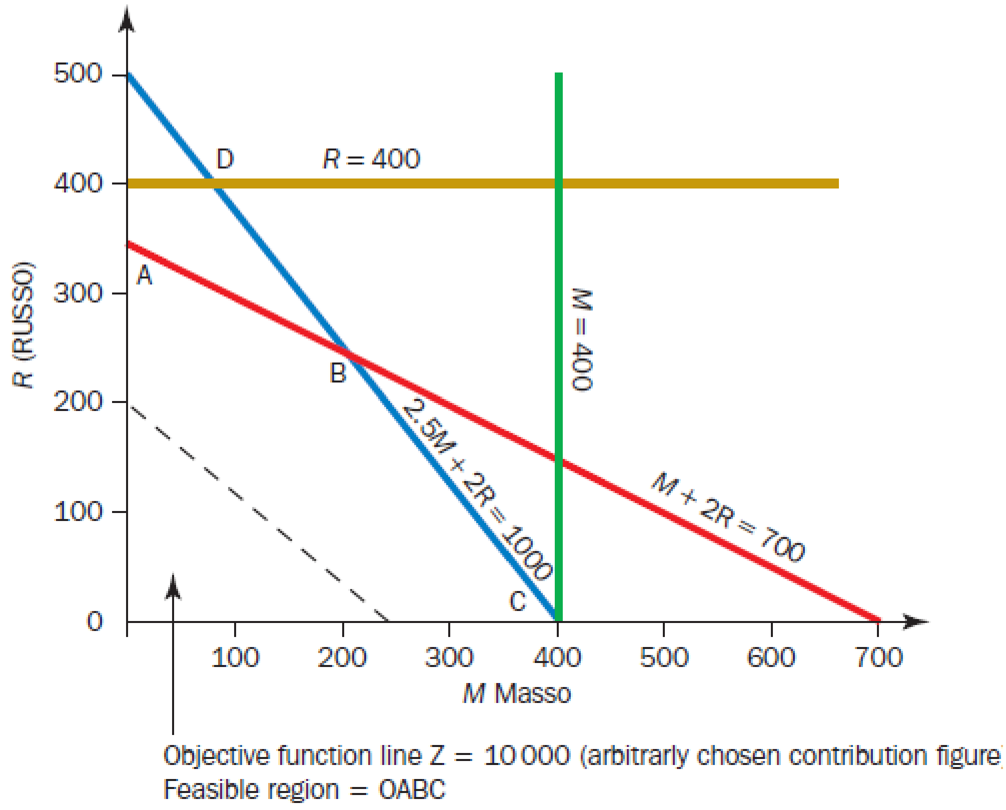
Machining constraint: line from (M = 700, R = 0) to (R = 350, M = 0)
Assembly constraint: line from (M = 400, R = 0) to (R = 500, M = 0)
Output of Masso constraint: line from M = 400
Output of Russo constraint: line from R = 400

At the optimum point (B in the graph) the output mix is as follows:

		R
200 units of Masso at a contribution of R40 per unit	=	8 000
250 units of Russo at a contribution of R50 per unit	=	12 500
Total contribution		20 500
Less: fixed costs		17 000
Profit		3 500

The optimum output can be determined exactly by solving the simultaneous equations for the constraints that intersect at point B:

2,5M + 2R	=	1 000	(1)
M + 2R	=	700	(2)



Subtract equation (2) from equation (1)
1,5M = 300
M = 200

Substituting in equation (1)
2,5 X 200 + 2R = 1 000
R = 250

b. <u>Machining capacity</u>

If we obtain additional machine hours, the line $M + 2R = 700$ will shift upward. Therefore the revised optimum point will fall on the line *BD*. If one extra machine hour is obtained, the constraints $M + 2R = 700$ and $2,5M + 2R$ will still be binding and the new optimal plan can be determined by solving the following equations:

$M + 2R = 701$ (revised machining constraint)

$2,5M + 2R = 1\ 000$ (unchanged assembly constraint)

The values for M and R when the above equations are solved are $M = 199,33$ and $R = 250,83$.

Therefore Russo is increased by 0,83 units and Masso is reduced by 0,67 units and the change in contribution will be as follows:

R

Increase in contribution from Russo (0,83 X R50)	=	41,50
Decrease in contribution from Masso (0,67 X R40)	=	(26,80)
Increase in contribution	**=**	**14,70**

Hence the value of an independent marginal increase in machine capacity is R14,70 per hour.

Assembly capacity

With an additional hour of assembly capacity, the new optimal plan will be given by the solution of the following equations:

$M + 2R = 700$ (unchanged machining constraint)

$2{,}5M + 2R = 1\ 001$ (revised assembly constraint)

The values for M and R when the above equations are solved are $M = 200{,}67$ and $R = 249{,}67$. Therefore Masso is increased by 0,67 units and Russo is decreased by 0,33 units, and the change in contribution will be as follows:

		R
Increase in contribution from Masso (0,67 X R40)	=	26,80
Decrease in contribution from Russo (0,33 X R50)	=	(16,50)
Increase in contribution	**=**	**10,30**

Hence the value of an independent marginal increase in assembly capacity is R10,30 per hour.

c. The assumptions underlying the above calculations are:

i. linearity over the whole output range for costs, revenues and quantity of resources used;

ii. divisibility of products (it is assumed that products can be produced in fractions of units);

iii. divisibility of resources (supplies of resources may only be available in specified multiples);

iv. the objectives of the firm (it is assumed that the single objective of a firm is to maximize short-term contribution);

v. all of the available opportunities for the use of the resources have been included in the linear programming model. **[Source: Drury textbook 8th edition, 2012: 25.11]**

Note:

The shadow price represents the premium (the extra) amount one is prepared to pay for additional supplies of the constrained resource and not the price per unit. If the current price for the constrained resource is R6 per kg, and the shadow price is 35 cents, the organisation is prepared to pay up to R6,35 to obtain more of the scare resource.

4. Uses of linear programming

As you have seen up to now, linear programming is a very powerful technique that helps managers to determine how to apply scarce resources in order to maximise profits or minimise costs.

Now study the following theory subsections in Drury (up to the end of "Control") and then attempt the activity below:

Chapter	Subsection
25	*Uses of linear programming*

Note:

The "Calculation of relevant costs" subsection in Drury refers to opportunity costs being derived from the final row of the third and final matrix. As the simplex tableau is not prescribed for this course, you will need to calculate the opportunity cost or shadow price algebraically as taught above.

Activity 11.3

Answer the questions posed in Real World Views 25.1 in your Drury textbook, 8^{th} or 9^{th} edition.

Solution to Activity 11.3

Find the solution to the questions in Real World Views 25.1 online via your CourseMate account.

5. Summary

In this study unit, you have learnt to

- solve the allocation of resources where two products are produced and two or more constraints are present by applying linear programming
- solve the optimum production output by means of the graphical or the simultaneous equation method
- calculate the maximum price to be paid for additional supplies of the limited resources per input unit
- describe the different uses of linear programming

6. Self-assessment theory review questions

After working through the relevant sections in Drury and this study unit, you should now be able to answer review questions 25.1 to 25.5 and 25.8 in your Drury textbook, 8th or 9th edition covering the theory at the end of chapter 25.

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

7. Online enrichment activity

Complete the online activities for chapter 25 relating to the specified learning outcomes.

8. Self-assessment questions

QUESTION 11.1

Higgins Co (HC) manufactures and sells pool cues and snooker cues. The cues both use the same type of good quality wood (ash) which can be difficult to source in sufficient quantity. The supply of ash is restricted to 5 400 kg per period. Ash costs R40 per kg.

The cues are made by skilled craftsmen (highly skilled labour) who are well known for their workmanship. The skilled craftsmen take years to train and are difficult to recruit. HC's craftsmen are generally only able to work for 12 000 hours in a period. The craftsmen are paid R18 per hour.

HC sells the cues to a large market. Demand for the cues is strong, and in any period, up to 15 000 pool cues and 12 000 snooker cues could be sold. The selling price for pool cues is R41 and the selling price for the snooker cues is R69.

Manufacturing details for the two products are as follows:

	Pool cues	**Snooker cues**
Craftsmen time per cue	0,5 hours	0,75 hours
Ash per cue	270 g	270 g
Other variable costs per cue	R1,20	R4,70

HC does not keep inventory.

REQUIRED

a. Calculate the contribution earned from each cue.
b. Determine the optimal production plan for a typical period assuming that HC is seeking to maximise the contribution earned. You should use a linear programing graph. Identify the feasible region and the optimal point and accurately calculate the maximum contribution that could be earned using whichever equations you need.

[Source: Drury textbook, 8th edition, 2012: 25.12a and b]

SOLUTION TO QUESTION 11.1

a. The calculation of the contribution per cue is as follows:

	Pool cue	**Snooker cue**
	R	**R**
Selling price	41,00	69,00
Material cost at R40/kg	(10,80)	(10,80)
Craftsmen cost at R18/hr	(9,00)	(13,50)
Other variable cost	(1,20)	(4,70)
Contribution per cue	20,00	40,00

b. Let P and S be the number of pool and snooker cues made and sold in any three-month period and C represent the contribution earned in any three-month period. The linear programming model is formulated as follows:

Maximise C = 20P + 40S

Subject to:

Craftsmen:	0,5P + 0,75S ≤ 12 000
Ash:	0,27P + 0,27S ≤ 5 400
Demand levels – Pool cues	P ≤ 15 000
Demand levels – Snooker cues	S ≤ 12 000
Non negativity:	P,S ≥ 0

Reference to the diagram indicates that the feasible region is inside area OABCDE. Within this feasible region a contribution line is inserted for a combination of pool and snookers cues that results from an arbitrarily selected contribution value. The contribution line is extended outwards to determine the last corner point within the feasible region. This is point D where the line S = 12 000 and 0,5P + 0,75S= 12 000 intersect.

Substituting S = 12 000 in equation (2)

0,5P + (0,75 x12 000) = 12000

0,5P + 9000) = 12 000

0,5P = 12 000 – 9000

0,5P = 3 000

P = 6 000

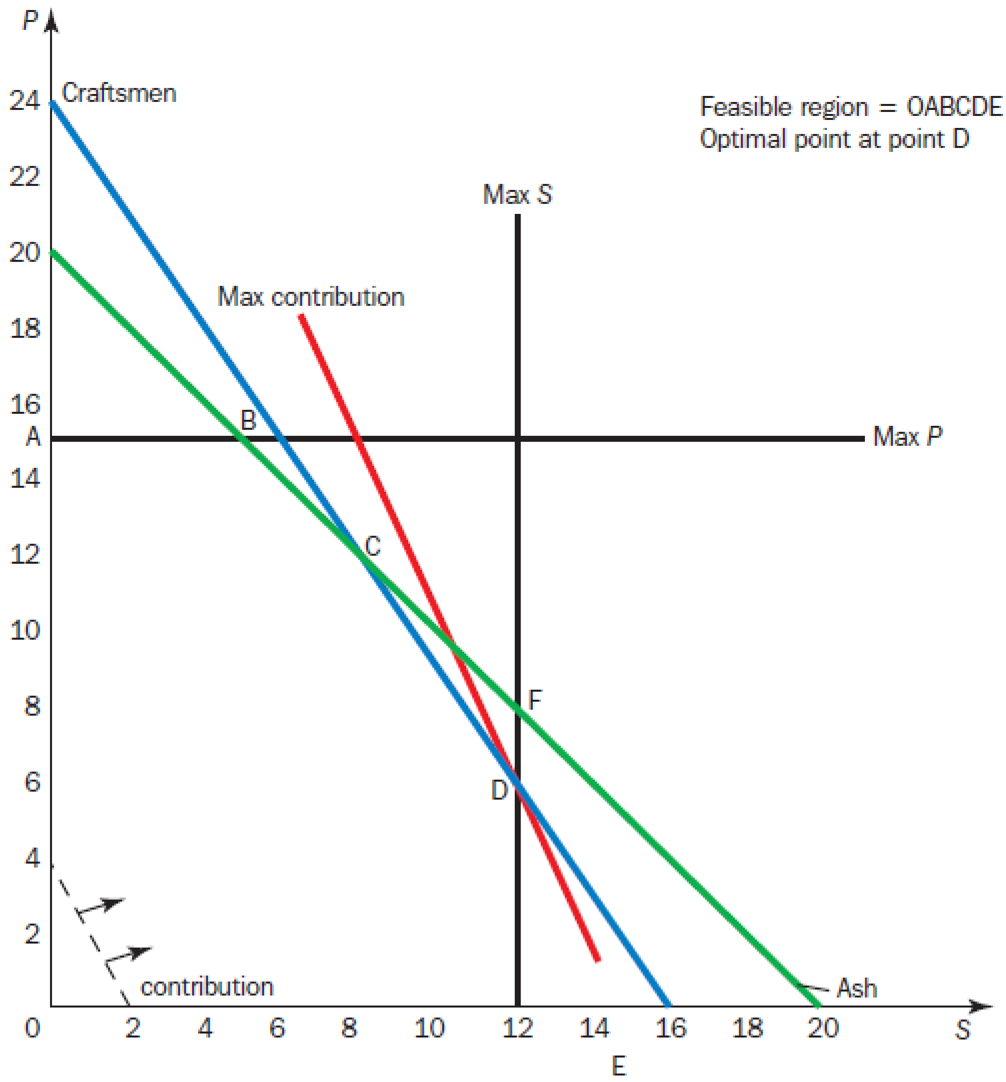
Therefore the maximum contribution is earned when 6 000 pool cues and 12 000 snooker cues are made and sold in a three month period.

The contribution earned is

C = (20 x 6000) + (40 x 12000)

C = 120 000 + 480 000

C = R600 000



[Source: Drury textbook, 8th edition, 2012: 25.12a and b]

Note:

There are 1 000 g in a kilogram.

Therefore, the material cost per cue is calculated as follows:

	Pool cues	**Snooker cues**
Ashwood per cue:		
270 g/1 000 g x R40	R10,80	R10,80

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QUESTION 11.2

Answer question 25.3 in the Drury student manual, 8th or 9th edition.

SOLUTION TO QUESTION 11.2

Find the solution to question 25.3 at the back of the Drury student manual, 8th or 9th edition.

Note:

For question 25.3 (b), the fixed cost of R150 000 was calculated as follows:

R20 x 90 000 x 1/12

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QUESTION 11.3

Answer question 25.4 in the Drury student manual, 8th or 9th edition.

SOLUTION TO QUESTION 11.3

Find the solution to question 25.4 at the back of the Drury student manual, 8th or 9th edition.

PART 3, TOPIC 7 – PRICE SETTING FOR INTERNAL AND EXTERNAL PURPOSES

INTRODUCTION

The price of a product or service will directly impact the profitability of an organisation. Your role as an accountant or financial manager is very important in this respect. In practice you will also work closely with the marketing department in determining the final prices. Accounting information, specifically costing information, plays a vital role when an organisation needs to make pricing and pricing method decisions regarding its products. This is relevant to products or services sold both internally (between divisions or companies forming part of the same group) and externally (to customers or third parties). In this topic, you will learn about pricing techniques to determine the selling price of products sold both internally and externally. You will also gain an understanding of the factors that play a role in determining the final selling price.

We encourage you to consider pricing questions as if you were setting the prices for your own business's products or services.

LEARNING OUTCOMES

After studying this topic, you should be able to

- describe the different purposes of a transfer pricing system
- explain the difference between intermediate and final products
- identify and describe the different transfer-pricing methods that are used in the short term and in a perfectly competitive market
- identify the need for the inclusion of opportunity costs in the transfer price
- calculate the applicable opportunity costs when using variable cost plus opportunity cost as the transfer-pricing method
- differentiate between price-setting and price-taking organisations
- distinguish between customised and non-customised products
- explain the relevant cost information that should be included in the long-term external pricing decisions for price-setting organisations
- identify the role that different levels of fixed cost play in the price-taking organisation when deciding to discontinue a product or product line from the product mix

- describe different cost-plus pricing methods for setting the long-term selling price
- explain the limitations and benefits of cost-plus pricing
- identify and describe different pricing policies from a marketing perspective

ASSUMED PRIOR KNOWLEDGE

The learning outcomes covered in this topic were not covered in previous modules. However, this topic relies heavily on your basic knowledge of relevant costing and cost behaviour concepts. Please revise the applicable previous topics if you do not feel confident to proceed.

THIS TOPIC CONSISTS OF THE FOLLOWING STUDY UNITS:

STUDY UNIT	TITLE
STUDY UNIT 12	**DIVISIONAL FINANCIAL PERFORMANCE MEASURES**
STUDY UNIT 13	**LONG-TERM EXTERNAL PRICE SETTING**

Note:

We dealt with short-term external pricing under special-order scenarios in topic 6 on relevant decision making in various scenarios.

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STUDY UNIT 12 INTRODUCTION TO TRANSFER PRICING

1. Introduction

In study unit 9 you learnt that some organisations have a divisional organisational structure.

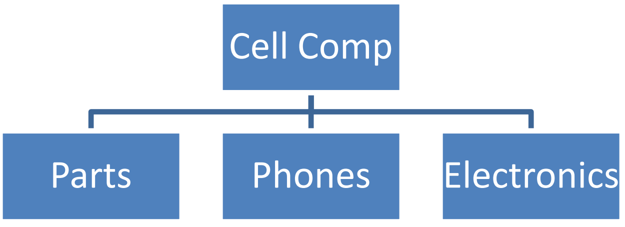
Often, different divisions in an organisation provide products or services to other divisions in the same organisation. We refer to the amount charged for the product transferred or service rendered as the **transfer price**. The transfer price will have an impact on the profit (a performance measure) of both of the divisions, and it is therefore important to determine the most beneficial transfer price for the group as a whole.

Before we look at the theory for setting transfer prices, do the following activity to see what impact the transfer price could have on the purchasing and transferring divisions if it is higher than the available external purchase price.

Activity 12.1

In activity 9.5, we explored why it would be unfair to keep the manager of the phones division responsible for the extra costs incurred when he purchased product A100 from the parts division and not from Phones CC.

In this activity, we will investigate the actual impact the organisation's transfer pricing policy has on the performance of the divisions and the organisation as a whole. For ease of reference, the group structure is set out in the diagram below:



Remember: the parts division manufactures all the parts used by the phones division. The phones division is responsible for assembling the phones and getting them in working order. The parts division sells all of their output to the phones division. The company's strategic pricing policy states that the phones division should first buy parts from the parts division at a market-related price that is determined at the beginning of each year, before purchasing parts from an outside company. The agreed purchase price of one of the parts with product code A100 is determined at R100 per unit. The performance contract of the phones divisional manager contains a key performance indicator for cost savings.

Phones CC, a competitor of the parts division that also produces product A100 has lost a big customer and therefore has extra (idle) capacity. Phones CC is currently selling the extra units of product A100 at the discounted price of R75 per unit.

REQUIRED

a. Determine the impact it would have on the profit of the phones division if they purchased 2 000 000 units from the competitor at the discounted price instead of at the regular price from the parts division.
b. What impact do you think it would have on the parts division if the phones division were allowed to buy from Phones CC?
c. Discuss what factors the group financial manager of Cell Comp should consider when deciding whether or not to allow the phones division to buy from third parties.
d. Discuss what other factors should be considered before the parts division decides to buy from Phones CC.

Solution to Activity 12.1

Transfer price		=	R100 per unit	①
External market price		=	R75 per unit	②
Price difference	① - ②	=	R25 per unit	③
Number of units		=	2 000 000	④
Change in cost	③ x ④	=	R50 000 000	⑤

a. Impact on phones division

The phones division will save costs of R50 000 000. The divisional manager would be able to comply with his performance measure (and possibly earn a bonus).

b. Impact on parts division

If the phones division is allowed to purchase outside the group, the parts division will lose sales of 2 000 000 units. However, it will also "save" the variable cost of manufacturing those units. It will therefore forfeit the contribution on sales of 2 000 000 units. We don't have the cost information, but for now we will assume that fixed costs are not affected.

Current policy does not allow the parts division to sell the **spare capacity** to third party buyers. The divisional manager of the parts division will perform worse, since his profits are deteriorating.

c. Impact on Cell Comp as a whole

Currently the phones division pays R200 000 000 to the parts division for the units. It constitutes a cash outflow for the phones division and a cash inflow for the parts division. The group is therefore cash neutral for this transaction. The revenue for the group is generated by the external sale of the final product ─ the phones. We will assume that this sales value will remain unchanged, irrespective of the source of the parts. It is therefore irrelevant to the decision.

Therefore, the group financial manager should ask the following questions:

- What is the incremental **cash** manufacturing cost of the 2 000 000 units in the parts division? This represents a cash outflow for the group.
- What is the **cash** cost of buying the 2 000 000 units from Phones CC? The answer is R75 x 2 000 000 = R150 000 000. This represents a cash outflow for the group.

The final answer therefore depends on whether it is cheaper (< R150 000 000) to **manufacture** the 2 000 000 units in the parts division than **buying** it from an external third party. If it is cheaper to manufacture the units in the parts division, phones division should continue to buy from parts division, even though a cheaper option is available in the market.

Note:

① Did you notice that we referred to incremental cash outflows? In other scenarios, where there are changes in the selling prices of the buying and selling division, we will refer to incremental cash **contribution**.

② From a group perspective, we will always try to increase the group's incremental cash contribution, whilst trying to maintain or improve the performance measures (and motivational levels) of both the buying and selling divisions. In later modules you will learn what mechanisms are available to compensate the phones division.

③ It is important for you to be aware of the interplay between optimising the group's cash contribution and individual divisional performance.

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d. Other factors to consider

- Phones CC has temporary capacity. Would they be able to supply Cell Comp in the long run (if it is more cash advantageous to buy from them)?
- Does Phones CC provide the same quality as the parts division?
- How would it influence parts division's supplier contracts if they manufactured 2 000 000 fewer units? Could it impact current bulk discounts?
- How would Phones CC utilise the spare capacity in the parts division if the phone division bought from Phones CC?
- How would the spare capacity influence the employees in the parts division? Could retrenchments be on the cards?
- Do the parts of Phones CC comply with the same environmental and safety standards as those of Cell Comp?

Now that you have a better understanding of the issues involved in setting an equitable transfer price, we will delve deeper into transfer pricing. We will focus on the background and purpose of transfer pricing, transfer pricing methods and domestic transfer pricing recommendations.

This study unit is based on **selected sections** from chapter 20 of your prescribed Drury textbook.

2. Background and purpose of transfer pricing

This section will explain the purpose of determining a selling price (transfer price) for products that are transferred from one division to another in an organisation.

Now study the following theoretical subsection in Drury, chapter 20, and then attempt the activity:

Chapter	Subsection
20	*Purpose of transfer pricing*

Note:

① It is important to understand the difference between an intermediate and a final product as this determines who the transferring and the receiving divisions are.

② The costs incurred by the receiving division to complete the final product are called **further processing costs**. Further processing costs are incurred irrespective of whether the intermediate product is sourced from another division in the group or from an external source.

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In the next activity, we will look into the purposes of transfer prices by applying transfer prices to a practical scenario.

Activity 12.2

ORMB Ltd is a company that manufactures mountain bikes. The company has two divisions: the tyres division that manufactures tubeless tyres, and the mountain bike (MTB) division that assembles and sells mountain bikes. They operate from the same industrial premises.

The MTB division contracts with various suppliers for the different parts of the bicycles. All the parts are purchased at a market-related price. The factory of the current supplier of the tubeless tyres burnt down and they are in the process of rebuilding it. They would probably only resume supply in six months' time. The MTB division predicts that there will be a demand for 5 000 mountain bikes over the next six months.

The tyres division has a maximum capacity of 100 000 tyres per annum. They are currently running at 90% capacity.

The market price of the tyres manufactured by the tyres division of ORMB Ltd is R575 per tyre. The variable manufacturing cost per tyre amounts to R400. The tyres division incurs additional cost of R20 per tyre for packaging and delivery purposes to all external customers.

The management of ORMB Ltd and the two divisions need a solution for this short-term problem. They are considering running the tyres division at 100% capacity and transferring the tubeless tyres from the tyres division to the MTB division.

The mountain bikes of the MTB division are selling at a unit price of R9 500. The variable cost (excluding the tyres) amounts to R6 050 per bike.

You may assume a perfectly competitive market for tubeless mountain bike tyres.

REQUIRED

a. Identify the intermediate and final product produced by ORMB Ltd.
b. Calculate the contribution per tyre if the tyres division sold the tyres to its external customers.
c. Would it benefit ORMB Ltd in the short term to transfer the tyres from the tyres division to the MTB division instead of buying them from another external supplier?
d. Determine the effect on both divisions and the company as a whole if the transfer price was set to
   i. the variable cost per tyre
   ii. the market price less saving of the tyre
   iii. the market price of the tyre

Solution to Activity 12.2

a. Intermediate and final products

Intermediate product:	*Tubeless tyres*
Final product:	*Mountain bikes*

b. Contribution generated by the tyres division per tyre

	Tyres division (rand)
Selling price	575
Variable cost (incremental cost)	(400)
Additional variable packaging and delivery costs	(20)
Contribution per tyre from external market sales	**155**

c. Incremental cash contribution of the group in the short term

i. Determining if the extra capacity of the tyres division will cover the need of the MTB division

Total available capacity		=	100 000 tyres	①
Current capacity (@ 90%)	(100 000 x 90%)	=	90 000 tyres	②
Spare capacity	① - ②	=	10 000 tyres	③
Capacity required by the MTB division	(5 000 x 2 tyres per bicycle)	=	10 000 tyres	④
Shortage/Surplus	③ - ④	=	-	

Therefore, the spare capacity of the tyres division will be enough to cover the need of the MTB division.

Note:
Always determine how much spare capacity is available in the transferring division (if any) before doing any of the other calculations. This will determine if existing sales need to be sacrificed, which will mean that we will have to include opportunity cost in the transfer price. The principle is the same as that used for the special short-term orders covered in topic 6.

ii. Cash contribution of ORMB Ltd when using internal transfer vs another external supplier for the tyres

	Internal transfer from tyres division (rand)		***Purchase from external supplier (rand)***	
External selling price of final product	*9 500*		9 500	
Incremental further variable cost in MTB division	(6 050)		(6 050)	
Incremental manufacturing cost of tyres in tyres division	(800)	①	-	
Packaging and distribution cost	-	③		
External purchase cost of tyres	-		(1 150)	②
Contribution per mountain bike	**2 650**		**2 300**	
Demand over the short term	5 000		5 000	
Total contribution	**R13 250 000**		**R11 500 000**	

Notes:

① (R400 x 2)

② (R575 x 2) As it is a perfectly competitive market, we assume that other tyre suppliers would be willing to sell their tyres in the external market at the same price as the tyres division.

③ With internal transfers, there is usually no need to incur special packaging costs. As the divisions operate from the same premises, there are also no distribution costs. If the question is silent, you may assume that these types of costs are not incurred for internal transfers. Otherwise, read the question carefully to see how much of the incremental costs for packaging and distribution are saved through transferring internally. Sometimes this saving will also apply to debt collection costs and bad debts incurred.

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Additional contribution to ORMB Ltd in the short term	=	Contribution A – contribution B
	=	R13 250 000 – R11 500 000
	=	R1 750 000

Conclusion

It is therefore to the benefit of the ORMB Ltd group to maximise the capacity in the tyres division and transfer the tubeless tyres to the MTB division. This should continue for as long as the tyres division has spare capacity. If the spare capacity runs out, the calculations should be done again.

Note:

① The second step is always to determine whether the **group as a whole is better off in terms of incremental cash inflow or reduced cash outflow**. For this purpose, one only considers transactions that result in **incremental** cash outflows and inflows to parties **outside** the company, that is: employees, customers and various suppliers.

② We ignore payments between divisions, because this will be cash neutral from a group perspective regardless of the amount of the transfer price. The transfer price paid is a cash outflow for the receiving division and a cash inflow for the transferring division. On consolidation, intergroup transactions are eliminated. This is the same concept you applied in your FAC modules for consolidation questions.

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d. Effect on individual divisions and the company as a whole

i. Transfer at variable cost

	Tyres division (rand)		MTB division (rand)	
Selling price	400		9 500	
Variable cost (incremental cost)	(400)		(6 050)	
Transfer cost (R400 x 2)			(800)	
Additional variable sales and marketing costs - external market	-		-	
Contribution	-		**2 650**	
Units	10 000		5 000	
	-	①	**13 250 000**	②
Total contribution for ORMB Ltd	① + ②		**13 250 000**	

Note:

If the transfer price is set at the transferring division's incremental cost (usually variable manufacturing cost) they **make no profit, and the full benefit of the R1 750 000 saving accrues to the receiving division**. Even though the transferring division made no profit on their spare capacity previously, they would not be willing to enter into this transaction if the decision was theirs alone (additional external sales orders could arise which they would not be able to take up as they would be manufacturing at full capacity).

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ii. Transfer at market price less savings

The transfer price is calculated using the transferring division's external market price less the cost saving on variable packaging and delivery cost when the tyres are not sold in the external market.

	Tyres division (rand)		MTB division (rand)	
Selling price (R575 – R20)	555		9 500	
Variable cost (incremental cost)	(400)		(6 050)	
Transfer cost (R555 x 2)			(1 110)	
Additional variable packaging and delivery costs - external market	-		-	
Contribution	**155**		**2 340**	
Units	10 000		5 000	
	1 550 000	①	**11 700 000**	②
Total contribution for ORMB Ltd	① + ②		**13 250 000**	

Note:

In this scenario, the group benefit of R1 750 000 is allocated mainly to the transferring division, with a small saving of R200 000 (packaging and delivery cost) being passed on to the receiving division. The transferring division would be very happy to enter into this transaction. The receiving division would also be satisfied, as it would be buying the tyres at a better price than from any other external supplier. The receiving division, however, might argue that it requires a larger discount (share in the incremental cash saving) as the transferring division had spare capacity (no extra sales) and would not have incurred these sales if it had not been for the receiving division's demand.

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iii. Transfer at market price

	Tyres division (rand)		**MTB division (rand)**	
Selling price	575		9 500	
Variable cost (incremental cost)	(400)		(6 050)	
Transfer cost (R575 x 2)			(1 150)	
Additional variable sales and marketing costs				
- external market	-		-	
Contribution	**175**		**2 300**	
Units	10 000		5 000	
Contribution	**1 750 000**	①	**11 500 000**	②
Total contribution for ORMB Ltd	① + ②		**13 250 000**	

Note:

In this scenario, the transferring division will absorb all the incremental profit, whilst the receiving division will receive none of the savings. The transferring division will be very eager to enter into this transfer deal. The receiving division will be indifferent to either buying internally or from another supplier in the market, as it makes **no** difference to their profits.

The risk is the following: if the receiving division decides to buy from another external party, the group will lose incremental cash savings to the value of R1 750 000. Setting the transfer price at the external market price **without** any discount is therefore risky, as the receiving division might decide to buy externally and deprive the group of incremental cash benefits. If the group head office instructed the receiving division to enter into the transfer deal, it would demotivate the managers of the receiving division as it would interfere with their autonomy in decision making.

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Summary of profits

Transfer pricing method	Tyres division (rand)	MTB division (rand)	ORMB Ltd (rand)
Variable cost of the tyres	0	13 250 000	13 250 000
Market price less saving of the tyres	1 550 000	11 700 000	13 250 000
Market price of the tyres	1 750 000	11 500 000	13 250 000

You will notice that the total contribution of the company remains the same in all three scenarios. The transfer prices will therefore not impact the company as a whole, as the company has the spare capacity required to produce the product. However, if the divisional managers have autonomous decision-making powers, they might not always agree to enter into the transfer deal as discussed previously (scenarios i and iii).

From the summary above, it is clear that the tyres division will not agree to use variable cost as the transfer price, as they will not receive any profit, while the MTB division will maximise their profits. The MTB division might not agree to use the full market price as the transfer price, because they will not generate any additional profits then. In the absence of interference from group head office, **setting the transfer price at market price less internal savings will usually incentivise each division to agree to the transfer deal independently**.

The two divisions will need to negotiate the transfer price, since the MTB division will favour using the market price less savings, whereas the tyres division will favour using the market price as the transfer price.

Did you notice that when you deal with a divisionalised organisation, the transfer pricing decisions are much more complex than when you deal with a functionally structured organisation? In a functionally structured organisation, your pricing decision will be to the benefit of the organisation as a whole, since manufacturing takes place in different departments which are not measured on profit. In a divisionalised organisation, a dominant divisional manager might decide on a transfer price that is only to the benefit of that division and its managers and not to the benefit of the other divisions or the organisation as a whole. When all divisions in a group work together towards the greater good of the group as a whole, we say that goal congruency is achieved.

From this activity, did you notice the following regarding the transfer price?

1. It was used for decision making in each division (transferring or receiving).
2. It affected the profitability (performance measurement) of each division.
3. It could lead to suboptimal decision making that may not be in the interest of the group as a whole.
4. It may only be agreed upon after interference by group head office, which may curtail the autonomy of divisional managers.

Now that you are more aware of the sometimes conflicting objectives of transfer prices, we will discuss which transfer prices are recommended in certain circumstances.

3. Transfer pricing methods

Having worked through activity 12.2, you would have noticed that there are many different methods to determine transfer prices. Now refer to the following subsection in Drury, chapter 20, for a list of six alternative pricing methods:

Chapter	Subsection
20	*Alternative pricing methods*

In this module (MAC3701) we will focus on the transfer pricing methods used for

- short-term decisions
- intermediate products that have a perfectly competitive market

This study unit will therefore only cover the following methods to determine transfer prices:

- market-based transfer prices
- incremental (marginal)/variable cost plus opportunity cost transfer prices

We will discuss the other methods (where there is no market or an imperfect market for the intermediate product) in later MAC modules. This will include long-term orders for transfers.

3.1 Market-based transfer prices – transferring division at full capacity

The first method to determine transfer prices covered in this study unit are market-based transfer pricing. This method is normally used when a perfectly competitive market exists for the intermediate product and the transferring division is operating at full capacity.

Now study the following subsection in Drury, chapter 20, and the additional guidance, and then attempt the activities:

Chapter	Subsection
20	*Market based transfer prices*

Please pay careful attention when you work through exhibit 20.2 in your Drury textbook, 8th or 9th edition. You will notice that the contribution (profit) of both divisions is exactly the same in both scenarios. When a competitive market exists for the intermediate product and the transfer price is equal to the market price, both the divisions and the company as a whole will be in exactly the same financial position and it will not matter whether the divisions buy or sell the intermediate product internally or externally.

Note:

① This rule applies as long as the transferring division is capable of selling all their output to the external market. When there is spare capacity, a different approach should be followed. This is discussed in the next subsection.

② Savings that arise from transfers should be split between the divisions or passed on fully to the receiving division. It makes no sense to incur costs on external sales that could have been saved on internal group transfers. This will also incentivise the receiving division to rather buy internally than externally.

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Activity 12.3

The hardware division of a computer company is responsible for the manufacturing of hard drives. These hard drives can either be sold to the assembly division of the same company or to outside customers. The market for hard drives is perfectly competitive.

The information set out below is applicable for the year 20X1.

Selling price per hard drive	R850
Production cost per hard drive	R550
Number of hard drives:	

• produced during the year (100% capacity)	20 000
• sold to outside customers	16 000
• transferred to the computer assembly division	4 000

The hardware division could also have sold the 4 000 transferred units in their own external market, but agreed to the transfer because the transfer price to the assembly division was set at the same price as the selling price to their external customers.

The assembly division assembles laptops that are sold to the external market. The hard drives transferred from the hardware division were one of the components used for assembling the final product of the computer company. All the hard drives are sourced from the hardware division. Each laptop had only one hard drive. The assembly division incurred additional further costs of R3 500 to assemble the laptops.

These laptops were sold externally at a price of R6 000 per laptop.

REQUIRED

Prepare a profit statement for the hardware division, the assembly division and the company as a whole for the year 20X1.

Solution to Activity 12.3

		Hardware division (rand)	**Assembly division (rand)**
External sales			
- per hard drive	(16 000 x R850)	13 600 000	
- per laptop	(4 000 x R6 000)		24 000 000
Internal sales	(4 000 x R850)	3 400 000	
Transfer cost			(3 400 000)
Production cost			
- per hard drive	(20 000 x R550)	(11 000 000)	
- per laptop (further cost)	(4 000 x R3 500)		(14 000 000)
Total profit		**6 000 000**	**6 600 000**

Total profit of the company	=	hardware div. contribution + computer div. contribution
	=	R6 000 000 + R6 600 000
	=	R12 600 000

Note:

① The transferring division in effect had no spare capacity, as it could have sold the 4 000 units externally as well. Therefore, the transfer should take place at market-related prices to compensate them for "lost" external sales.

② The question does not mention selling and distribution costs. If there have been such costs, remember to read carefully to see if there are any savings that arise from transfers. These savings (or a portion of it) should be passed on to the receiving division in order to entice them to buy internally rather than externally and to keep the cash savings in the group.

③ We are including **all the sales** of both divisions in the calculations. Therefore, the costs would be the full absorption costs incurred to generate all sales in both divisions. The net result is the profit of each division (and the group) and no longer the contribution. In the case of once-off transactions, or short-term options, one would include only incremental cash inflows and outflows.

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3.2 Marginal/Variable cost plus opportunity cost transfer prices – transferring division has spare capacity

In the previous subsection, the transferring division could have sold all their output in their own external market. We will now learn what happens when the transferring division has spare capacity, but the receiving division wants more units than can be provided by using the available spare capacity. The principles explained here are very similar to those covered in topic 6. Instead of an external customer wanting to place a special short-term order, the transferring division has another division in the group as customer.

Now study the following subsection in Drury, chapter 20, and the additional guidance, and then attempt the activities:

Chapter	Subsection
20	*Marginal / variable cost plus opportunity cost transfer prices*

The opportunity cost (contribution foregone on lost sales) is a function of idle capacity of the transferring division and the size (units) of the transfer order.

Activity 12.4

We will use some information included in activity 12.2 to explain these concepts further.

Information relating to the tyres division of ORMB Ltd

100% capacity:	100 000 tyres
Market price per tyre:	R575 per tyre
Variable cost per tyre:	R400 per tyre

The mountain bike (MTB) division is currently experiencing problems with the supplier of the tyres and would like to purchase tyres from the tyres division in the short term until the problem is resolved. Based on estimates, the MTB division will need to purchase 10 000 tyres.

REQUIRED

Determine the opportunity cost when there is

a. no idle capacity, therefore the production and external sales are at a 100%
b. some idle capacity, and the production and external sales are at 95%
c. idle capacity, and the production and sales are at 90%

Solution to Activity 12.4

Refer to the table below for the calculation.

Selling division with	**Contribution margin on lost sales**	**Number of units transferred**	**Opportunity cost per unit**	**Transfer price per unit**
a. no idle capacity (100 000 tyres produced and sold)	10 000 x (R575 – R400) =R1 750 000	10 000	R1 750 000 / 10 000 =R175	R400 + R175 = R575

Selling division with	Contribution margin on lost sales	Number of units transferred	Opportunity cost per unit	Transfer price per unit
b. some idle capacity (5% available = 5 000)	5 000 x (R575 – R400) =R875 000	10 000	R87,50	R400 + R87,50 =R487,50
c. idle capacity (10% available = 10 000)	0 x (R575 – R400) =R0	10 000	R0	R400 + R0 =R400

It is important for you to know how to calculate the opportunity cost per unit to determine the final transfer price.

Note:

Did you notice that the transfer price equals the external market price of R575 in the absence of spare capacity (scenario a)? That is because the formula for contribution is sales less variable cost. When we add back variable cost, we arrive at sales again. If the transferring division can sell the tyres for R575 in a perfectly competitive market, it would not be willing to sell them to the receiving division for less. Refer to the previous subsection on market-based transfer prices.

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The transfer price (TP) can be calculated in any of the following ways:

TPi per unit = [**total INCREMENTAL** ① cost (all units to be transferred) + **total** opportunity cost (from external sales forfeited)] ÷ total number of units to be transferred

OR

TPii per unit = **INCREMENTAL** cost **per unit** (all units transferred) + (total opportunity cost of external sales forfeited ÷ **total number of units** to be transferred ②)

OR

TPiii ③ per unit = [**INCREMENTAL** cost (order 1: units manufactured in spare capacity) + external sales revenue **less savings as a result of internal transfer** (order 2: units forfeited) ④] ÷ total number of units to be transferred

Notes:

① Remember, you should always consider the **incremental** cost and not only the variable manufacturing cost. This is the same principle you used in topic 6 on relevant decision making in various scenarios, where we considered the special short-term order. Incremental costs include **any additional costs** as a result of the decision to transfer. This will automatically include the variable production costs, but it might also include some once off costs which are not traceable to individual units. The manager of the transferring division wants to at least recoup all his costs arising from the transfer transaction.

② TPii is a variation of TPi. Each component of the total cost is divided by the number of units transferred. Many students incorrectly divide the total opportunity costs by the number of external sales units forfeited (e.g. 5 000 units). You should divide by the total number of units of the transfer transaction (10 000 units). The opportunity cost is spread across **all** units transferred.

③ TPiii is used in scenarios where the orders can be divided. This means that the first order from the receiving division is only for the units that can be made in the idle (spare) capacity. This is charged at full incremental cost. The second order is issued for the units redirected from the external market to the internal market (receiving division). The principles here are the same as those covered in sub-section 3.1 Market-based transfer prices – transferring division at full capacity.

④ The argument here is that the transferring division would have manufactured these units in any case (for the external market) and that manufacturing these units thus does not result in incremental costs. The opportunity cost is therefore solely the external sales revenue that is forfeited when the sales are redirected to the receiving division.

⑤ We recommend that you rather use TPi in questions where you are required to calculate one transfer price for all units transferred, as because students tend to make fewer mistakes using this method. Calculate all incremental costs and all opportunity costs, add them together, and only then divide by the total number of units to be transferred.

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Activity 12.5

Refer to the information included in activity 12.3. Assume that the hardware division is running at 100% capacity. According to the budget, the assembly division wants to purchase 5 000 hard drives in 20X2 and not 4 000 hard drives.

REQUIRED

Determine the transfer price for the additional order of 1 000 units of the intermediate product by using the incremental cost plus the opportunity cost. Show all your calculations.

Solution to Activity 12.5

If the assembly division would like to increase their current demand with 1 000 hard drives, the sales to external customers in the hardware division would need to decrease with 1 000 hard drives, since the hardware division is currently running at 100% capacity and selling all the hard drives manufactured. It therefore has no idle capacity.

Calculation of transfer price for redirected units

$$\text{Transfer price} = \text{incremental cost} + \text{opportunity cost}$$

$$= R0 + \frac{\text{revenue of lost sales}}{\text{number of units redirected}}$$

$$= R0 + \frac{R850 \times 1\ 000}{1\ 000}$$

$$= R0 + R850$$

$$= R850$$

Therefore, the transfer price of the redirected units is the same as the market price.

It is also important for you to understand that every company should determine what its optimal output should be as a whole.

Note:
When working through this section, make sure you understand the principles for incremental (usually variable) and opportunity costs. Please note that you will only be tested on the transfer price in a perfect competitive market in this study unit. We will cover the pricing for an imperfect market in later MAC modules.

*****

4. Summary

In this study unit, you learnt

- to describe the different purposes of a transfer pricing system
- to explain the difference between an intermediate and a final product
- to identify and describe the different transfer pricing methods that are used in the short term and in a perfectly competitive market
- to identify the need for including opportunity cost in the transfer price
- to calculate the opportunity cost applicable when using variable cost plus opportunity cost as the transfer pricing method
- that the minimum transfer price from the viewpoint of the transferring division will always be
    - ➢ incremental cost (variable cost plus any other costs incurred) when there is idle capacity
    - ➢ market price (less savings on delivery and packaging costs, if any) where units are redirected from external customers in a perfectly competitive market
- that the maximum transfer price for the intermediate product from the viewpoint of the receiving division in a perfectly competitive market will always be the external market price less some incentive (savings on delivery and packaging costs, if any) to rather buy internally

5. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer review questions 20.1 to 20.4 in the textbook, 8th or 9th edition covering the theory.

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

6. Online enrichment activity

Complete only those online activities for chapter 20 that relate to the learning outcomes specified for MAC3701.

7. Self-assessment questions

After working through all the relevant sections in the textbook and the guidance and activities provided in this study, you should now be able to attempt the following self-assessment questions:

QUESTION 12.1

Answer review problem 20.15 in the Drury textbook, 8th or 9th edition.

SOLUTION TO QUESTION 12.1

Find the solutions to review problem 20.15 at the back of the textbook, 8th or 9th edition.

QUESTION 12.2

RBC Ltd is a company that manufactures road bicycles. The group structure consists of two divisions. The frames division manufactures carbon frames, and the RB division assembles and sells completed road bikes. The manufactured carbon frames can either be sold to outside customers in a perfectly competitive intermediate market, or to the RB division.

The following information is available:

Frames division

Capacity in number of frames	75 000
Number of frames currently sold on the intermediate market	75 000
Selling price per frame on the intermediate market	R3 750
Variable cost per frame	R3 000

RB division

Capacity in number of road bicycles	50 000
Purchase price of carbon frames from external supplier	R3 750
Additional (further) variable and assembly costs per bicycle	R4 250
Selling price per road bicycle	R10 500

REQUIRED

The RB division decides to purchase the frames directly from the frames division. Calculate the opportunity cost if the company uses the incremental cost plus opportunity cost to determine the selling price.

SOLUTION TO QUESTION 12.2

The frames division is running at 100% capacity. If the RB division intends to buy from them, the frames would have to redirect or forfeit the equivalent number of external sales units. They would have incurred the variable cost on those units in any case, therefore it becomes irrelevant. The opportunity cost consists solely of the external revenue forfeited.

$$\text{Opportunity cost} = \frac{\text{total relevant contribution on lost sales}}{\text{number of units transferred}}$$

$$= \frac{(\text{R3 750} - \text{R0}) \times 50\ 000}{50\ 000}$$

= R3 750 per unit redirected (also equals the external market price)

QUESTION 12.3

Use the information provided in **question 12.1.** Assume now firstly, that the total variable cost per frame of R3 000 includes R200 variable delivery cost, and secondly, that the delivery cost can be avoided on inter-company sales.

REQUIRED

Calculate the price ranges that can be charged for the frames when the frames are transferred from the frames division to the RB division, and explain the significance of each of the limits of the price range.

SOLUTION TO QUESTION 12.3

Minimum transfer price (transferring division)	=	market price (see question 1) less all the savings in delivery cost passed on to the receiving division
	=	R3 750 – R200
	=	R3 550

Maximum transfer price	=	market price currently paid to external supplier
(receiving division)	=	R3 750

The frames division would prefer to charge the higher amount of R3 750 per frame, but then the RM division has no incentive to buy from them, and they might still buy from their external supplier at that price. The group will then lose out on cash savings of R200 per unit (the variable delivery cost no longer incurred). Remember that the external purchase cost saved by the RB division is equal to the external revenue now forfeited in the frames division. The frames division would still incur the variable manufacturing cost irrespective of whom the customer is (external or internal) and it is therefore irrelevant. Therefore, the benefit for the group is purely the saving in delivery costs. This benefit would be lost for the group if both divisions continue to contract with their external parties.

The minimum price that the frames division would accept is R3 550. That leaves them with a contribution of R3 550 – R2 800 = R750 per unit, which is equal to what they achieved on their external sales (R3 750 – R2 800 – R200). They might still be indifferent at this price. Setting the transfer price at R3 551, or higher, would increase their contribution per unit and make the transfer more attractive.

The maximum price that the RB division is prepared to pay is equivalent to the current market price of R3 750. With that price, they would not be worse off. However, the managers of the RB division would lose their autonomy, as the group head office would instruct them to buy from the frames division. If the transfer price is set R3 749, or lower, per frame, the RB division would arrive at the decision to buy from the frames division independently, since their contribution per completed unit would increase.

The managers of the two divisions would need to negotiate to find a price in this price range that is acceptable to them. It boils down to how the R200 saving in delivery cost should be split between the two divisions. The return on investment of each division would probably be calculated at various price levels (between R3 551 and R3 749) to see how it would influence this performance measure for each.

The calculations below are not part of the answer, but merely illustrate how the saving is attributed if each division claims the maximum saving.

Current arrangement

	Frames division (rand)		RB division (rand)	
External selling price	3 750		10 500	
Variable cost (incremental cost)	(2 800)		(4 250)	
Variable delivery cost	(200)			
External purchase cost per frame			(3 750)	
Contribution per unit	**750**		**2 500**	
Units	75 000		50 000	
Contribution per division	**56 250 000**	①	**125 000 000**	②
Total contribution for RBC Ltd	① + ②		**181 250 000**	

Transfer between the two divisions

i. Transfer at market price less savings

The transfer price is calculated using the market price less the costs that will be saved when the frames are not sold in the external market (i.e. the variable marketing and delivery costs).

	Frames division (rand)	RB division (rand)
Transfer price	3 550	
External selling price		10 500
Variable cost (incremental cost)	(2 800)	(4 250)
Transfer cost		(3 550)
Delivery costs	-	-
Contribution per unit	**750**	**2 700**

Units	50 000		50 000	
	37 500 000	①	**135 000 000**	
Contribution from external sales				
25 000 x (R3 750 – R2 800 – R200)	18 750 000			
Total contribution per division	**56 250 000**	①	**135 000 000**	②
Total contribution for RBC Ltd	① + ②		**191 250 000**	

ii Transfer at full market price

	Frames division (rand)		**RB division (rand)**	
Transfer price	3 750			
External selling price			10 500	
Variable cost (incremental cost)	(2 800)		(4 250)	
Transfer cost			(3 750)	
Delivery costs	-		-	
Contribution per unit	**950**		**2 500**	
Units	50 000		50 000	
	47 500 000	①	**125 000 000**	
Contribution from external sales				
25 000 x (R3 750 – R2 800 – R200)	18 750 000			
Total contribution per division	**66 250 000**	①	**125 000 000**	②
Total contribution for RBC Ltd	① + ②		**191 250 000**	

The net contribution position of RBC Ltd will increase by R10 000 000 (R191 250 000 – R181 250 000) if the frames are transferred from the frames division to the RB division. The transfer price will impact the performance of the two individual divisions and that of the company as a whole.

STUDY UNIT 13 LONG-TERM EXTERNAL PRICE SETTING

1. Introduction

In study unit 10, you learnt about costs that will play a role in determining the selling price of a product for special orders in the **short term**. In this study unit, we focus on the pricing decisions of products in the **long term** and how the required cost information differs from that required when making these long-term pricing decisions.

Please note that we covered short-term pricing decisions in study unit 10 and will therefore not pay further attention to it in this study unit.

Setting the selling price correctly for long-term regular customers is important for two reasons. Firstly, the level of the selling price will determine whether the customers are willing to pay that price and enter into a purchase transaction with the organisation, and secondly, the level of the selling price determines the profit that is generated by each sales transaction.

In this study unit, we focus on the function of cost information in pricing decisions. We also look at price-setting organisations, price-taking organisations, cost-plus pricing methods and pricing policies.

This study unit is based on **selected sections** from chapter 10 of your prescribed Drury textbook.

2. Function of cost information in pricing decisions

In this section, we explain the difference between a price-setting and a price-taking organisation as well as the importance of costing information to both these types of organisations.

Now study the following subsections in Drury, chapter 10, and then attempt the activity:

Chapter	Subsection
10	*The role of cost information in pricing decisions*

Now that you understand the difference between a price-setting and a price-taking organisation, do the following activity.

Activity 13.1

Consider the products or services sold by the following four companies and state whether the companies are price-setting or price-taking organisations:

	Company	**Products/Services**
1.	Telkom	Providing land line telephone options to clients
2.	Pick n Pay	Coffee product line
3.	Shoprite	Frozen food product line
4.	Eskom	Providing energy to most of South Africa's households and businesses

Solution to Activity 13.1

1.	Telkom	Price-setting organisation Telkom is the market leader in providing land line telephone services in South Africa.
2.	Pick n Pay	Price-taking organisation Coffee is not a customised product, but a product that is readily available. Identical coffee brands are sold at various retailers. Competition ensures that no individual market player can influence the price.
3.	Shoprite	Price-taking organisation Frozen food is not a customised product, but a product that is readily available. Identical frozen food brands are sold at various retailers. Competition ensures that no individual market player can influence the price.
4.	Eskom	Price-setting organisation Eskom is the market leader in providing energy to South Africans and currently has a monopoly in the country.

Note:
Make sure you understand the function of cost information in price-setting and price-taking organisations before you start the next subsection. The price-setter uses cost information to set

the price. The price-taker uses cost information to determine profitability and then decide whether to enter or stay in the market at the market-determined price.

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3. Price-setting organisations facing long-term pricing decisions

Now that you understand what a **price-setting organisation** is, we will explore how they use cost information to set prices. For now, we will only focus on two of the three approaches, namely pricing customised products and pricing non-customised products. In both these scenarios, cost-plus pricing is used. We will cover pricing non-customised products/services using target costing in later MAC modules.

Note:
Remember, we are dealing with **long-term pricing decisions** in this study unit. Therefore, any selling price determined should cover both direct variable costs and all fixed costs and generate a profit at the same time. Where more than one product is sold, allocating fixed costs between products becomes very important.

*****

3.1 Pricing customised products/services

Because highly customised products or services are likely to be sold to a single customer or a few customers only, it is not that difficult to estimate the sales volume of these products. Direct costs would normally be accumulated with a job-costing system. Prices would also differ between customised products as each product is unique.

Now study the following subsection in Drury, chapter 10, and the additional guidance, and then attempt the activity:

Chapter	Subsection
10	*A price-setting firm facing long-run pricing decisions.* - *Pricing customised products / services*

Make sure you understand the difference between the various cost bases and the impact they will have on your markup percentage.

The sophistication of the organisation's costing system will determine how much detailed costing information is available. Usually, direct variable costs are easier to determine. These, however, exclude all fixed costs. You therefore need a higher markup percentage to make a contribution towards the direct fixed costs of the production line (or factory) and the general fixed costs. The more costs the accountant can justifiably allocate to the product, the lower the markup percentage needs to be, as the base cost already includes most of the costs. See the table below for further explanation:

	Cost base	**Markup %**	**The markup should cover the following:**
1	Direct variable cost	High	Direct fixed costs **and** indirect costs (overheads) **and** profit
2	Total direct cost	Medium	Indirect costs (overheads) **and** profit
3	Total cost (Full/long-term cost)	Low	Profit

The table above and the table included in your textbook in this subsection clearly illustrate that different cost bases require different markup percentages, which will result in different selling prices. Therefore, organisations sometimes may need to re-evaluate the accuracy of their costing system to ensure that they are still making a profit.

Activity 13.2

Solve review problem 10.19 in the Drury textbook, 8th edition or review problem 10.21 in the 9th edition.

Solution to Activity 13.2

Find the solution to review problem 10.19 at the back of the Drury textbook, 8th edition or review problem 10.21 in the 9th edition.

3.2 Pricing non-customised products/services

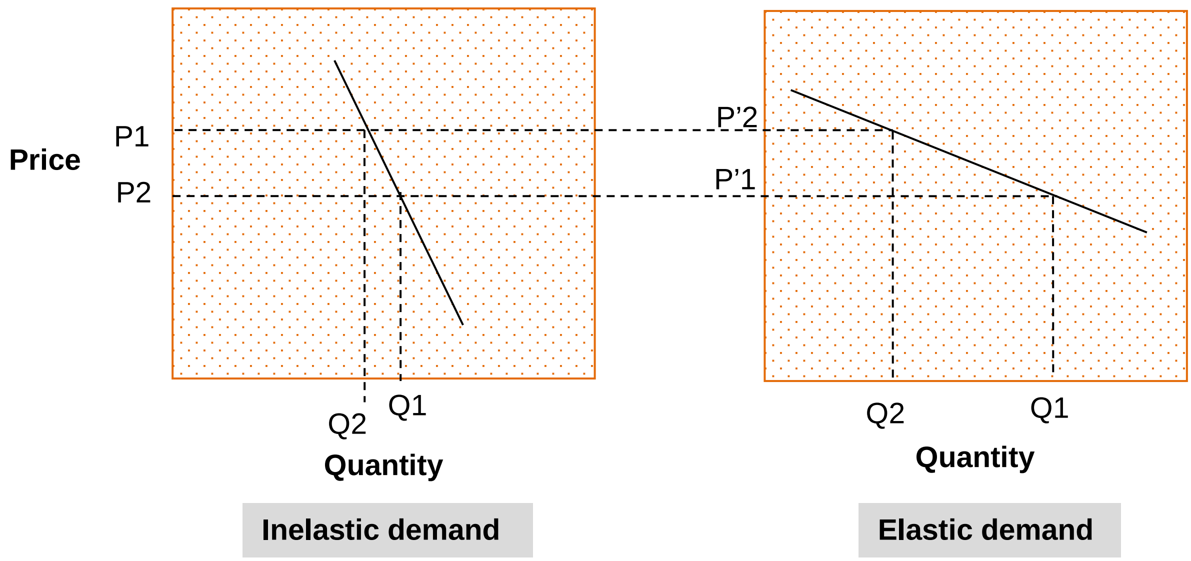
When dealing with non-customised products, the products are sold to thousands of customers, so it is more difficult to estimate the sales volume. We recommend that you estimate the selling price for a range of potential sales volumes. The selling price and cost structure that generates the most profit is usually the best option.
Now study the following subsections in Drury, chapters 2 and 10, and the additional guidance, and then attempt the activity:

Chapter	Subsection
2	*Incremental and marginal costs*
10	*A price-setting firm facing long-run pricing decisions.*
	- *Pricing non-customised products / services*

It is also important that you understand the concept of demand elasticity. This was covered in your economics module. You will remember that there is a negative correlation between demand and price. If the price increases, the demand will usually decrease. The percentage with which the demand decreases is an indication of the elasticity of the demand. If the percentage change in demand is less than the percentage change in the price, the product's demand is deemed inelastic.

Customers are not sensitive to price changes when it comes to necessities such as certain food items and luxury goods. When demand changes a lot after a small change in price, the product's demand is deemed elastic. Customers quickly change their purchasing behaviour or switch to competitor or substitute products. For a visual illustration refer to the graphs below reflecting the initial price (P_1) and demand quantity (Q_1) as well as the price (P_2) and demand quantity (Q_2) after a price increase.

Inelastic and Elastic Demand



Pay careful attention to example 10.1 in the Drury textbook, 8th or 9th edition. It illustrates the practical implications when a company makes a pricing decision based on little or no knowledge of the market (refer to case A) compared to a company that base their pricing decision on knowledge obtained from the market (refer to case B). You will notice that the volume (demand) increases as the selling price decreases.

Notes on example 10.1, case A

① The sales volume is firstly used to estimate the total cost structure (fixed and variable) at various production levels.

② The *Required sales revenues* line is calculated by adding the *Total cost* line and the *Required profit contribution* line.

③ The *Required selling price to achieve target profit contribution* line is calculated by dividing the *Required sales revenues* lines by the *Sales volume* line.

④ The *Unit cost* line is calculated by dividing the *Total cost* line by the *Sales volume* line.

Notes on example 10.1, case B

① The *Estimated sales revenue* line is calculated by multiplying the *Potential selling price* line with the *Estimated sales volume at the potential selling price* line

② The *Estimated profit* line is calculated by deducting the *Estimated total cost* line (based on different volumes) from the *Estimated total sales revenue* line.

*****

Activity 13.3

Solve review problem 10.13 in the Drury textbook, 8th or 9th edition.

Erratum:

Replace the cost per unit of R24 for the demand equal to 1 100 units with of a cost per unit of R22.

Solution to Activity 13.3

Find the solution to review problem 10.13 at the back of the Drury textbook, 8th or 9th edition.

You may also calculate the total profit at each level to determine the selling price at which the company profits are maximised. Refer to the table below:

Demand in units	Selling price per unit	Total revenue	Marginal revenue	Cost per unit	Total cost	Marginal cost	Total profit	Marginal profit
(a)	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**
1 100	48	52 800		22	24 200		28 600	
1 200	46	55 200	2 400	21	25 200	1 000	30 000	1 400
1 300	**45**	58 500	3 300	20	26 000	800	**32 500**	2 500
1 400	42	58 800	300	19	26 600	600	32 200	-300

Note:

- The **marginal** revenue/cost/profit is calculated by deducting the **total** revenue/cost/profit at a specific demand level from the total revenue/cost/profit at the **previous** level.
- Total profits will increase as long as marginal revenue exceeds marginal cost. The optimum selling price is where marginal revenue = marginal cost (or the last price for which marginal revenue still exceeds marginal cost).
- Setting prices where marginal revenue is ≥ marginal cost is an important concept when decision making involves different levels of pricing and costs. Make sure you understand this concept.

Enrichment activity 13.4

Answer the questions posed in Real World Views 10.2 in your Drury textbook, 8th or 9th edition.

Solution to Enrichment activity 13.4

Find the solution to the questions in Real World Views 10.2 online via your CourseMate account.

It is important to note that these methods only assist management in preparing initial estimates of selling prices for discussion. The prices calculated may still be adjusted based on management's knowledge of the market and their judgement. The financial, marketing and sales managers will work closely with each other in this respect.

4. Price-taking organisations

In the previous section, you focused on the importance of cost information for price-setting organisations. In this section, we will briefly discuss the importance of cost information for **price-taking organisations**. We covered the basics of the function of cost information in the pricing decisions section of this study unit. Unlike price-setting organisations, price-taking organisations do not use cost information as the basis for determining selling prices, but rather for deciding which products and/or services to sell (or to continue selling) in the light of their market prices.

Now study the following subsection in Drury, chapter 10, and the additional guidance, and then attempt the activity:

Chapter	Subsection
10	*A price-taking firm facing long-run product mix decisions*

Pay careful attention to exhibit 10.1 in your Drury textbook, 8th or 9th edition and the explanation provided. Also make sure you understand the difference between cost allocation to the products and the product lines when using the direct costing versus the absorption costing approaches.

A product or product line will not necessarily be discontinued after a periodic profitability analysis. Management need to consider many factors before they decide to discontinue a product or product line. The profitability analysis will only assist them to focus on the costs allocated to certain products and product lines and to re-engineer or redesign the production of the products in order to be more cost effective. It is very important to consider the contribution of each product to covering the joint and general fixed overheads before you decide to discontinue a product or product line.

Note:
We already studied the application of the principles regarding the profitability of products in a product mix and in discontinuation decisions in topic 6. Therefore, there are no further activities or questions in this study unit.

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5. Cost-plus pricing

You have now studied the use of cost information in both price-setting and price-taking organisations. In this section, we will look at cost-plus pricing in more detail.

Now study the following **theory** subsections in Drury, chapter 10, and then attempt the activity:

Chapter	Subsection
10	*Surveys of practice relating to pricing decisions*
10	*Establishing target markup percentages*
10	*Limitations of cost-plus pricing*
10	*Reasons for using cost-plus pricing*

Activity 13.5

You are the plant accountant for company Alpha. You recently invested R5 000 000 in the expansion of your factory to manufacture a new product. The cost price per unit of this product amounts to R150, and according to your market research there will be an annual demand of 25 000 units. The target rate of return on capital invested is 12%.

REQUIRED

Determine the target markup per unit as well as the target price per unit.

Solution to Activity 13.5

$$\text{Target markup} = \frac{12\% \text{ x R5 000 000}}{25\ 000}$$

$$= \frac{\text{R600 000}}{25\ 000}$$

$$= \text{R24}$$

$$\text{Target price} = \text{R150 + R24}$$

R174

Activity 13.6

Refer to your calculation in activity 13.2. Then answer the second part of the question in review problem 10.14 (a) in the Drury textbook, 8^{th} or 9^{th} edition by explaining the advantages and disadvantages of each method used in activity 13.2.

Solution to Activity 13.6

Find the solution to review problem 10.14 (a) at the back of the Drury textbook, 8^{th} or 9^{th} edition.

Make sure that you understand what other factors management consider when adjusting the calculated price based on the methods discussed. You should also use cost information and other market and customer information before arriving at the recommended price. We discuss some of these aspects in the next section.

6. Pricing policies

In the previous subsections we pointed out that the costing information served only as a basis for the final pricing decisions made by management. Management consider many other factors before they determine the final price, resulting in adjustments to the price originally calculated. A pricing policy will assist management to be consistent when making such amendments to the calculated prices.

Now study the following subsection in Drury, chapter 10, and then attempt the activity:

Chapter	Subsection
10	*Pricing policies*

Enrichment activity 13.7

Answer the questions posed in Real World Views 10.3 in your Drury textbook, 8^{th} or 9^{th} edition.

Enrichment activity 13.7

Find the solution to the questions in Real World Views 10.3 online via your CourseMate account.

Activity 13.8

Solve review problem 10.14 (b) in the Drury textbook, 8^{th} or 9^{th} edition.

Solution to Activity 13.8

Find the solution to review problem 10.14 (b) at the back of the Drury textbook, 8^{th} or 9^{th} edition.

You will now understand that many factors play a role in determining the final price of a product, and that the price of a product can change frequently due to factors impacting it. Management should also consider the stage at which the product is in the product life cycle and should determine on a regular basis whether the product is still profitable based on the current and expected future demand.

7. Summary

In this study unit, you have learned how to

- differentiate between price-setting and price-taking organisations
- distinguish between customised and non-customised products
- explain the relevant cost information that should be included in the long-term external pricing decisions for price-setting organisations
- identify the role played by different levels of fixed cost in the price-taking organisation when management decides to discontinue a product or product line from the product mix
- describe different cost-plus pricing methods for setting the long-term selling price
- explain the limitations and benefits of cost-plus pricing
- identify and describe different pricing policies from a marketing perspective

In study unit 14, we will explore how to do multi-product cost-volume-profit analysis.

8. Self-assessment theory review questions

After working through the relevant sections in the textbook and the guidance and activities provided in this study unit, you should now be able to answer the review questions in the Drury textbook, 8^{th} or 9^{th} edition covering the theory at the end of chapter 10.

Find the solutions to these theory questions on the page(s) indicated next to the specific question.

You can ignore questions 10.5, 10.6 and 10.12 as these will be covered in later MAC modules.

9. Online enrichment activity

Complete the online activities for chapter 10 that relate to the specified learning outcomes.

10. Self-assessment questions

After working through all the relevant sections in the textbook and the guidance and activities provided in this study unit, you should now be able to attempt the following self-assessment questions. **Please note that any reference to short-term pricing should be treated as revision as it was covered in topic 6.**

QUESTION 13.1

Ella Ltd recently started to manufacture and sell product DG. The variable cost of product DG is R4 per unit and the total weekly fixed costs are R18 000.

The company has set the initial selling price of product DG by adding a mark-up of 40% to its total unit cost. It has assumed that production and sales will be 3 000 units per week.
The company holds no stocks of product DG.

REQUIRED

a. Calculate for product DG:

   i. the initial selling price per unit; and
   ii. the resultant weekly profit.

c. Distinguish briefly between penetration and skimming pricing policies when launching a new product.

[Source: Drury textbook, 8th edition, 2012: 10.15(a) and (c)]

SOLUTION TO QUESTION 13.1

a. Initial selling price = [Variable cost (R4) + unit fixed cost (R18 000/3000)] x 1,4 = R14

   Profit for the period = Contribution (3000 x R10) – fixed costs (R18 000) = R 12 000

c. Cost information is only one of many variables that must be considered in the pricing decision. The final price that is selected will depend upon the pricing policy of the company. A price-skimming policy is an attempt to exploit those sections of the market that are relatively insensitive to price changes. For example, high initial prices may be charged to take advantage of the novelty appeal of a new product when demand is not very sensitive to price changes. A skimming pricing policy offers a safeguard against unexpected future increases in cost, or large fall in demand after the novelty appeal has declined. Once the market becomes saturated, the price can reduced to attract that part of the market that has not yet been exploited. A skimming pricing policy should not be adopted when a number of close substitutes are already being marketed. Here demand is likely to be very sensitive to price changes, and any price in excess of that being charged for a substitute product by a competitor is likely to lead a large reduction in sales.

   A penetration pricing policy is based on the concept of charging low prices initially with the intention of gaining rapid acceptance of the product. Such a policy is appropriate when close substitutes are available or when the market is easy to enter. The low price discourages potential competitors from entering the market and enables a company to establish a large share of the market. This can be achieved more easily when the product is new, than later on when buying habits have become established.

[Source: Drury textbook, 8th edition, 2012: 10.15(a) and (c)]

QUESTION 13.2

A manufacturer of electrical appliances is continually reviewing its product range and enhancing its existing products by developing new models to satisfy the demands of its customers. The company intends to always have products at each stage of the product life cycle to ensure the company's continued presence in the market. Currently the company is reviewing three products:

Product K was introduced to the market some time ago and is now about to enter the maturity stage of its life cycle. The maturity stage is expected to last for ten weeks. Each unit has a variable cost of R38 and takes 1 standard hour to produce. The Managing Director is unsure which of four possible prices the company should charge during the next ten weeks. The following table shows the results of some market research into the level of weekly demand at alternative prices:

Selling price per unit	R100	R85	R80	R75
Weekly demand (units)	600	800	1 200	1 400

Product L was introduced to the market two months ago using a penetration pricing policy and is now about to enter its growth stage. This stage is expected to last for 20 weeks. Each unit has a variable cost of R45 and takes 1,25 standard hours to produce. Market research has indicated that there is a linear relationship between its selling price and the number of units demanded, of the form $P = a - bx$. At a selling price of R100 per unit demand is expected to be 1 000 units per week. For every R10 increase in selling price the weekly demand will reduce by 200 units and for every R10 decrease in selling price the weekly demand will increase by 200 units.

Product M is currently being tested and is to be launched in ten weeks' time. This is an innovative product which the company believes will change the entire market. The company has decided to use a market skimming approach to price this product during its introduction stage.

The company currently has a production facility which has a capacity of 2 000 standard hours per week. This facility is being expanded but the extra capacity will not be available for ten weeks.

REQUIRED

a. Calculate which of the four selling prices should be charged for product K, in order to maximise its contribution during its maturity stage.

b. Compare and contrast penetration and skimming pricing strategies during the introduction stage, using product M to illustrate your answer.

c. Explain with reasons, for each of the remaining stages of M's product life cycle, the changes that would be expected in the

i. average unit production cost

ii. unit selling price

[Source: Drury textbook, 8th edition, 2012: 10.17 excluding (a)(ii)]

SOLUTION TO QUESTION 13.2

a. The total contribution at each selling price for product K is:

Selling price per unit (R)	100	85	80	75
Less: Variable cost per unit (R)	38	38	38	38
Contribution per unit (R)	62	47	42	37
Demand (units)	600	800	1 200	1 400
Total contribution (R)	37 200	37 600	50 400	51 800

Capacity remaining to produce L (2 000 hours – 1 400 hours for product K)	=	600
Product L maximum production (600 hours/ 1,25 hours)	=	480

In order to maximise contribution during the maturity stage product K should be sold at R75 per unit.

b. See 'pricing policies' in Chapter 10 of your Drury textbook 8th or 9th edition for the answer to this question. The answer should also point out that it is appropriate to use a price skimming policy for product M since it is an innovative product that is likely to change the entire market.

c. i. In the growth stage, production costs per unit are likely to decline because of economies of scale and the impact of the learning and experience curves (see Chapter 23). In the maturity stage unit production costs are likely to remain fairly constant because the learning effect will have ended and the workforce will be experienced in the operating processes. In the decline stage production costs per unit may increase due to lower volumes.

ii. Because the product is innovative with low competition the initial price during the early growth stage will be high in an attempt to recover the development costs of the product. Competitors will be attracted to the product by its high price and will seek to compete with it by introducing similar products. To deter competitors entering the market the company should reduce its price during the growth stage of the product's life cycle. Price reductions during this stage may also be implemented to make it more affordable to other market segments. As the product enters the maturity stage the price will need to be lowered so as to provide a minimal contribution to fixed costs. Fixed costs should have been covered at earlier stages of life cycle so the focus will be on marginal rather than full cost pricing.

[Source: Drury textbook, 8th edition, 2012: 10.17 excluding (a)(ii)]

QUESTION 13.3

Solve review problem 10.6 (a) in the Drury student manual, 8th edition or review problem 10.5 (a) in the 9th edition.

SOLUTION TO QUESTION 13.3

Find the solution to review problem 10.6 (a) at the back of the Drury student manual, 8th edition or review problem 10.5 (a) in the 9th edition.

Notes:

Calculation of variable costs per product

The question states that fixed cost is recovered at 200% of the variable cost per unit.

Let variable cost be equal to **y**

Therefore, the total cost	=	fixed cost + variable cost
	=	(2y) + y
	=	3y

The cost of the products needs to be divided by 3, and only the solution to y is included as variable cost.

Calculation of contribution per processing hour

To calculate the contribution per processing hour, you need to divide the production contribution per unit by the number of hours needed to produce the unit.

Total contribution per product

Remember, when you work out the total contribution per product, you need to use the amounts calculated for the production unit, and not the contribution per processing hour.

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PART 3, TOPIC 8 – ADVANCED ASPECTS OF SENSITIVITY ANALYSIS

INTRODUCTION

In MAC2601, you learnt the basics of cost-volume-profit (CVP) analysis and about the sensitivity of profit to changes in selling price, costs and volume; probability theory and decision trees. CVP and sensitivity analyses aid management in making many types of decisions, for example decisions on budgeting, performance measurement, what product to manufacture or sell, pricing policies and marketing strategy. Most decision making takes place in conditions of uncertainty. It is important for management to realise that their inputs into projection models are sensitive to a variety of factors. This study unit will explain some of the tools we can use to measure the uncertainty of and predict the variations in outcomes.

Topic 8 is made up of the following study unit:

STUDY UNIT 14 ADVANCED SENSITIVITY ANALYSIS

LEARNING OUTCOMES

After studying this topic, you should be able to

- construct contribution and profit-volume graphs as alternatives to the break-even chart
- apply CVP analysis in a multi-product setting
- explain the meaning of operating leverage
- describe the role of operating leverage in measuring risk and the way in which it influences profits
- evaluate the operating leverage of different organisations
- identify and explain the assumptions on which CVP analysis is based
- use computerised models to determine sensitivities to changes in the different CVP variables
- explain the meaning of standard deviation and the coefficient of variation as measures of risk
- recommend courses of action based on elementary scenarios involving standard deviation and the coefficient of variation

ASSUMED PRIOR KNOWLEDGE

In your MAC2601 module, you mastered the following learning outcomes:

- used CVP analysis to determine the expected effect of decisions and events on profit or the variables that influence profitability
- made suitable recommendations based on the above calculations
- determined the sensitivity of profit to changes in selling prices, costs and volumes
- determined what actions or decisions are required to achieve a predetermined outcome in different scenarios by using appropriate techniques
- differentiated between biased and unbiased probabilities
- described the different concepts relating to probability measurements
- described the concept and components of a decision tree as well as conditional profits
- identified qualitative factors that may have to be considered when a decision is made in conditions of risk and uncertainty

Please refer to your second year guide to refresh your knowledge.

For another perspective, you may also refer to the following subsections in your prescribed Drury textbook:

Chapter	Subsection
7	*External and internal reporting*
7	*Some arguments in support of variable costing*
7	*Some arguments in support of absorption costing*
8	*Linear CVP relationships*
8	*A numerical approach to cost-volume-profit analysis*
8	*The profit-volume ratio*
8	*Relevant range*
8	*Margin of safety*
8	*Constructing the break-even chart*
8	*Cost-volume-profit analysis assumptions*
8	*Separation of semi-variable costs*
12	*Risk and uncertainty*
12	*Probability distribution and expected values*
12	*Attitudes to risk by individuals*
12	*Decision tree analysis*

STUDY UNIT 14 ADVANCED SENSITIVITY ANALYSIS

1. Introduction

CVP analysis is an effective technique which assists management in understanding the interaction between cost, volume and profit. It can be very useful for planning and control purposes, as it highlights how sensitive profit is to various factors. We will investigate some further applications of CVP principles that can assist management with decision making.

Variability in outcomes adds risk to any decision about the future actions of an organisation. Therefore, we will also explore some additional statistical indicators that can assist management in deciding between different options.

This study unit is based on **selected sections** from chapters 8 and 12 in your prescribed Drury textbook.

2. The importance of relevant range and other assumptions

Economists have shown that many costs actually act in a curvilinear fashion (i.e. following a curved line). Although costs are not exactly linear, curvilinear costs can be estimated with a straight line **within the relevant range**. This gives accountants the opportunity to predict cost behaviour with mathematical linear equations. Although we covered the underlying assumptions of CVP analysis in MAC2601, we include them again because they are very important.

Now study the following subsections in Drury, chapter 8, and attempt the activity:

Chapter	Subsection
8	*Curvilinear CVP relationships*
8	*Linear CVP relationships*
8	*Cost Volume Profit analysis assumptions*

Revision activity 14.1

Solve review problem 8.13 in the Drury textbook, 8th or 9th edition.

Solution to Revision activity 14.1

Find the solution to review problem 8.13 at the back of the Drury textbook, 8th or 9th edition.

Enrichment activity 14.2

Answer the questions posed in Real World Views 8.1 in your Drury textbook, 8th or 9th edition.

Solution to Enrichment activity 14.2

Find the solutions to the questions in Real World Views 8.1 online via your CourseMate account.

Note:
If you do not take these assumptions into account when analysing the data, it will lead to incorrect decisions.

*****

3. Other features of Cost volume profit (CVP) analysis

In MAC2601, you learnt about the break-even graph. In this section, we will reveal alternative graphical methods of presenting CVP analysis.

Now study the following subsections in Drury, chapter 8, and attempt the activity:

Chapter	Subsection
8	*Alternative presentation of cost-volume-profit analysis*

The contribution graph differs from the break-even graph in that it starts with the plotting of the variable cost line. The fixed costs are then plotted on top of that to get to the total cost line. The break-even chart graph starts with the fixed cost line on which the variable costs are plotted.

The profit-volume graph clearly shows the profit/loss at each sales volume level. At zero sales, the loss is equivalent to the fixed cost, so that becomes your intercept on the y-axis.

Enrichment activity 14.3

Answer the questions posed in Real World Views 8.3 in your Drury textbook, 8th or 9th edition.

Solution to Enrichment activity 14.3

Find the solutions to the questions in Real World View 8.3 online via your CourseMate account.

Activity 14.4

Solve review problem 8.18 in the Drury textbook, 8th or 9th edition.

Solution to Activity 14.4

Find the solution to review problem 8.18 at the back of the Drury textbook, 8th or 9th edition.

Note:
Please make sure you know the difference between these graphs, as you may be required to construct them in assignment or examination questions. You will not earn marks for presenting the wrong graph.

*****

4. Multi-product CVP analysis (common fixed costs)

When an organisation sells more than one product, we can still use break-even analysis to identify the number of units the organisation needs to sell of each product in the sales mix to break even. Organisations with a wider product range usually have fixed overhead costs that are not directly related to individual products but are incurred to support the organisation as a whole. These **common fixed costs** should also be covered by the contribution generated by all the products.

When we calculate the break-even point in a multi-product organisation, we follow the same pattern as in a single product organisation. The numerator will be the combined fixed costs, while the denominator will be the weighted average contribution margin. The contributions are "weighted" to give an average contribution for the products.

Now study the following subsections in Drury, chapter 8, and attempt the activities:

Chapter	Subsection
8	*Multi-product cost-volume-profit analysis*

With multi-product CVP analysis, we must make an assumption regarding the sales mix. Should the sales mix change, the calculated amounts (weighted contribution) would also change. Please work through example 8.2 in your Drury textbook, 8th or 9th edition carefully. In this example, the optimal product mix is 800 units of the deluxe machine and 400 units of the standard machine. The break-even sales **value** would be as follows

Break-even sales value	=	(800 units x R300) + (400 units x R200)
	=	R240 000 + R80 000
	=	R320 000

However, if you are required to calculate the break-even sales value only, you need not determine the sales mix first. The calculation would then be as follows:

Break-even sales value	=	Fixed costs/ contribution ratio
	=	(R117 000 + R39 000)/ (R234 000/R480 000)
	=	R156 000/ 0,4875
	=	R320 000

Activity 14.5

Solve review problem 8.15 in the Drury textbook, 8th or 9th edition.

Solution to Activity 14.5

Find the solution to review problem 8.15 at the back of the Drury textbook, 8th or 9th edition.

Note:
In this question, the break-even sales value is required, but because no totals are given, you need to calculate the weighted contribution first.

Activity 14.6

Solve review problem 8.17 in the Drury textbook, 8th or 9th edition.

Solution to Activity 14.6

Find the solution to review problem 8.17 at the back of the Drury textbook, 8th or 9th edition.

Alternative solution

Let revenue of product Z = x

Sales	=	fixed costs	+	Variable costs	+	Profit
20 m + 10 m+ x	=	5,5 m	+	8,5 m + 18 m + 0,75x	+	1 m
0,25x	=	3 m				
x	=	12 m				

Note:
In multi-product organisations, it is more useful from a management and control perspective to work with the number of units required to break-even for each product than with the combined break-even sales value. This is because the sales values per unit might differ extensively between the various products.

*****

5. Operating leverage

Operating leverage is the ratio of an organisation's fixed costs to its variable costs. Organisations with a higher proportion of fixed costs and a lower proportion of variable costs have a high operating leverage, while organisations with a lower proportion fixed costs and a higher proportion variable costs have a low operating leverage.

Now study the following subsection in Drury, chapter 8:

Chapter	Subsection
8	*Operating leverage*

Enrichment activity 14.7

Answer the questions posed in Real World Views 8.4 in your Drury textbook, 8th or 9th edition.

Solution to Enrichment activity 14.7

Find the solutions to the questions in Real World Views 8.4 online via your CourseMate account.

Activity 14.8

You have the following information for two organisations:

	ABC Ltd	**XYZ Ltd**
Contribution	8 000	8 000
Profit	2 000	6 500

REQUIRED

Which organisation is more vulnerable to a downturn in the economy?

Solution to Activity 14.8

	ABC Ltd	**XYZ Ltd**
Operating leverage	8 000/2 000	8 000/6 500
	= 4	= 1,2308

ABC Ltd has a higher operating leverage due to its high fixed costs (8 000 – 2 000 = R6 000). They would need to sell a lot more units in order to break even and therefore are more vulnerable to changes in their sales volumes.

6. Information technology (IT) and CVP analysis

Modern software packages allow managers to run various CVP scenarios, testing sensitivities to a variety of factors.

Now study the following subsection in Drury, chapter 8:

Chapter	Subsection
8	*The impact of information technology*

There are many computer programmes one can use to do calculations for decision-making purposes. In this module we use Microsoft Excel.

Activity 14.9

The following information relates to Tuli Traders:

Sales	15 000 units @ R100 per unit
Variable cost per unit	R30
Total fixed costs	R800 000

REQUIRED

e. Use a spreadsheet to calculate the following:

i. current profit
ii. profit if 18 000 units are sold
iii. profit if the selling price decreases to R90 per unit

For ii. and iii. you should assume that all other inputs stay the same.

f. For ii. and iii., calculate the sensitivity of the profit to the change in scenario.

Solution to Activity 14.9

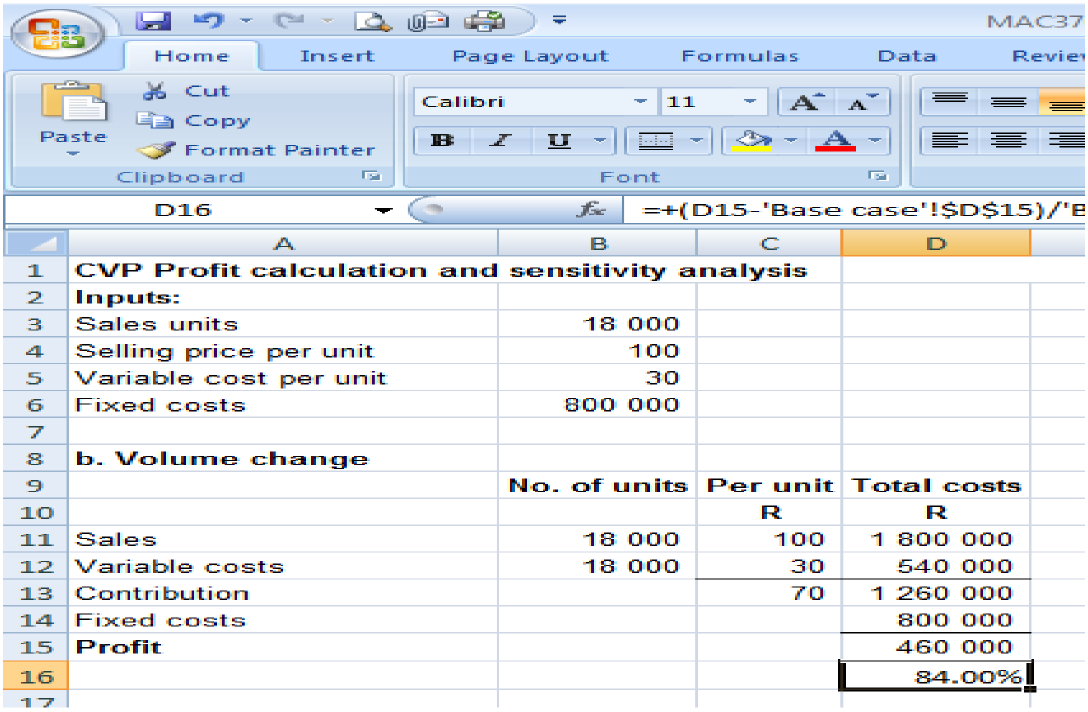
Start by creating fields for all the input variables. Then create your profit statement with the necessary formulae fields.

	A	B	C	D
1	**CVP Profit calculation and sensitivity analysis**			
2	**Inputs:**			
3	Sales units	15 000		
4	Selling price per unit	100		
5	Variable cost per unit	30		
6	Fixed costs	800 000		
7				
8	**a. Base case**			
9		**No. of units**	**Per unit**	**Total costs**
10			**R**	**R**
11	Sales	15 000	100	1 500 000
12	Variable costs	15 000	30	450 000
13	Contribution		70	1 050 000
14	Fixed costs			800 000
15	**Profit**			250 000
16				

By enabling the "Show formulas" function under the "Formulas" tab, you can see what the formulas should be:

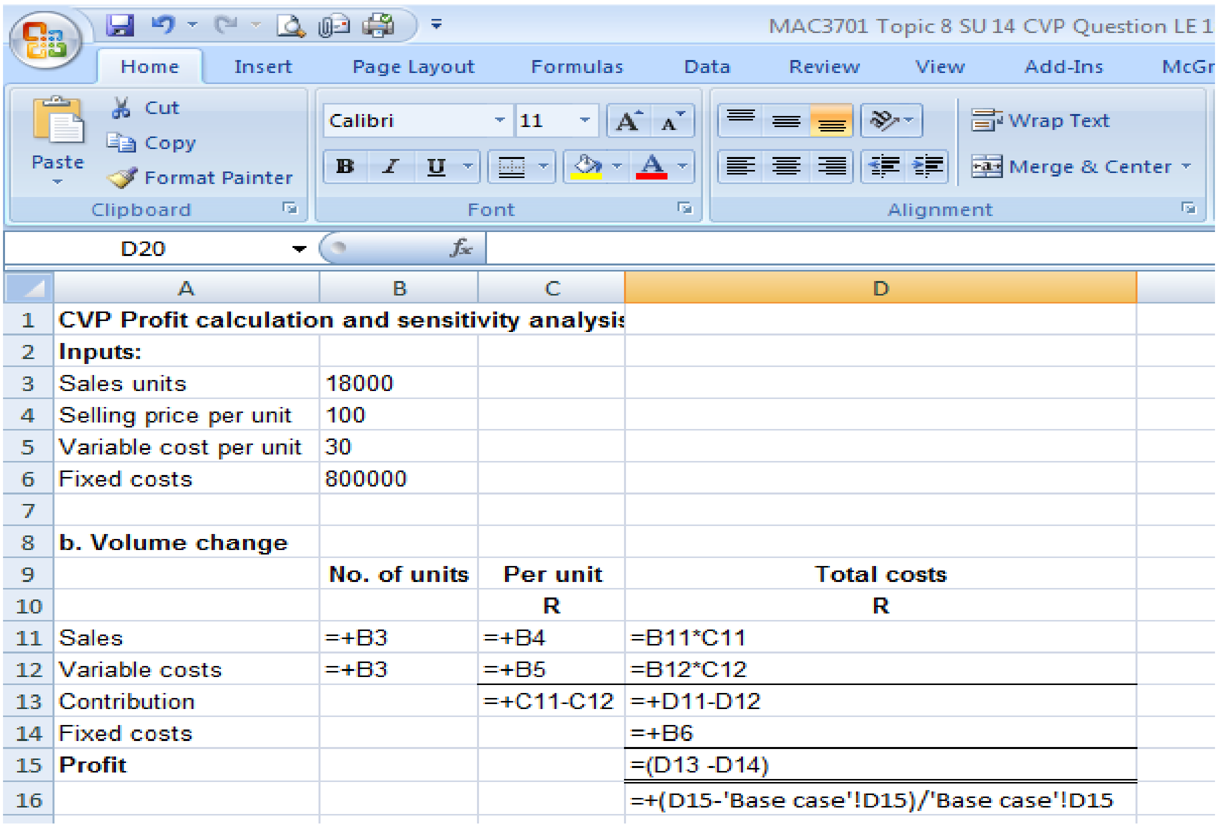
	A	B	C	D
1	**CVP Profit calculation and sensitivity analysis**			
2	**Inputs:**			
3	Sales units	15000		
4	Selling price per unit	100		
5	Variable cost per unit	30		
6	Fixed costs	800000		
7				
8	**a. Base case**			
9		**No. of units**	**Per unit**	**Total costs**
10			**R**	**R**
11	Sales	=+B3	=+B4	=B11*C11
12	Variable costs	=+B3	=+B5	=B12*C12
13	Contribution		=+C11-C12	=+D11-D12
14	Fixed costs			=+B6
15	**Profit**			=(D13 -D14)

If you changed the relevant input field (B3 and B4), your profit statement would update automatically. You should save each scenario to its own sheet in the spread sheet file so that you have the different versions separately.



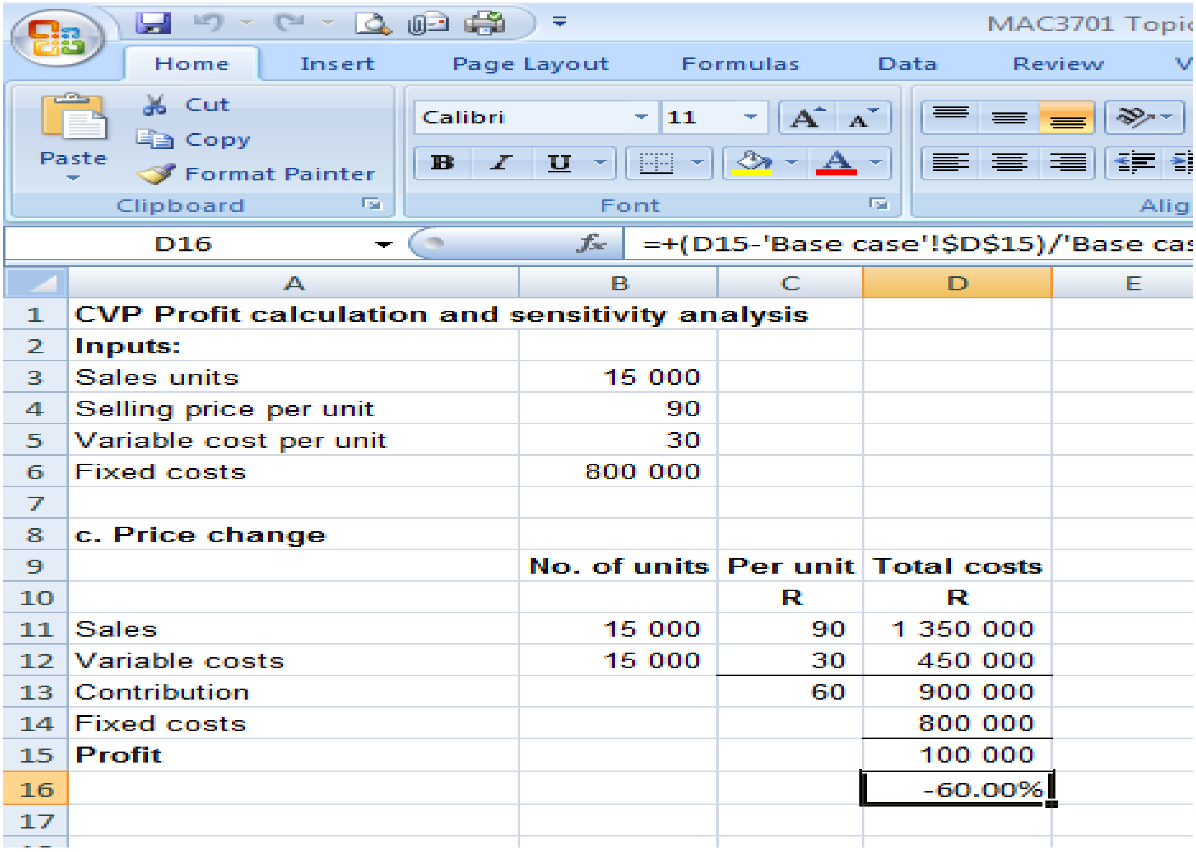
D16 =+(D15-'Base case'!D15)/'B

	A	B	C	D
1	**CVP Profit calculation and sensitivity analysis**			
2	**Inputs:**			
3	Sales units	18 000		
4	Selling price per unit	100		
5	Variable cost per unit	30		
6	Fixed costs	800 000		
7				
8	**b. Volume change**			
9		**No. of units**	**Per unit**	**Total costs**
10			**R**	**R**
11	Sales	18 000	100	1 800 000
12	Variable costs	18 000	30	540 000
13	Contribution		70	1 260 000
14	Fixed costs			800 000
15	**Profit**			460 000
16				84.00%



MAC3701 Topic 8 SU 14 CVP Question LE 1

	A	B	C	D
1	**CVP Profit calculation and sensitivity analysis**			
2	**Inputs:**			
3	Sales units	18000		
4	Selling price per unit	100		
5	Variable cost per unit	30		
6	Fixed costs	800000		
7				
8	**b. Volume change**			
9		**No. of units**	**Per unit**	**Total costs**
10			**R**	**R**
11	Sales	=+B3	=+B4	=B11*C11
12	Variable costs	=+B3	=+B5	=B12*C12
13	Contribution		=+C11-C12	=+D11-D12
14	Fixed costs			=+B6
15	**Profit**			=(D13 -D14)
16				=+(D15-'Base case'!D15)/'Base case'!D15



	A	B	C	D	E
1	**CVP Profit calculation and sensitivity analysis**				
2	**Inputs:**				
3	Sales units	15 000			
4	Selling price per unit	90			
5	Variable cost per unit	30			
6	Fixed costs	800 000			
7					
8	**c. Price change**				
9		**No. of units**	**Per unit**	**Total costs**	
10			**R**	**R**	
11	Sales	15 000	90	1 350 000	
12	Variable costs	15 000	30	450 000	
13	Contribution		60	900 000	
14	Fixed costs			800 000	
15	**Profit**			100 000	
16				-60.00%	
17					

We also suggest that you calculate the break-even number of units and safety margins for each scenario, as these are crucial indicators.

7. Standard deviation and the coefficient of variation

In MAC2601, you learnt about probabilities, expected values (outcomes) and decision trees. Management are also interested in the level of uncertainty of expected future profits, sales or costs. One would have much more confidence in a forecast of sales units where the probable outcome is between 10 000 and 15 000 units than where it is between 3 000 and 21 000 units. The spread of possible outcomes is called the dispersion, and that is an indication of risk. We can measure this risk by means of standard deviation and the coefficient of variation.

Now study the following subsections in Drury, chapter 12, and attempt the activity:

Chapter	Subsection
12	*Measuring the amount of risk [Drury, 9th edition]*
	or Measuring the amount of uncertainty [Drury, 8th edition]

Standard deviation provides a quantified estimate (an absolute value, e.g. 3 258 units, or R876 of sales) of the uncertainty of future outcomes. The coefficient of variation is useful, because the standard deviation of data must always be understood in the context of the mean (expected value) of the data. In contrast, the actual value of the coefficient of variation is independent of the unit in which the measurement has been taken, so it is a dimensionless number. (It is relative and expressed as a percentage.) When you need to compare sets of data with different units of measurement (e.g. hours and meters) or widely different means, you should use the coefficient of variation instead of standard deviation.

Management often have limited time available. Therefore, it is better for them to compare expected values and coefficients of variation when they have to choose between many different alternatives.

Note:

① You do not need to know how to calculate standard deviation or the coefficient of variation, but you must be able to interpret them when making decisions regarding uncertain future profits. Calculating the expected value is straightforward, and you should know how to do that.

② Standard deviation and the coefficient of variation are also used in investment portfolio analyses. You will learn more about those in your MAC3702 module.

****

Activity 14.10

Management is considering two marketing plans. The outcomes of each are as follows:

	TV campaign	**Flyers at traffic lights**
Expected outcome/Mean profit	R540 288	R640 203
Standard deviation in profits	R36 964	R154 491

REQUIRED

Do a risk analysis and advise management on the most suitable plan.

Solution to Activity 14.10

On the surface, it seems as if the flyers campaign is the most profitable. However, the uncertainty is higher, as evidenced by the higher standard deviation. We should therefore calculate the coefficient of variation for each.

	TV campaign	Flyers at traffic lights
Coefficient of variation	R36 964 / R540 288	R154 491 / R640 203
	= 6,84%	= 24,13%

The range of outcomes for the TV campaign is grouped more closely together (smaller standard deviation). The coefficient of variation is also smaller. Because the outcome of the TV campaign is more certain (less risky), you should recommend it. However, the risk appetite of management should also be taken into account. A risk-seeking management team might be prepared to take a chance on a campaign with a 24% coefficient of variation.

8. Summary

In this study unit, you learnt to

- construct contribution and profit-volume graphs as alternatives to the break-even chart
- apply CVP analysis in a multi-product setting
- explain the meaning of operating leverage
- describe the role of operating leverage for measuring risk and the way in which it influences profits
- evaluate the operating leverage of different organisations
- identify and explain the assumptions on which CVP analysis is based
- use computerised models to determine sensitivities to changes in the different CVP variables
- explain the meaning of standard deviation and the coefficient of variation as measures of risk
- recommend courses of action based on elementary scenarios involving standard deviation and the coefficient of variation

This is the final study unit.

9. Self-assessment theory review questions

After working through the relevant sections in the textbook and the material provided in this study unit, you should now be able to answer review questions 8.1 to 8.10 and 12.1 to 12.7 in the Drury textbook, 8th or 9th edition covering the theory at the end of chapters 8 and 12.
Find the solutions to these theory questions on the page(s) indicated next to the specific question.

10. Online enrichment activity

Complete the online activities for chapters 8 and 12 that relate to the specified learning outcomes.

11. Self-assessment questions

After working through all the relevant sections in the textbook and the guidance and activities provided in this study unit, you should now be able to attempt the following self-assessment questions.

QUESTION 14.1

XYZ Ltd produces two products and the following budget applies for 20X2:

	Product X	Product Y
Selling price	R6	R12
Variable cost	R2	R4
Contribution margin	R4	R8
Fixed cost apportioned	R100 000	R200 000
Units sold	70 000	30 000

You are required to calculate the break-even points for each product and the company as a whole and comment on your findings.

[Source: Drury textbook, 8th edition, 2012: 8.21]

SOLUTION TO QUESTION 14.1

Break-even point = $\dfrac{\text{Fixed cost}}{\text{Contribution per unit}}$

Product X	25 000 units (R100 000/R4)
Product Y	25 000 units (R200 000/R8)
Company as whole	57 692 units (R300 000/R5.20①)

Calculation: ① $= \dfrac{(70\ 000 \times R4) + (30\ 000 \times R8)}{100\ 000 \text{ units}}$

= R5,20

The sum of the product break-even points is less than the break-even point for the company as a whole. It is incorrect to add the product break-even points because the sales mix will be different from the planned sales mix. The sum of the product break–even points assumes a sales mix of 50 percent to X and 50 percent to Y. The break-even point for the company as a whole assumes a planned sales mix of 70 percent to X and 30 percent to Y. CVP analysis will yield correct results only if the planned sales mix is equal to actual sales mix.

[Source: Drury textbook, 8th edition, 2012: 8.21]

QUESTION 14.2

Answer question 8.5 in the Drury student manual, 8th edition or question 8.6 in the 9th edition.

SOLUTION TO QUESTION 14.2

Find the solution to question 8.5 at the back of the Drury student manual, 8th edition or question 8.6 in the 9th edition.

QUESTION 14.3

Answer question 8.7 in the Drury student manual, 8th edition or question 8.9 in the 9th edition.

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SOLUTION TO QUESTION 14.3

Find the solution to question 8.7 at the back of the Drury student manual, 8th edition or question 8.9 in the 9th edition.

QUESTION 14.4

Mr Naidoo wants to invest R200 000 in a new machine. The estimated annual cash flows and probabilities based on different output levels are as follows:

Net cash flow R	Probability
65 000	0,15
100 000	0,20
130 000	0,30
160 000	0,20
200 000	0,15

REQUIRED

a. Calculate the weighted amounts and the expected value for the annual cash flow.

b. Calculate the coefficient of variation (standard deviation is R41 570).

SOLUTION TO QUESTION 14.4

a. The expected value of each option

Net cash flow R	Probability	Weighted amount R
65 000	0,15	9 750
100 000	0,20	20 000
130 000	0,30	39 000
160 000	0,20	32 000
200 000	0,15	30 000
		130 750

b. The coefficient of variation

= Standard deviation / expected value
= R41 570/130 750
= 0,3179
= 31,8%

IMPORTANT INFORMATION:
This annexure contains important information about your module.

Dear Student

CONCEPTS IN MANAGEMENT ACCOUNTING
We want to emphasise the importance of a thorough knowledge of these developments in the management accounting field. You should be able to answer examination questions pertaining to the study material included in this annexure.

1. Activity-based management (ABM)
2. Benchmarking
3. Value added
4. Just in time (JIT)
5. Life-cycle costs
6. Non-financial indicators (NFI)
7. Quality costing
8. Target costing (TC)
9. The theory of constraints and throughput accounting
10. Balance scorecard
11. Enterprise Resource planning

1. ACTIVITY-BASED MANAGEMENT (ABM)

Activity-based management (ABM) is the analysis and costing of activities in order to improve work processes in an organisation. ABM is used to improve the performance of an organisation and to manage costs. The primary objective in managing activities is the costing of activities, followed by secondary activities such as costing of products, services or customers.

An ABM analysis involves a series of steps which commences within a department and is expanded to other departments when activities and processes cut across them. The major steps in the ABM analysis are the following:

- Obtain existing financial information to determine the current operating costs.
- Determine the major processes that occur in the department.
- Identify the inputs and outputs of each of the major processes.
- Determine the activities and list all tasks that are part of each activity.
- Identify all resources (people, computer time, furniture, space) used for each activity and determine whether they can be directly or indirectly traced to the activity.
- Define output measures (financial or non-financial) for each major activity.
- Define performance measures (financial and non-financial) for each major activity.
- Record the actual performance linked to the performance measures.
- Determine how well activities are performed. If data is available about other organisations, it should be obtained and used (benchmarking).
- Brainstorm improvement ideas.

ABM analyses lead to a better process understanding by means of focussing on work, understanding of cross-organisational impacts, and recognising interdependencies across the organisation. ABM leads to improved organisational decisions through available information on the costs of the design of the product, cost reductions owing to benchmarking, and easier planning and budgeting. ABM encourages good organisational behaviour by emphasising the importance of process knowledge, that continuous improvement is expected, and the empowerment of employees through participation in the improvement procedures.

ABM could have a negative impact on people because of the natural resistance to change, the perception of being observed doing their jobs, and that the efficiency of the improved system might lead to job losses.

ABM serves to provide better product cost data that enables organisations to make product or customer-related decisions and to reduce product and process costs. ABM is concerned with the activity as the object of interest, while activity-based costing (ABC) is concerned with secondary cost objects, such as products and customers. ABM is interested in how much an activity costs while ABC is interested in how other cost objects, such as products, utilise or consume activities. The consumption of activities is used to trace and assign costs to these other cost objects.

2. BENCHMARKING

Benchmarking consists of the investigating and identifying of best practices and utilising them as standards to improve processes and activities. Benchmarking is a systematic search for best practices from whatever source, to be utilised in improving an organisation's practices. It is a technique for achieving continuous improvement. The services, products and activities of an organisation are measured against those of top performing world-class organisations, and against practices either internal or external to the organisation. The latest developments, and best practices and methods could then be incorporated, directly or with adaptations, within various sectors of the organisation.

Benchmarking as a means of searching for information comprises of a systematic set of steps. The benchmarking team begins the procedure with planning and organisation. Team members are selected and the team would include the accountant or management accountant. The team then benchmarks their own process in terms of measurements in numbers, and practices in each step of the process. In the following step, information is obtained on what to benchmark and what information to ask for. The necessary approvals are gained and plans finalised for exchange visits. At the benchmarking organisation's site parallel information in terms of measurements and practices is sought. Finally, the benchmarking team analyses the data, plans, proposes changes and follows through with activities.

3. VALUE ADDED

Just as profits are returns to shareholders, value added refers to the returns earned by workers, capital providers and authorities. The concept of added value is a measure of performance to determine the increase of wealth for an ongoing enterprise. Value-added activities would include activities which are essential to a customer, such as the arrival of perishable goods at the designate time and in good condition. Value-added activities are essential to the functioning of an organisation, such as record keeping.

Activities pertaining to value added would include the value chain in the extended enterprise. The extended enterprise encompasses the organisation's customers, suppliers, dealers and recyclers. It captures the interdependences across these separate organisations.

The value chain can therefore be used to identify all the cost-incurring activities. Investments could be focussed on those activities which offer the greatest scope for efficiencies and cost reduction. Efficient utilisation of capacity can lead to the building up of the market share by investing resources in selling and marketing. If money can be saved, some activities might be outsourced.

4. JUST IN TIME (JIT)

The basic JIT approach starts with the customer initiating and driving the activity within the supplying organisation in such a way which will promptly meet demand. Where a customer order can trigger the initial acquisition of necessary resources and they can be converted fast enough to deliver on time to the customer, then the carrying costs of stock and work-in-process becomes a non-value-added characteristic of the organisation. Purchasing has to be arranged so that suitable materials are available just as the first work department in the production process is ready for them. To work efficiently an appropriate layout which streamlines the movement of work in work-in-process is necessary. The productive resources of labour and capital equipment must be scheduled for availability when needed and efforts made to eliminate bottlenecks and reduce production lead time.

In order to assess the continuity of supply, the purchasing organisation's accountants need to be involved in assessing the supplier's financial viability. Although the purchase costs of supplies from sources which can satisfy these requirements may exceed that available elsewhere, the benefits of JIT will often outweigh them, so creating a demand for secure, quick and flexible supplies.

A JIT approach is financially attractive. Although the benefits of holding stock are largely lost, the costs and risks associated with stockholding are avoided. These costs would be the following:

- risk of damaging stocks
- risk of stock becoming obsolete
- opportunity costs of tying up funds in stock
- costs of storing and moving stock internally
- risk of holding losses (where supply prices are falling)

In addition to the operation of an organisation according to the JIT principles stock levels, the JIT approach allows management to address and solve other problems. Production management has to be developed to cope with bottlenecks, absenteeism, scheduling and the effective balancing of resources. There is a need for total quality management to ensure the smooth flow of good output. The availability of operating capacity has to be ensured by policies of total preventative maintenance.

5. LIFE-CYCLE COSTING

Life-cycle costs are the accumulation of costs for activities that occur over the entire life cycle of a product from inception to abandonment. Effective life-cycle cost management consists of the following components:

- Life-cycling costing. 80-85% of life-cycle costs are committed by decisions made early in the production life cycle. It is possible to design out costs to be incurred later on during the life cycle of the product, such as costs for remediation purposes.
- Product life-cycle management. This would involve costs incurred in the management, production and marketing during all stages of the production process, including disposal and maintenance costs.
- Organisational structure. Various forms could be considered, such as vertical and horizontally differentiated groups which would fragment activities during the life cycle. With multi-functional teams each team would be responsible for better management through the whole life cycle.
- Responsible cost reduction methods. Reducing costs over the entire life cycle of the product would increase the competitive advantage. During periods of low market prices for commodities, this would ensure the survival of the organisation.

In addition the assessment of life-cycle costs during the life cycle of the product, changes and potential changes in the life cycle should be determined at the planning and budget stage. The optimum sequence of events in the life cycle should be determined at the planning stage. These planning strategies would prevent inefficient allocation of resources which might result in lower profits.

6. NON-FINANCIAL INDICATORS

Non-financial performance measures can give indications of resource consumption patterns and therefore cost incurrence. The easiest way to manage costs is often to measure, report and control the physical variables which can mean more than monetary indicators. Non-financial performance measures include areas such as quality, delivery, market position and human resources. Examples of other non-financial measures are the number of customer complaints, pollution levels, flexibility, simplicity of operations, timeliness, organisation image, safety, ethical attitudes of decision makers, morale and skills. The ideal situation would be frameworks where both financial and non-financial information are combined for both internal and external disclosure purposes.

The appropriate internal and external non-financial information will depend on the industry and on the strategy of each organisation. Each organisation knows its critical success factors for measuring performance in these areas both over time and against its competitors. Some non-financial aspects are difficult to measure, such as customer complaints indicating customer satisfaction, as all customers do not complain when they are not entirely satisfied with the product or service.

7. QUALITY COSTING

What is quality?

Quality is defined as customers' satisfaction with total experience of a product or service. Quality has two dimensions, namely features and performance.

What are quality costs?

Quality costs are costs incurred to ensure that a product or service meets or even exceeds customers' expectations. One has to spend (incur cost) on quality in order to gain strategic benefit. The spending on quality has not only to do with providing a feature customers want, but also making sure that the feature performs at the level expected by customers. Spending on quality has to be focussed on those aspects of quality which are most valued by customers.

Quality costing can be defined as the measurement and management of costs related to providing a customer's required level of product or service performance including costs incurred to monitor and prevent problems in product performance, and costs incurred to remedy problems that do occur.

Background to quality costing

A USA engineer, Walter Shewhart and a statistician, W. Edwards Deming used statistical methods to explain variation in manufacturing processes. Their focus was on measuring and controlling variation in order to minimise production of defective units. The Shewhart-Deming approach measured quality by the number of defects (defective products) which fell outside the acceptable limits for production variation.
The technical focus of this approach was expanded after World War II by Deming, Juran and Taguchi to encompass customer expectations and societal considerations. This lead to the introduction of the idea of building quality in, rather than inspecting products for defects after production.

When the Japanese industry tried to gain competitive advantage by implementing a manufacturing system with no inventory and faster time to market in the 1950s, they asked Deming for help since such a modern manufacturing system would require extremely high standards of quality. This lead to the "Total Quality Management" (TQM) movement in which quality costing plays a major role.

The basis and objective of quality costing

The basis of a quality costing system is to build quality into the product from the designing phase since quality cannot be added by inspection. Inspection, rework and product recalls do not add quality. These are non-value-added activities. By building quality into the product from the start, time savings occur from eliminating the non-value-added activities and this time saving results in cost savings.

The objective of quality costing is to help management maximise the value customers receive from a product or service. Failures of product performance result in costs for both the manufacturer and his customers.

For a manufacturer a product's total cost does not only include the manufacturing cost thereof but also any additional costs incurred due to quality problems, i.e. to fix any defects. For a customer the total cost of ownership of a product consists of the purchase price as well as all costs of ownership i.e. repair and maintenance costs.
Failures of product performance results in costs for both the manufacturer and the customers. When product performance is improved, there is less need for reworking of defective units, fewer product recalls and fewer warranty claims and thus time and costs are saved. Costs incurred by customers over the life of the product (life-cycle costs) will be reduced because there will be less operating, maintenance and repair costs when the product or service is of high quality.

Quality costs as a strategic goal

In today's global environment strategic goals should focus on quality, cost and time. In order to pursue quality as a strategic goal, a good quality cost measuring system is needed. This will also enhance the other two strategic goals of reasonable cost and timely delivery.

A good quality cost measuring system will support effective quality management and will help a company to compete on the basis of having a comparative advantage with regard to quality.

How to measure and report quality costs in order to achieve the quality goals.

Quality costs are not visible in traditional management accounting systems because it is combined with other costs, mostly overheads. When quality costs are not identified separately it is difficult for management to determine spending on quality and it is not possible to assess the effectiveness of the spending on quality. It cannot be determined whether quality spending is focussed on the right items or whether the spending on quality is yielding benefits.

Companies that do measure quality costs classify total quality costs into four categories, namely prevention, appraisal, internal failure and external failure costs (Figure 1).

Figure 1: Classification of total quality costs into four categories

PREVENTION COSTS	APPRAISAL COSTS	INTERNAL FAILURE COSTS	EXTERNAL FAILURE COSTS
Costs incurred to prevent quality problems from occurring e.g. training of workers	Costs incurred by measuring and monitoring activities which are related to quality e.g. time which is spent on inspection of output in order to determine the % of defective units which were manufactured	Costs incurred to remedy defects which are discovered before the product goes to the customer e.g. rework of defective units	Costs incurred to remedy defects discovered by the customer e.g. warranty repair costs

- M. Lötter

8. TARGET COSTING

What is a target cost?

A target cost is the allowable amount of cost that can be incurred on a product so that the required profit on the product can still be earned.

Definition of target costing

Target costing is a system of profit planning and cost management that is price led, customer focussed, design centered and cross functional. It initiates cost management from the earliest stages of product development which is applied throughout the product life cycle by involving the whole value chain.

Background of target costing

Target costing started in Japan in the 1960s when the Japanese took the American idea of "value engineering", originating from General Electric during World War II and developed it into a dynamic cost reduction and profit planning system. Value engineering was an approach of how to produce products in the face of shortages of certain parts. The idea was to design products which could consist of fewer parts.

Leading Japanese companies which use target costing are Toyota, Nissan, Sony, Cannon etc. The USA only started adopting target costing in the late 1980s when Chrysler had lost market share to Japanese companies.

The use of target costing

Target costing is used as a strategic profit planning and cost management tool. It differs from traditional cost management tools, such as break-even analysis, because it anticipates costs before they are incurred and focuses on customer requirements and competitive threats. Products and process designs are continually improved.

Benefits of target costing

A company's competitive position can improve due to the improvement of quality, reduction of costs and accelerated time to market.

Quality is improved because it is an explicit objective of the product development process. When costs are determined, no compromises are made with regard to the features, performance and reliability which the customers require.

The reduction of costs is a central objective of target costing. Cost reduction is however not attained by managing costs after production has started, but costs are managed before they are incurred by using a clever customer-focussed design process. Cost planning is thus a part of profit planning.

Since products and processes are designed simultaneously, time from concept to the marketing of the product is reduced. No time is needed to correct design errors once manufacturing has started, because the manufacturing process is already determined while the product is designed.

Conceptual foundation of target costing

- Costs are established by first determining a competitive market price. The required profit margin is then subtracted from the market price. What is left is the target cost. This is an example of price led costing. Product and process design are then used to reduce product cost so that it is equal to the allowable target cost.

- Cost analysis is guided by customer requirements about quality, price and timeliness. The target cost must not only yield the target profit, but also allow the manufacturer to provide the features customers expect. Target costing is therefore said to be customer driven.

- Cost reduction efforts are attained by simultaneously designing the product and the manufacturing process (concurrent engineering). This eliminates expensive features and minimises the need for changes after production has started.

- A joint responsibility rests on cross-functional teams such as design, engineering, sales, marketing, material procurement, cost accounting, service and support. The cross-functional team is responsible for the entire product from the initial concept through to production.

- Cost of ownership to the customer is minimised by life-cycle costing. All life-cycle costs of owning a product, such as purchase price, operating costs, maintenance and repairs and disposition costs are considered.

- A target costing system is based on the long term, mutually beneficial relationship with suppliers, distributors, dealers, service and support personnel and recyclers in order to focus cost reduction efforts throughout the value chain.

Four stages in the target costing process (Figure 2)

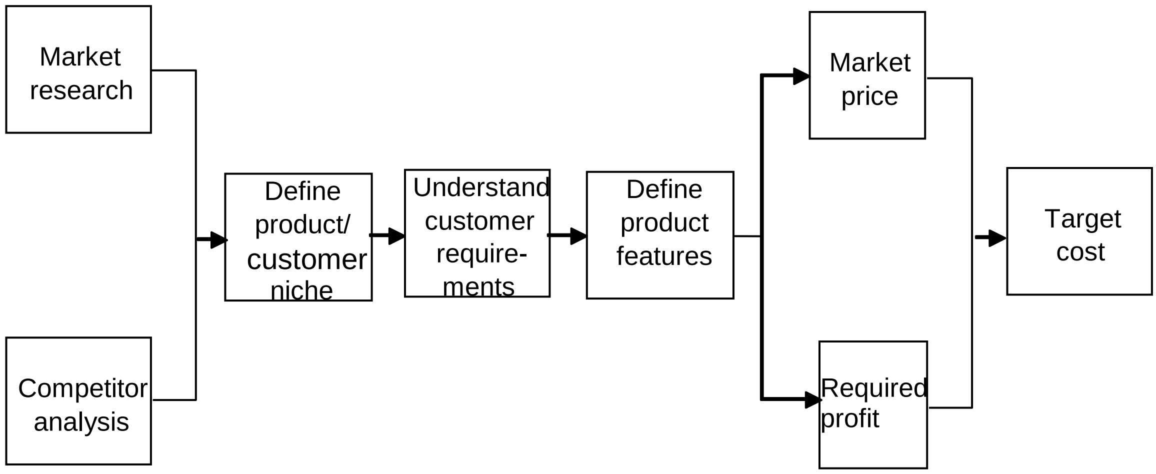
Stage 1: Product planning - define the product and customer niche.

Stage 2: Concept development and feasibility testing - develop a product concept and test its feasibility.

Stage 3: Design development - transform the feasible product concept into a detailed product design.

Stage 4: Production - after the final design is released, production can begin.

Figure 2: Major activities in establishing target costs



M Lötter

9. THE THEORY OF CONSTRAINTS AND THROUGHPUT ACCOUNTING

9.1 The theory of constraints (TOC)

Eliyah M. Goldratt and J. Cox first introduced the concept in *The Goal* in 1984 that was eventually called the Theory of Constraints (TOC) by Goldratt in 1990. According to TOC the organisation's goal must be reached for which certain conditions such as good customer service, quality products and employee satisfaction are necessary. Irrespective of the form of organisation, the goal will only be reached if throughput is increased. Throughput can only be increased if the constraint that is preventing the desired output is identified and minimised. In TOC the sale must have taken place before it can be classified as throughput.

The organisation must be seen as a system that consists of various processes in which tasks are performed that depend on each other. Five steps of focussing were developed to improve the total performance of the system. These steps are: to find the constraint, exploit the constraint to maximise output, to subordinate everything to the constraint, to elevate the constraint and to continue repeating the steps once a constraint is broken. It is important to realise that there will always be a constraint that cannot be elevated cost effectively. For this reason it is essential to first determine where the next constraint is going to be, before elevating the existing constraint.

When these steps are applied in a production organisation, inventory must be released according to the pace set by the constraint with a buffer to prevent the constraint from being starved for work, should a problem emerge in a non-constraint. The result will be less inventory with lower levels of work-in-progress.

The correct measurements are important as these measurements must judge the impact of decisions on the global goal of the organisation. The measurements used in TOC are throughput (T), investment (I) and operating expense (OE). Throughput (T) is defined as sales less total variable expenses. According to TOC all labour and overhead costs are fixed and since there are no other significant variable costs, other than direct materials, throughput is calculated as sales revenue less direct material. Inventory (I) is defined as all the money invested to purchase that which the system intends to sell. This includes machinery and buildings. According to conventional financial accounting this definition of inventory is identical to the definition of assets. The only asset not included under inventory in TOC is material inventory, which is seen as a variable cost and is deducted from sales to determine throughput.

Operating expense (OE) is all the money the system spends in turning inventory into throughput. This includes manufacturing expenses as well as selling expenses in accordance with the definition of throughput.

The measurements of TOC are not new, but their scale of importance is. To increase sales, throughput must increase and operating expense and inventory must decrease. Some improvement can be acquired if inventory and operating expense are decreased but it will not result in ongoing improvement.

The following are the most important financial measurements used in the theory of constraints.

1. Throughput = Sales revenue - Direct material cost

2. Net profit = Throughput - Operating expense

3. Return on capital $= \dfrac{\text{Throughput}}{\text{Investment}}$

When a physical constraint is experienced and a product mix decision must be made, the following ratio is used to determine the product mix:

4. Throughput per constraint minute

$$= \frac{\text{Sales revenue - Material cost}}{\text{Minutes on constraint resource}}$$

The theory of constraints can be seen as a management accounting system that could revolutionise business approaches.

9.2 Throughput accounting

David Waldron, who also worked with Goldratt, developed throughput accounting with associate David Galloway. The concept is very similar to TOC, but it is more an accounting-based technique. The measurements used and its sequence are the same as that of TOC. The main concern of throughput accounting is the rate at which an organisation can generate profits.

Its key measure is:

$$\text{Return per time period} = \frac{\text{Sales revenue - Material cost}}{\text{Time period}}$$

As time is a crucial part of the ratio, managers will automatically focus their attention on what is preventing the organisation to produce at optimal levels, thus identifying and eliminating the bottleneck.

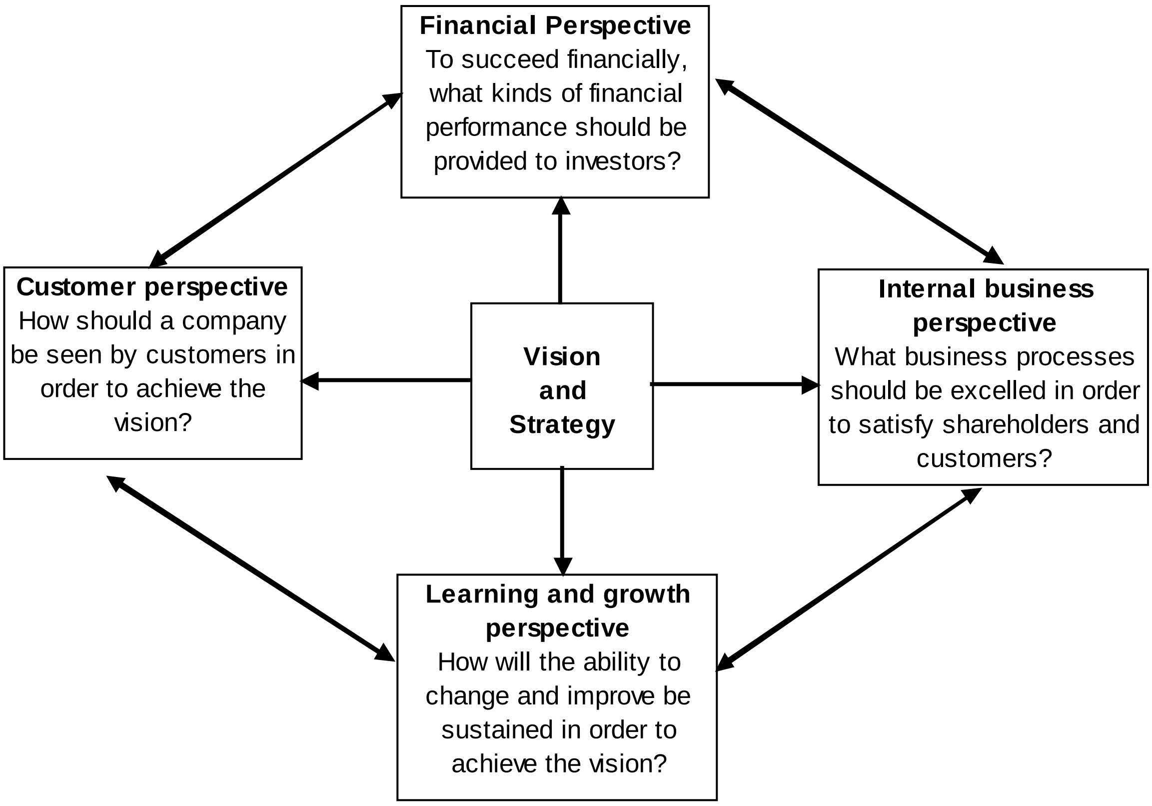
In throughput accounting activity-based costing is used for product costing which is the main difference between TOC and throughput accounting.
- ES de Klerk

10. THE BALANCE SCORECARD

The balance scorecard approach to performance measurement uses a set of financial and non-financial measures that relate to the critical success factors of an organisation. The balance scorecard approach helps to keep management focussed on all of a company's critical success factors, not only the financial ones, by integrating financial and non-financial performance measures. The balance scorecard derives its name from the balance it attempts to achieve among an organisations' strategy and key performance indicators.

The balance scorecard approach requires looking at performance from four different but related perspectives, namely financial, customer, internal business and learning and growth. This strategy is summarised in figure 3.

Figure 3 The Balance scorecard strategy



11. ENTERPRISE RESOURCE PLANNING (ERP)

ERP systems are used to collect, organise, report and distribute data from all aspects of a company's business and to transform that data into useable knowledge necessary for managers to make proper business decisions.

An ERP system digitally records every business transaction a company makes, regardless of whether it is input through accounting, purchasing, sales or manufacturing, and automatically updates all connected systems to reflect each transaction. Real-time information is provided to decision makers throughout the company. The ultimate goal of ERP system is to get the right information to the right people at the right time. ERP systems can allow organisations to achieve higher levels of profitability.