MANAGEMENT ACCOUNTING AND CONTROL

PERFORMANCE MANAGEMENT FOR SUSTAINABLE BUSINESS

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Preface

This book emerged from our desire to bring together the fields of management accounting and management control in a single, coherent, and accessible volume. Our ambition has been to offer a text that is firmly rooted in academic research while remaining directly applicable. In doing so, we have placed emphasis on the themes and perspectives that we believe matter most in today's organisations.

In the first part of the book, *Management Accounting*, we aim to equip readers with the ability to calculate different costs for different purposes and to understand how these calculations can facilitate managerial decision-making.

In the second part of the book, *Management Control*, we discuss how control practices can be designed and combined to achieve strategic alignment of all organisational members, especially in contemporary organisations striving for sustainable performance.

We hope this book will serve both teaching and practice alike – undergraduate and graduate students, instructors seeking to build a strong conceptual and practical foundation, and executives, controllers, and information system designers looking for tools that can be readily deployed in their organisations.

The authors
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PART 1

MANAGEMENT ACCOUNTING

CHAPTER 1

What is Management Accounting?

1. The Roles of Accounting Information

Organisations implement an information system to collect, process, and distribute data and knowledge across the entire organisation. The internal accounting system is a subset of this, focusing on financial transactions, regulatory compliance, and cost tracking. Importantly, internal accounting information serves two purposes: (1) providing information for planning and decision making, and (2) motivating and monitoring individuals in organisations. It complements the financial accounting system, which focuses on external users.

First, internal accounting information provides insight into the organisation's financial health, enabling managers to make better decisions. This is referred to as the **decision-facilitating role** of accounting information and is the focus of the first part of this book (Part 1 – Management Accounting). **Management accounting** information thus refers to costing and performance information intended to improve managers' knowledge, allowing them to make better informed decisions.

Second, internal accounting information should provide information that helps align the interests of managers and owners, since a conflict of interest exists between them. More specifically, owners desire high profits to maximise firm value, while managers prefer to maximise their own utility in terms of easier jobs (more leisure), higher wages, and more fringe benefits. To motivate managers to direct effort and attention to activities that benefit the organisation, organisations design a **management control system** to monitor, measure, evaluate, and reward managerial behaviour. This is referred to as the **decision-influencing role** of accounting information and is the focus of the second part of this book (Part 2 – Management Control).

Together, the management accounting and control system leverage both financial and non-financial data from the organisation's information system to evaluate performance, align organisational behaviour, and support decision making.

2. Different Costs for Different Purposes

The purpose of Part 1 of this book is to offer insight into the most important management accounting techniques, aiming to provide accurate and relevant information to managers to support them in decision-making. In **Chapter 2**, we introduce the reader to the fundamental concepts of cost and management accounting. Starting from a motorcycle example, the notion of cost is explained. We also focus on different cost classifications as well as the organisation of costs and income statements by function.

In **Chapter 3** the problem of allocating indirect costs is examined in greater depth. Complex business processes that involve a combination of small and large production volumes require more detailed allocation keys than the traditional (volume-based) methods used in Chapter 2. Activity-based costing (ABC) and time-driven activity-based costing (TDABC) allow indirect costs to be allocated more accurately across different products, services, orders, or customers. These techniques are especially relevant for companies facing a large proportion of indirect costs, where understanding the factors that drive those costs is of strategic importance.

Chapter 4 addresses a wide range of short-term decisions. As captured by the phrase 'different costs for different purposes', we illustrate that short-term decisions should primarily be supported by a sound understanding of variable costs and the contribution of various products and services, and that relying solely on the full cost may lead to poor decisions. We begin by clarifying the difference between absorption and variable costing, followed by break-even analysis: how much must be sold at a minimum to cover all costs? Next, we deal with other common questions in practice: should a company accept an order for which the customer offers only a low selling price; when is it more advantageous for a company to buy something, and when is it better to make it in-house; which mix of products or orders will yield the highest short-term profit for the company?

Companies facing strong price pressure in the market should not only have an accurate and detailed understanding of the costs of their products and services, they should also make considerable efforts to continually reduce these costs. The technique of variance analysis is explained in **Chapter 5**, which is the final chapter of Part 1. By comparing actual costs and revenues in detail with the budgeted costs and revenues, it becomes possible to identify the causes of any variances. Revealing these variances provides a starting point for preventing them in the future. As such, in the final chapter of Part 1, we move from cost calculation to cost control.

CHAPTER 2

Fundamental Concepts of Cost and Management Accounting

1. Introduction

Before addressing the fundamental concepts of costing, we shall first present an example to clearly illustrate the problem of costing and to make the definitions more tangible. We shall frequently refer to this basic example in the following chapters.

2. Motorcycle Example

A company manufactures a single type of motorcycle and normally employs 178 workers. The motorcycle consists of an engine, purchased at 250,00 euros, and a set of diverse materials, which are manufactured in-house using specialised machinery. The cost of materials required to produce these parts amounts to 375,00 euros. The total machine time required to produce these parts is 20 machine hours, and the total labour time is also 20 hours. Additionally, the assembly of the motorcycle requires 10 hours of labour.

There are two types of workers in the factory. On the one hand, there are the 175 direct workers who complete parts and assemble the motorcycles. These workers earn 20,00 euros per hour and can normally perform 1.750 hours of productive work per year. On the other hand, there are 3 indirect workers responsible for maintaining the machinery, working 1.750 hours annually at 26,00 euros per hour. The machinery can operate for 200.000 machine hours per year. Depreciation costs (for the factory building and machinery) amount to 200.000,00 euros per year. The consumption of energy and utilities is 2,50 euros per machine hour.

The company incurs annual salary costs of 250.000,00 euros for general management, accounting, and planning. The office building is rented at 2.500,00 euros per month. Operating costs of general management amount to 51.400,00 euros annually (covering the depreciation of furniture, computers, office supplies, etc.). The sales department incurs annual salary costs of 135.000,00 euros and 5.000,00 euros for third-party services. Interest on the total capital is 175.500,00 euros. As the capital is largely invested in production elements, this interest is considered a production cost. The total capital consists of 60% equity and 40% debt. The company is required to repay a loan at a rate of 75.000,00 euros annually in the coming years.

Fifty percent of general and administrative costs are assigned to the production department, with the remaining fifty percent assigned to the sales department.

The motorcycles are sold for 2.500,00 euros per unit. Upon sale, a commission of 50,00 euros per motorcycle (2% of the selling price) is payable to the sales representative. The company normally produces 10.000 units annually.

What is the cost of the motorcycle?

3. The Notion of Cost

3.1 Definition of the Term 'Cost'

'Cost' is defined as the monetary value of the sacrifices made in utilising production resources. When calculating a cost, the following questions must be addressed:

1. What is the nature of the performance?
2. Which categories of costs are required for this performance?
3. How is the value of these costs determined?

3.2 Manufacturing Cost Versus Total Cost

First, we must clearly define the subject of our cost calculation. The **cost object** is anything that the cost analyst may want to estimate the cost of. This can refer to a product, a service, a product group, etc. Additionally, we must differentiate between the production process and the sales process.

If the performance is the **manufactured product or service**, specifically at the point when the production process is completed, we refer to this as the **manufacturing cost**. This is the total monetary value of the production resources required to produce the finished product or service. To arrive at the manufacturing cost price in a manufacturing company, one must aggregate all costs incurred from the delivery of raw materials to the factory to the delivery of the finished product to the warehouse.

If the performance pertains to the **sold product or service**, the sales process is included in addition to the production process. In this case, we refer to the **total cost**, which is equal to the manufacturing cost plus any costs required to complete the sale (i.e., non-manufacturing costs).

3.3 Categories of Costs

The production of any output (product or service) requires the utilisation of production resources. For the purpose of costing, these resources must first be identified.

a. Distinction Between Costs and Cash Outflows

In identifying the constituent elements of cost, it is important not to confuse costs with cash outflows. The notion of **cash outflows** (or **expenditures**) pertains to liquid assets (cash, bank accounts). In contrast, **costs** (or **expenses**) represent the sacrifices made during the production process to achieve the performance. The timing of payment for those sacrifices is independent of their actual utilisation. A cost is incurred when value is sacrificed, not when the production resource is acquired or paid for.

For example, the purchase of a machine (paid immediately) is a cash outflow, whereas the annual depreciation of that machine constitutes a cost. Let us consider a few more examples.

Costs that are not cash outflows:
- Depreciation
- Provisions
- Usage of materials from existing inventory

Costs that are also cash outflows (out-of-pocket expenses or cash expenses):
- Personnel costs
- Immediately consumed third-party services (e.g., fuel, office supplies, water, electricity)

Cash outflows that are not costs:
- Repayment of a loan
- Payment of a debt to a supplier
- Payment for the purchase of a building or machine

A similar distinction can be made between **cash inflows** and **revenues**.

Revenues that are not cash inflows:
- Sales on credit
- Inventory increases of finished goods or work in progress

Revenues that are also cash inflows (cash revenues):
- Cash sales

Cash inflows that are not revenues:
- Receipt of borrowed funds (incurring debt)
- Customer payments
- Receipt of a new capital contribution

Finally, it is important to note that the difference between cash inflows and outflows, when added to the existing cash, represents the **cash balance**, as shown on the balance sheet. Revenues and costs, on the other hand, appear in the income statement. The difference between revenues and costs constitutes the pre-tax profit for the fiscal year. The difference between cash revenues and cash expenses is defined as **cash flow**[1] (in its purest sense). Therefore, the mention in our example that the company must repay a loan at 75.000,00 euros per year is redundant in the search for the cost. Loan repayment does not constitute a cost, but it does affect cash.

1 Cash flow may also be defined as profit plus non-cash expenses or profit plus depreciation. Although these are approximate definitions, they are commonly used.

b. Constituent Elements of Cost

The various types of costs involved in the creation of output constitute the elements of the cost. When referring to the cost of an object, it is important to specify the type of cost (i.e., manufacturing cost or total cost). It is also good practice to clarify which constituent elements or categories of costs are included in the calculation. In some cases, costs may be deliberately excluded.

Traditionally, cost calculations follow a basic structure, as illustrated in Figure 2.1. Costs are divided into three categories: **production costs**, **general and administrative costs**, and **selling costs**.

Note that interest on invested capital is also a constituent element of cost. It is up to the company to decide whether financial costs should be included in the cost (see further in Section 3.4.e).

The **total cost** includes selling, general and administrative, and production costs. However, the notion of manufacturing cost is not so clearly defined. It undoubtedly includes production costs but excludes selling costs. Yet, what about general and administrative costs? General and administrative costs are incurred to support both production and sales, and therefore, they must be appropriately distributed across these two categories. Hence, **the manufacturing cost** of a product or service equates to the production costs, along with an assignment of general and administrative costs. Consequently, to accurately calculate the manufacturing cost price, one must thoroughly analyse the general and administrative costs and determine what portion (or percentage) of the total general and administrative costs are attributed to production, and what portion supports the sales department.

By applying this basic framework to our example, we can arrive at the cost breakdown presented in Table 2.1.

Figure 2.1 Constituent Elements of Cost

Total cost	**Manufacturing costs**	**Production costs**	Direct production costs	Usage of direct materials Direct remuneration
			Indirect production costs	Usage of utilities Indirect remuneration Depreciation machinery Depreciation factory building Rent, water factory Heating factory Lighting factory Insurance, electricity, maintenance factory Property tax factory building Cost of capital
	Selling costs	**General and administrative costs**	Indirect costs	Remuneration management Remuneration administration Office supplies management and administration Rent, water office Heating office Lighting office Insurance, electricity, office maintenance Depreciation office building, furniture Property tax office building Cost of capital
		Specific selling costs	Direct costs	Commission Packaging costs finished products
			Indirect costs	Remuneration sales staff, warehouse staff Rent, water warehouse Lighting warehouse Insurance warehouse Office supplies sales Maintenance trucks Transport costs Advertising costs Travel and accommodation expenses for sales representatives Credit insurance Showroom rent Depreciation warehouse Depreciation trucks Road tax Cost of capital

Table 2.1 Motorcycle Cost Chart (per Unit, in Euros)

	Costs	
Direct production costs		
Engine		250,00
Diverse materials		375,00
Direct labour: 30 labour hours at 20,00 euros		600,00
Indirect production costs		
Energy and utilities: 2,50 euros per machine hour, 20 machine hours per unit		50,00
Indirect labour: 3 × 1.750 × 26,00 euros	136.500,00	
Depreciations	200.000,00	
Cost of capital	175.500,00	
Total	512.000,00	
Per unit (10.000 units)		51,20
General and administrative costs		
Salaries	250.000,00	
Office rent	30.000,00	
General management	51.400,00	
Total	331.400,00	
50% charged to production	165.700,00	
Per unit (10.000 units)		16,57
MANUFACTURING COST		**1.342,77**
Selling costs		
Commission		50,00
Salaries	135.000,00	
Third-party services	5.000,00	
General and administrative costs charged to sales	165.700,00	
Total	305.700,00	
Per unit (10.000 units)		30,57
TOTAL COST		**1.423,34**

3.4 Historical Versus Standard Costs

a. Actual Versus Allowable Costs

When calculating costs in the basic example (see Table 2.1), we assume all figures are exactly known: the engine costs 250,00 euros, the usage of diverse materials is 375,00 euros, direct wages amount to 30 labour hours at 20,00 euros per hour, depreciation is 200.000,00 euros, etc. However, determining these amounts presents a challenge and can be approached in different ways: either based on actual costs or allowable costs.

b. Costing Based on Actual Costs (Historical Costing)

In this method, the value of the resources required for performance is equated to the historical or actual recorded costs that were incurred. Thus, costing is based on the actual recorded costs during a specified period.

In our example, the engine costs 250,00 euros because the engines used were purchased at an average price of 250,00 euros during the previous month. The same applies to the diverse materials. Direct labour amounts to 600,00 euros per finished motorcycle, as in the current period, an average of 30 hours were needed per motorcycle, at an average hourly wage of 20,00 euros. Depreciation totals 200.000,00 euros, based on the recorded financial accounting amounts.

The cost based on actual costs is referred to as the **historical or ex-post calculated cost**. This cost is used in both financial and cost accounting for inventory valuation and determining profit for the period. However, this cost is less useful for managerial decision-making. Some of the actual costs may be wasteful and, therefore, avoidable. This issue can be addressed by employing standard costing in decision-making processes.

c. Costing Based on Allowable Costs (Standard Costing)

As mentioned, costing for **financial accounting** purposes is always based on historical costs. In the income statement, the costs reflect those incurred during the fiscal year. Of these, some are **unavoidable**, while others may be considered **avoidable**. The avoidable costs are often referred to as wastages. For example, excess material may be consumed

due to carelessness on the part of employees, or excessive labour hours might be utilised as a result of inefficient work practices. Perhaps, in the motorcycle example, the 20 machine hours required could be reduced to 18 hours through improved training for machine operators.

In the context of **managerial decisions**, **avoidable costs** should **not** be included, and the focus should be on unavoidable, allowable costs. Decisions regarding product mix, pricing of the final product, or outsourcing of components should not be influenced by irrational or inefficient use of production resources. For instance, it would be imprudent to withdraw a product from the market solely due to its lack of profitability if this unprofitability stems from an excessively high cost caused by organisational inefficiencies. Similarly, it would be unwise to decide to outsource the production of a component simply because material consumption costs were unusually high in the past, perhaps due to the poor quality of raw materials, which caused delays and increased wastage.

To minimise the risk of making poor managerial decisions, it is preferable to use **normative or standard costs** in decision-making. Standard costs represent only the required use of resources. Therefore, the cost calculation should not be based on the actual consumption of resources but on the normal, economically justified consumption. For managerial decisions, incidental discrepancies between actual and normal resource consumption should not affect the cost. Consequently, for such decisions, historical costs should not be used; instead, allowable or standard costs should be applied.

The standard cost, therefore, includes only the **allowable, unavoidable** costs. A standard is set for each quantity (e.g., material usage, direct hours), and standards are also predetermined for purchase prices and hourly wages. The cost is calculated based on a **normal occupation rate**. These standards can be determined based on historical experience (such as average processing times from past production orders) or technical research (such as time and motion studies). Standards should be attainable rather than ideal. It is also advisable to ensure that the standards are future-oriented. Since the standard cost is calculated for future use, the standards should be based on anticipated future prices and quantities.

However, the standard cost is distinct from the **budgeted cost**. The budgeted cost is calculated based on planned costs for a planned level of production and is always tied to a specific budget period. In contrast, the standard cost is generally independent of any specific budget period and is based on the production level that would normally be achieved.

d. Purchase Value or Replacement Value

As previously stated, costs represent the sacrifice of inputs, expressed in monetary terms. However, there is an additional dimension when valuing usage of material and fixed assets. In **financial accounting**, the value of materials and depreciation of assets are typically based on purchase value, meaning the value is determined by the purchase price at the time the asset was acquired. While this is appropriate for financial accounting, it is of limited use for managerial decisions. **Managerial decisions** should be based on **current** prices rather than **historical** ones. Thus, it is preferable to base cost calculations on the **replacement value**, which is the current value of replacing the consumed inputs.

Moreover, since costing for management purposes should provide information for future decision-making, it may be argued that it is better to use **future** replacement values (e.g., the expected replacement value of an asset in the next year). Costing for decision-making should focus on 'accounting for the future' rather than 'accounting for the past'. The drawback of using future values is that they are estimates and, thus, lack precision. However, this is the essence of costing to facilitate managerial decision-making. Indeed, *'It is better to be approximately right than exactly wrong.'*

e. Cost of Capital

There is considerable debate surrounding whether interest on invested capital should be regarded as an element of the cost. We contend that its inclusion is essential for making the right decisions. At the end of the fiscal year, not only must the production, general and administrative costs, and selling costs be recouped to achieve profitability, but also the financial costs associated with debt capital. It is important to note that not only does debt capital incur a financial cost, but equity capital must also be compensated. If we consider two identical companies with different financing structures – one with minimal debt capital and the other with substantial debt capital – it would be unrealistic for the first company to incorporate nearly no capital costs in its cost calculations.

How is the cost of capital determined? For debt capital, the applicable interest rate or various interest rates can be employed. For equity capital, the market interest rate on risk-free investments (such as government-issued treasury bonds) is often used, to which a risk premium of, for example, 2% may be added. Based on these rates and the respective capital components, a **weighted average cost of capital** (the so-called **WACC**) can be calculated.

In the case of a multi-product company, an additional challenge arises regarding how to distribute the total interest amount across the different products. In practice, interest costs are typically allocated alongside other indirect costs using a somewhat arbitrary allocation key, such as the number of direct labour hours or material usage.

To achieve a more accurate allocation, one would need to examine how much capital each product utilises, including the necessary machinery, the required inventories, and the amount of accounts receivable attributable to each product. Nonetheless, there remain a number of common assets, such as the buildings, cash, and cash investments, which are essential for the overall operation of the company and are difficult to allocate at product level, unless the interest costs are incorporated into the determination of activity costs using activity-based costing (see next chapter).

4. Fixed and Variable Costs

4.1 Definitions

In the motorcycle example from Table 2.1, the manufacturing cost per unit is 1.342,77 euros. Therefore, for a production volume of 10.000 units, the total manufacturing cost would be 1.342,77 euros × 10.000 = 13.427.700,00 euros. However, this does not imply that if the production increases to 11.000 motorcycles, the total manufacturing cost will be 1.342,77 euros × 11.000 = 14.770.470,00 euros.

This is because not all costs vary proportionally with the number of units produced. For instance, if the company produces 1.000 additional motorcycles, more engines and diverse materials will be consumed. It may also require 30 × 1.000 = 30.000 additional labour hours. Energy, utilities, and commissions may also rise proportionally. These costs, which **vary** with **the level of activity** (**volume**), are referred to as **variable costs**. In addition to variable costs, there are costs that **remain constant** regardless of activity levels (see Figure 2.2 below). These are called **fixed costs**.

Whether the company produces 9.000, 10.000, or 11.000 motorcycles, the total amount of certain costs, such as depreciation of the factory building and machinery, maintenance, the cost of capital, general and administrative costs, and sales department overheads, will

remain largely unchanged. Table 2.2 provides a breakdown of fixed and variable manufacturing costs.

It is important to note that the distinction between fixed and variable costs is situation specific. For example, maintenance costs might become variable, as increased machine usage (due to higher production volume) would necessitate more frequent servicing. In our motorcycle example, as maintenance costs refer to indirect labour costs, they are considered fixed because reducing the number of maintenance operations would not immediately result in personnel layoffs. Depreciation could also become variable if it is calculated based on occupation. Additionally, some costs can be **semi-variable or mixed**, having both a fixed and a variable component, such as energy costs, which have a fixed connection charge and a variable component that increases with production volume.

Table 2.2 Fixed and Variable Manufacturing Costs of a Motorcycle (in Euros)

Fixed manufacturing costs			
	Indirect labour		136.500,00
	Depreciations		200.000,00
	Cost of capital		175.500,00
	General and administrative costs (50%)		165.700,00
	Salaries	250.000,00	
	Office rent	30.000,00	
	General management	51.400,00	
	Total	331.400,00	
Total			677.700,00
Variable manufacturing costs per unit			
	Direct material cost		625,00
	Direct labour		600,00
	Energy and utilities		50,00
Total per unit			1.275,00

4.2 Graphical Representation

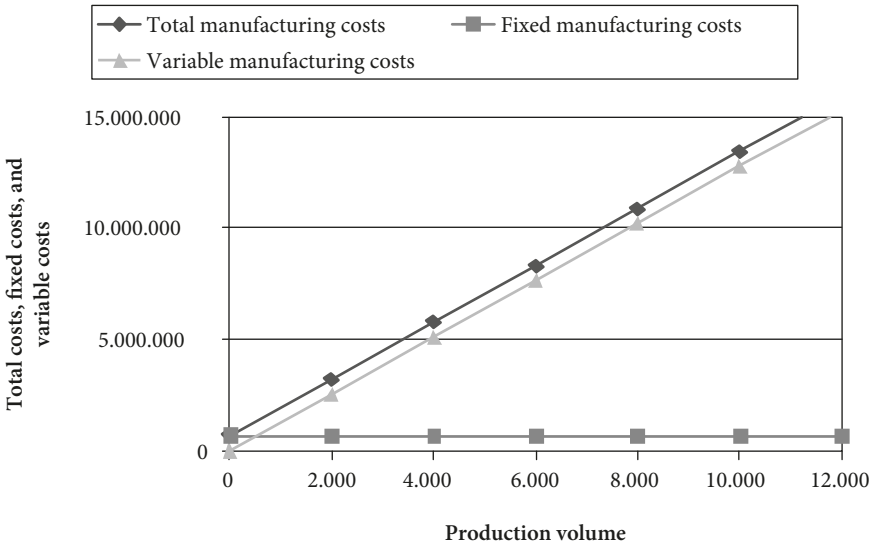
The distinction between fixed and variable costs provides insight into cost behaviour as production volume changes, allowing for a clearer understanding of the company's **cost-volume relationship**. The graph in Figure 2.2 illustrates this relationship. In our example, manufacturing costs would vary as follows:

- Total manufacturing costs = 677.700,00 euros + 1.275,00 euros × (number of units produced)
- Fixed manufacturing costs = 677.700,00 euros
- Variable manufacturing costs = 1.275,00 euros × (number of units produced)

For a production volume of 11.000 units, the total manufacturing costs would be: 677.700,00 euros + 1.275,00 euros × 11.000 = 14.702.700,00 euros. Per unit, this would amount to 14.702.700,00 euros ÷ 11.000 = 1.336,61 euros. This manufacturing cost per unit is lower than the original 1.342,77 euros.

This reduction occurs because the fixed costs are spread over a larger production volume. While variable costs per unit remain constant, fixed costs per unit decrease as production increases. Figure 2.3 shows how the total cost per unit decreases as production volume rises, with fixed costs distributed across more units.

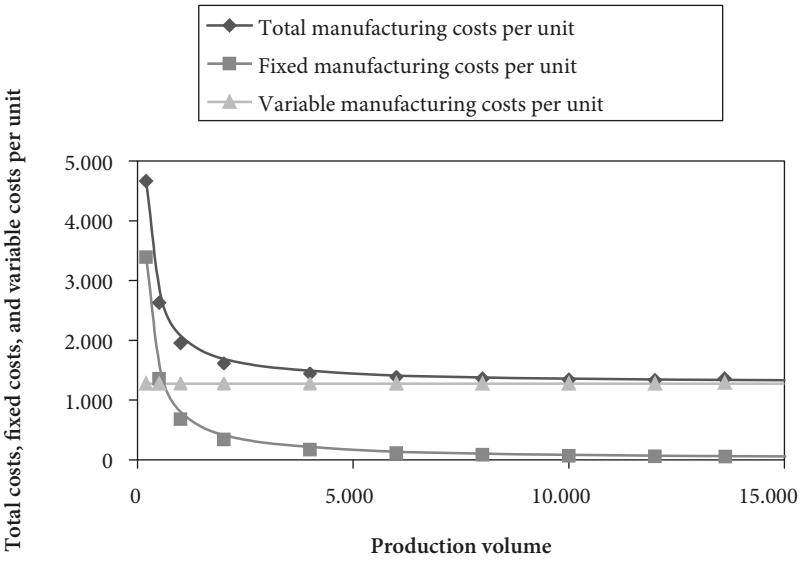
Figure 2.2 Graphical Representation of Manufacturing Cost Evolution as a Function of Production Volume



4.3 Implications for Standard Costing

Since unit costs decrease with increasing volume, the issue of fixed costs requires special attention in standard costing. It is important to remember that only unavoidable costs are considered in standard costing. As the fixed cost per unit depends on the capacity occupation rate, it is necessary to consider an efficient and, therefore, targetable capacity occupation rate, known as the **normal capacity occupation rate**.

Figure 2.3 Graphical Representation of Manufacturing Unit Cost Evolution as a Function of Production Volume



In our example, the company can typically produce 10.000 units per year. Therefore, the standard cost will be based on a normal occupation rate of 10.000 units annually. If the variable costs in Table 2.1 are derived from standard quantities multiplied by standard prices, and fixed costs are calculated based on a normal capacity occupation rate of 10.000 units, then Table 2.1 would be referred to as a 'standard cost chart' rather than a historical cost chart.

4.4 Capacity Limits and Budget Period

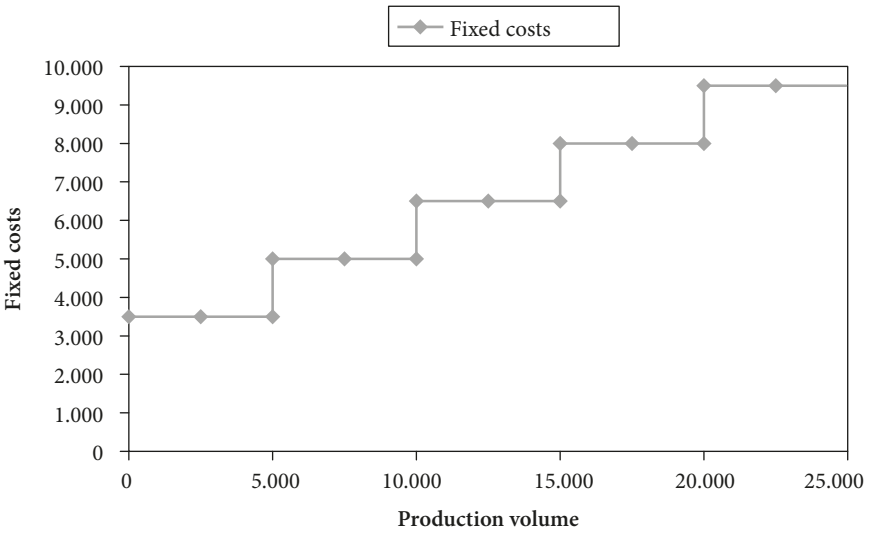
The assertion made earlier, that total fixed costs remain constant regardless of the level of activity, holds true only within certain constraints. Fixed costs are fixed only within specific capacity limits (**relevant range**) and for a designated period (**relevant time**). It is self-evident that if the company aims to produce 20.000 motorcycles instead of 10.000, additional machinery will be required, or existing machinery will need to operate in two shifts. This will result in increased wear and tear, possibly doubling the amount of maintenance. To produce 30.000 motorcycles, it may become necessary to introduce a second production line, or to employ additional personnel in areas such as planning and accounting.

Conversely, if production experiences a significant decline (e.g., a production of only 2.000 motorcycles), management may take steps to reduce fixed costs, such as selling machinery or employing only two maintenance workers.

Typically, fixed costs rise or fall in stages. For example, it is impossible to purchase or sell a quarter of a machine, which would correspondingly increase or decrease fixed depreciation costs by a quarter. The **step function** presented in Figure 2.4 offers a more realistic representation of the behaviour of fixed costs. Thus, we can state that fixed costs remain constant within a certain range, or more precisely, within the capacity limits of the existing production resources.

Fixed costs are also relative to a particular period. The director's salary, for instance, does not fluctuate based on the number of motorcycles produced. However, this does not imply that the salary will remain 50.000 euros annually, even if production remains at 10.000 motorcycles. This principle also applies to the wages of maintenance personnel. The amount of depreciation incurred may also vary from period to period, depending on the method of depreciation chosen (e.g., linear, degressive or progressive). One could, therefore, plot a similar graph to Figure 2.4, but with successive time periods on the x-axis. Fixed costs appear not to remain constant outside the designated period, as they too increase or decrease in steps.

Figure 2.4 Evolution of Fixed Costs Beyond Capacity Limits



5. Direct and Indirect Costs

5.1 Additional Data for the Motorcycle Example

Let us assume in the initial example that we are producing two types of motorcycles, Type I and Type II. The following distinctions are made between Type I and Type II:

- The engine for Type II is lighter and costs only 125,00 euros, while the engine for Type I remains at 250,00 euros. Diverse materials for both types are purchased at 375,00 euros.
- The parts for Type II require only 15 machine hours on specialised machinery, while Type I parts continue to require 20 machine hours. No labour hours are required to operate these machines.
- Type I parts require 20 labour hours, whereas Type II parts only require 15 labour hours. Additionally, assembly time for both types remains the same: 10 labour hours.
- The consumption of utilities and energy is 2,50 euros per machine hour for both types.

- Type II is sold at a selling price of 2.000,00 euros, earning representatives a commission of 40,00 euros. For Type I, the selling price is 2.500,00 euros, with a commission of 50,00 euros per unit.
- The salary costs for production planning are distributed as follows: 0,5 planner for Type I (28.800,00 euros) and 1 planner for Type II (57.600,00 euros).
  These planning costs are allocated based on the number of units produced. Annual production is expected to be 4.000 motorcycles for Type I and 6.000 motorcycles for Type II.
- The salary costs for general management and accounting amount to 163.600,00 euros. The office building is rented for 2.500,00 euros per month. General management operating costs remain at 51.400,00 euros annually. These general and administrative costs, totalling 245.000,00 euros, are assigned to production in proportion to the number of direct labour hours. There are 175 direct workers, each capable of working 1.750 hours per year.
- Indirect fixed production costs (maintenance, depreciation, and cost of capital totalling 512.000,00 euros) are distributed according to machine hours. Under normal circumstances, 200.000 machine hours can be performed annually.
- Indirect selling costs (sales department overheads amounting to 140.000,00 euros and 50% of general and administrative costs) are allocated based on the number of units sold.

5.2 Definitions

In the production of multiple products, the distinction between direct and indirect costs becomes critical. **Direct costs** are those that can be specifically and exclusively identified with a specific product and can thus be directly traced to it. These are also referred to as directly assignable costs.

In the motorcycle example, there is a clear correlation between the type of product and the cost of materials, direct labour, planning costs, and assigned commission wages. These costs, therefore, represent the direct costs.

Maintenance personnel, however, perform maintenance on machines used to produce both Type I and Type II motorcycles. The production machines and buildings serve both Type I and Type II, and interest, the other general and administrative costs, and sales department overheads are incurred for both types simultaneously. Additionally, utilities and energy costs for the machines are used to produce both products.

These costs are referred to as **indirect costs** or **'overhead' costs**. They do not have a direct, identifiable link to a specific product because they represent general costs, or because it is impractical or unfeasible to track the specific cost per individual product within the company.

If one still seeks to determine the cost of Type I and Type II separately, despite the presence of indirect costs, these indirect costs must be allocated between the two types using an appropriate **allocation key**. In the next chapter, we will discuss how to distribute indirect costs across individual products in a way that best reflects the causal relationship between the cost to be allocated and the allocation criterion.

Before allocating indirect costs, it is necessary to identify the variables that influence these costs. In other words, the cost drivers that impact indirect costs must be analysed. Potential variables include the number of units produced, labour hours completed, or machine hours utilised. The next chapter will delve deeply into the allocation of indirect costs.

It is important to note that indirect costs may be either variable or fixed. In the motorcycle example, utilities and energy costs are variable indirect costs. Fixed indirect costs include indirect labour, depreciation, the cost of capital, etc. It is equally crucial to find an allocation key for both variable and fixed indirect costs. For instance, since both types of motorcycles require a different number of machine hours, energy costs would be better allocated based on machine hours rather than per unit.

5.3 Cost Chart for Type I and Type II

Table 2.3 presents the standard cost per unit for both Type I and Type II motorcycles. The indirect (fixed and variable) production costs are allocated in proportion to the number of machine hours used. The 512.000,00 euros fixed indirect production cost is divided by the total number of machine hours available (under normal utilisation), resulting in a rate of 2,56 euros per machine hour. For Type I, which requires 20 machine hours per unit, a cost of 20 × 2,56 euros = 51,20 euros is allocated. For Type II, which requires 15 machine hours, a cost of 15 × 2,56 euros = 38,40 euros per unit is allocated. Variable indirect production costs (energy and utilities) are charged at a rate of 2,50 euros per machine hour.

General and administrative costs assigned to production are distributed based on the number of direct labour hours. Indirect selling costs are allocated based on the number of units sold.

From this calculation, we can also derive the **direct cost** of both types of motorcycles separately. The direct cost is the sum of all costs directly traceable to a specific product. The direct cost for both motorcycles is calculated in Table 2.4. Note that the sum of all direct production costs is also called the **prime cost**.

The concept of **direct cost** should not be confused with **variable cost**. Table 2.3 illustrates that certain general and administrative costs can be direct but fixed at the same time.

Although variable costs are often direct, some variable costs may still be classified as indirect. In our example, utilities (such as oils for machines) and energy costs are variable, but it is difficult to track the consumption of these materials to each product type. Therefore, these are classified as indirect costs. Similarly, in a furniture factory, glue is a variable cost. However, it may not be practical to differentiate glue consumption by product type. In such cases, glue consumption is recorded globally and distributed across products using an allocation key. Therefore, the distinction between fixed and variable costs should be kept separate from the distinction between direct and indirect costs.

Let us have a look at the following examples:

Variable direct costs:
- e.g., direct wages when the labour time per product is known.

Variable indirect costs:
- e.g., wages of workers when the time spent per product is not measured
- e.g., utilities
- e.g., energy for machinery

Fixed direct costs:
- e.g., specific general and administrative costs
- e.g., depreciation of a machine used exclusively for one type of product

Fixed indirect costs:
- e.g., general management wages

Table 2.3 Standard Cost Chart for Motorcycle Type I and Type II (Per Unit, at Normal Occupation, in Euros)

		Rate		Number		Costs	
		Type I	Type II	I	II	Type I	Type II
Direct (variable) production costs							
Engine		250,00	125,00	1	1	250,00	125,00
Diverse materials		375,00	375,00	1	1	375,00	375,00
Direct labour		20,00	20,00	30	25	600,00	500,00
Indirect production costs							
Variable, indirect production costs							
Energy and utilities		2,50	2,50	20	15	50,00	37,50
Fixed, indirect production costs							
Indirect labour	136,500,00						
Depreciations	200.000,00						
Cost of capital	175.500,00						
Total at 200.000 machine hours	512.000,00	2,56	2,56	20	15	51,20	38,40
General and administrative costs: specific							
Planner I for 4.000 units	28,800,00	7,20		1		7,20	
Planner II for 6.000 units	57.600,00		9,60		1		9,60
General and administrative costs: general							
Salaries	163.600,00						
Rent	30.000,00						
General management	51.400,00						
Total	245.000,00						
50% charged to production for 175 × 1.750 direct labour hours	122.500,00	0,40	0,40	30	25	12,00	10,00
MANUFACTURING COST						**1.345,40**	**1.095,50**
Selling costs							
Commission		50,00	40,00	1	1	50,00	40,00
Department overheads, per unit	140.000,00	14,00	14,00	1	1	14,00	14,00
General and administrative costs, per unit	122.500,00	12,25	12,25	1	1	12,25	12,25
TOTAL COST						**1.421,65**	**1.161,75**

Table 2.4 Direct Cost for Motorcycle Type I and Type II (per Unit, in Euros)

	Type I	Type II
Direct production costs		
engine	250,00	125,00
diverse materials	375,00	375,00
direct labour	600,00	500,00
Direct general and administrative costs	7,20	9,60
Direct selling costs	50,00	40,00
Direct cost	**1.282,20**	**1.049,60**

5.4 Capacity Variance on Fixed, Indirect Costs

In the motorcycle example, the existing capacity of machines and workers is not fully utilised. With a production of 4.000 units of Type I and 6.000 units of Type II, the allowable number of machine hours amounts to 4.000 × 20 + 6.000 × 15 = 170.000. For the allocation of fixed, indirect production costs amounting to 512.000,00 euros, a rate was calculated based on full occupation, i.e., 200.000 machine hours.

Given the production of 170.000 machine hours, it follows that the fixed, indirect costs will not be entirely covered. This shortfall of 30.000 machine hours, multiplied by the rate of 2,56 euros per machine hour, results in 76.800,00 euros. This discrepancy is termed the **negative capacity variance**. This excess capacity arises because the allowable machine hours for actual production are lower than the available machine hours, that is, the predetermined standard (normal) occupation used in calculating the rate for fixed, indirect costs. Indeed, with the fixed, indirect production costs of 512.000,00 euros, 200.000 machine hours can be performed in this example. To produce 4.000 units of Type I and 6.000 units of Type II, only part of these resources was utilised, specifically for the quantity of 170.000 machine hours, corresponding to a monetary value of 435.200,00 euros. This can be expressed in the equation as follows:

Available capacity (normal production) = allowable capacity (based on actual production) + unused capacity

or

512.000,00 = 435.200,00 + 76.800,00

The question arises as to how we should address the difference of 76.800,00 euros. Should it be charged to actual production, thereby increasing the cost per unit, or should it be treated as a loss for the period?

The answer to this question depends on the specific circumstances in which we find ourselves. If the existing capacity of 200.000 machine hours is necessary to manage peak loads to produce Type I and Type II motorcycles, it follows that at certain times of the year, the machines must operate at full capacity to fulfil these orders, particularly when customers require swift delivery of the motorcycles. In such instances, full capacity must be reserved for the motorcycles. Consequently, all fixed costs will need to be absorbed by the motorcycles, resulting in a significantly higher cost per motorcycle, as illustrated in Table 2.5.

Alternatively, if the company can accommodate orders beyond those for motorcycles, the responsibility of the management is to fully utilise the existing capacity of 200.000 machine hours. If, in a particular period, only 4.000 Type I motorcycles and 6.000 Type II motorcycles are produced, then the negative capacity variance should be treated as a loss for that period. In this situation, the current orders should not be influenced by the fact that the existing capacity could not be fully sold. During periods of excess capacity, there is a strong temptation to conclude that products become more expensive. The ex-post calculated (or historical) cost as determined by financial accounting will indeed increase, since it is predicated on the costs associated with the total available capacity. For the purposes of financial accounting, it is irrelevant whether this capacity was utilised for the current production.

From a management perspective, however, the focus is on resource consumption during production. A situation of overcapacity does not alter the resource consumption of the current products. Therefore, the same (standard) cost will consistently be employed in decision-making. Moreover, this standard product cost will not decrease as a result of producing additional products to mitigate excess capacity. In the example provided, if a third type of motorcycle is added to the range alongside Type I and Type II, leading to an increase in machine occupation, the cost for Type I and Type II will remain unchanged (1.421,65 euros and 1.161,75 euros respectively). The introduction of a Type III model will only serve to diminish the negative capacity variance, rather than affecting the normal resource consumption of Type I and Type II.

Conversely, it is also possible for the actual production quantity to exceed the quantity considered normal. In such instances, we refer to this as an over-recovery of fixed costs, or a **positive capacity variance**. The predetermined number of machine hours required to allocate indirect fixed costs will then be lower than the number of machine hours required for actual production. With a positive capacity variance, we are faced with a scenario of

'over-recovery' of fixed costs, precisely because the actual production surpasses the standard production. This positive variance may thus be regarded as a form of revenue for the period.

It is important to note that the capacity variance in our example only emerged for the indirect, fixed costs. A capacity variance could also arise in relation to direct fixed costs, particularly when actual production diverges from normal production. In the case of *variable* costs, costs fluctuate per unit produced, rendering the estimation of capacity in advance unnecessary; consequently, no capacity variance can arise.

Table 2.5 Historical Cost Chart for Motorcycle Type I and Type II (per Unit, at Actual Occupation, in Euros)

		Rate		Number		Costs	
		Type I	Type II	I	II	Type I	Type II
Direct (variable) production costs							
Engine		250,00	125,00	1	1	250,00	125,00
Diverse materials		375,00	375,00	1	1	375,00	375,00
Direct labour		20,00	20,00	30	25	600,00	500,00
Indirect production costs							
Variable, indirect production costs							
Energy and utilities		2,50	2,50	20	15	50,00	37,50
Fixed, indirect production costs							
Indirect labour	136,500,00						
Depreciations	200.000,00						
Cost of capital	175.500,00						
Total at 170.000 machine hours	512.000,00	3,01	3,01	20		60,24	45,18
General and administrative costs: specific							
Planner I for 4.000 units	28,800,00	7,20		1		7,20	
Planner II for 6.000 units	57.600,00		9,60		1		9,60
General and administrative costs: general							
Salaries	163.600,00						
Rent	30.000,00						
General management	51.400,00						
Total	245.000,00						
50% charged production for 270.000 direct labour hours	122.500,00	0,45	0,45	30	25	13,61	11,34
MANUFACTURING COST						**1.356,05**	**1.103,62**

Selling costs							
Commission		50,00	40,00	1	1	50,00	40,00
Department overheads, per unit	140.000,00	14,00	14,00	1	1	14,00	14,00
General and administrative costs, per unit	122.500,00	12,25	12,25	1	1	12,25	12,25
TOTAL COST						**1.432,30**	**1.169,87**

6. Income Statements by Function

6.1 The Overhead Analysis Sheet

In the calculations we have made so far, we did not consider where costs are incurred or who is responsible for their follow-up. This problem is addressed through the notion of cost centres. A **cost centre** is a department (or smaller organisational unit) led by a manager who is responsible for the costs of the department. Working with a cost centre structure is therefore also referred to as **responsibility accounting**.

Remember that direct costs are directly traceable to products (or services), while for indirect costs we use cost allocations to link them to cost objects. Although some costs are indirect in relation to products (or services), they may be directly traceable to a cost centre. For instance, salaries may be indirect in relation to products, but we do know in which departments specific staff members are working. To reorganise costs by nature, as in financial accounting, into an organisation by function (i.e., using cost centres) an **overhead analysis sheet** is used.

An overhead analysis sheet consists of two dimensions. As shown in Figure 2.5, the rows contain the different costs, organised by nature, originating from financial accounting records: material usage, third-party services, personnel, depreciation, and financial costs. The columns of the overhead analysis sheet represent the different cost centres of the company, as well as the cost objects. In a manufacturing company, the **cost objects** are the products (or product groups) for which we would like to calculate the cost. As allocation is not needed for direct costs, these can be directly recorded in the column of the specific cost object. Typical examples are material usage and direct labour.

Figure 2.5 Overhead Analysis Sheet

	Cost centres			Cost objects	
Costs organised by nature	**Support cost centres**	**Production cost centres**	**Sales cost centres**	**Product A**	**Product B**
Material usage					
Third-party services					
Personnel					
Depreciation					
Cost of capital					
TOTAL					
	Total	Total x	Total x	Total	Total
		Total		x	x
			Grand total	Grand total	Grand total

Although the structure of the overhead analysis sheet depends on the company's organigram, there are typically multiple cost objects, and it is common to observe the following cost centre hierarchy:

- **Support cost centres**: These group the general and administrative costs and are typically subdivided into engineered and discretionary cost centres, both of which provide support to production and/or sales. In an **engineered cost centre**, there is a causal relationship between inputs and outputs, such as in the facility management department, where output is typically expressed in square metres. In contrast, the support provided by a **discretionary cost centre** cannot be easily quantified. The administration department is a typical example, where costs are typically assigned to other departments based on a more arbitrary allocation key, such as the percentage of time spent.
- **Production cost centres**: These contain the production costs that are shared across products, i.e., indirect production costs. Similarly, in service companies, **service cost centres** are used to pool service-related costs that are not directly traceable to services.
- **Sales cost centres**: These group indirect selling costs and are responsible for selling the products or services. Examples include the transportation department, sales representatives, the marketing department, and the R&D team.

The purpose of the overhead analysis sheet is to distinguish the total **manufacturing costs** (per cost object) from the **period costs** (on the sales cost centres) based on the following **cascading** method:

1. Assign all overheads to support, production/service, and sales cost centres.
2. Reassign the costs assigned to support cost centres from support cost centres to production/service and sales cost centres.
3. Allocate production/service cost centre overheads to cost objects.
4. Treat sales cost centres as period costs.

6.2 The Cost of Goods Sold

The overhead analysis sheet shows the manufacturing costs registered across the period per cost object. However, there may also be an opening and closing inventory of work in progress. To arrive at the **manufacturing cost of finished goods manufactured**, the opening inventory of work in progress should be added, while the closing inventory will be transferred to the balance sheet. Similarly, as production may not equal sales, there can be an inventory change of finished goods.[2] After accounting for these two inventory changes, the **cost of goods sold** is obtained for each product, as demonstrated by the following scheme:

+ Total manufacturing costs
+ Opening inventory of work in progress
– Closing inventory of work in progress
= Manufacturing cost of finished goods manufactured
+ Opening inventory of finished goods
– Closing inventory of finished goods
= (Manufacturing) cost of goods sold

The cost of goods sold (or cost of sales) is thus a manufacturing cost. It can then be used to complete the income statement by function, as deducting it from sales results in **gross income** (profit or loss).

The sales cost centres in the overhead analysis sheet still contain the non-manufacturing costs (i.e., selling costs and general and administrative costs charged to sales). After allo-

2 When historical costing is used, the closing inventories of finished goods and work in progress are assessed based on FIFO (first in, first out), LIFO (last in, first out) or weighted average valuation.

cating these **period costs**[3] to the different cost objects (for instance based on sales), **net income** per product is obtained, resulting in the following **income statement by function**:

+ Sales
– Cost of goods sold
= Gross income
– Non-manufacturing costs
= Net income

The overhead analysis sheet thus enables the overall bottom line from the financial statements to be broken down into more analytical detail. Cost calculation based on an overhead analysis sheet is therefore also referred to as **analytical cost accounting**.

7. Conclusion

In this chapter, we have established that various cost concepts exist in costing and that, when calculating costs, we need to clarify in advance: firstly, the object whose cost we wish to ascertain; secondly, which costs we intend to include in the calculation; and thirdly, the valuation of the cost components included.

Certain costs remain unaffected by changes in production volume; we refer to these as fixed costs. Conversely, other costs fluctuate with the number of units produced; these are termed variable costs. Another significant classification is that of direct versus indirect costs. Direct costs have an immediately identifiable relationship with a specific product, while indirect costs are allocated to products, either due to their shared nature or because registration per product does not occur within the company.

Cost calculations can be based on actual recorded costs over a specific period. This is referred to as the historical cost, which is primarily used in financial and analytical accounting. For managerial decision-making, a cost calculation based on the standard use of production resources is also required. This is referred to as the standard cost. In this calculation, only the normal use of production capacity, rather than the entire available capacity, is factored in as costs.

3 When standard costing is used, any capacity variances are also written off as period costs.

Finally, we expanded our calculations by reorganising costs by function. The overhead analysis sheet provides insight into cost responsibility and enables income to be split per product in a structured way, using cost centres to distribute overheads across products.

Exercises

Construct

Construct is a small manufacturing company specialised in the production-to-order of air-conditioning units. The company employs 25 production workers and 3 workers responsible for machine maintenance. In case of a temporary drop in the market demand for air conditioning, factory output is reduced. Under those circumstances the workers receive an unemployment benefit from the government, but the company does not pay any supplementary compensations.

The company manufactures two types of air-conditioning units, called Type 40 and Type 50 respectively. The annual production volume and selling price for each type are shown in the following table:

	Annual production	Selling price (in euros)
Type 40	9.000	140,00
Type 50	5.250	150,00

Sales representatives receive a commission of 5% on the selling price.

Engines are purchased at 20,00 euros per unit for the production of **Type 40**. Other raw materials are purchased at 11,00 euros and are processed on specialised machinery. This process takes 2 hours per air-conditioning unit. The total labour time for Type 40 (manufacturing and assembly) is 3 hours per air-conditioning unit.

The engine of **Type 50** is more expensive than that of Type 40. It is purchased at 36,00 euros per unit. The cost of the raw materials is also higher (20,00 euros), but they require only 1 hour of processing time on the machines. Total labour time for Type 50 (manufacturing and assembly) is 2,5 hours per air-conditioning unit.

A worker works 1.750 hours a year (at standard productivity) at a cost of 25,00 euros per hour. Due to relatively high set-up times and the need for maintenance, total available machine capacity is 30.000 hours per year. Annual depreciation is 135.000,00 euros (including an adjustment of 45.000,00 euros for inflation). Three workers are responsible for machine maintenance; together, they cost 52.500,00 euros per year. The cost of power and other supplies is 1,00 euro per machine hour. Construct uses machine hours to allocate depreciation and maintenance costs.

The company pays a total of 87.500,00 euros for management salaries every year. The buildings are rented for 2.500,00 euros per month. Administrative costs are 22.500,00 euros per year, selling costs are 12.500,00 euros per year, and the total cost of capital is 66.250,00 euros per year. Management considers direct labour hours to be the best allocation basis for the non-manufacturing overhead costs.

Construct must pay back a bank loan at 25.000,00 euros per year (excluding interest expenses). Outstanding debt is 500.000,00 euros and costs 5% per year. Total liabilities and equity of Construct are 1.187.500,00 euros. The current tax rate is 25%.

Required

1. Calculate the standard cost of both products, from a management accounting viewpoint.
2. Calculate the historical cost of both products, from a management accounting viewpoint.
3. Explain the difference in outcomes.
4. Explain which cost managers should use to make decisions. Also explain why.
5. What is Construct's profit/loss according to the financial accountant and according to the management accountant?

Woody

Woody makes wardrobes and tables. The company has started to draft an overhead analysis sheet by organising its costs into cost centres.

Costs	Facility management	Admin	Production	Sales	Cost object wardrobes	Cost object tables
1. Material usage						
Raw materials					19.800,00	4.950,00
Utilities	2.000,00		2.230,00			
2. Third-party services						
Water			52,00			
Electricity	250,00					
Power			1.200,00			
Rent	4.500,00					
Fuel and maintenance truck				575,00		
Maintenance buildings	410,00					
Expenses sales rep				150,00		
Office supplies		106,00				

Costs	Facility management	Admin	Production	Sales	Cost object wardrobes	Cost object tables
3. Personnel						
Blue-collar					42.750,00	12.000,00
White-collar	5.250,00	12.900,00	10.125,00	6.600,00		
4. Depreciation						
Machines			37.500,00			
Truck				500,00		
Computers and furniture	200,00	652,00				
TOTAL	**12.610,00**	**13.658,00**	**51.107,00**	**7.825,00**	**62.550,00**	**16.950,00**

Management has decided to use the following allocation mechanisms:
- Re-assignment facility management
  - Admin: 675 m²
  - Production: 3.375 m²
  - Sales: 450 m²
- Reassignment admin
  - Production: 60%
  - Sales: 40%
- Allocation production
  - Wardrobes: 2.000 units
  - Tables: 500 units
- Allocation sales department (based on sales)
  - Wardrobes: 1.870 units at 60,00 euros per unit
  - Tables: 530 units at 65,00 euros per unit

The following information is provided with respect to inventories:
- Opening inventory of work in progress
  - Wardrobes: 0,00 euros
  - Tables: 2.787,60 euros
- Closing inventory of work in progress
  - Wardrobes: 13.537,44 euros
  - Tables: 8.915,15 euros
- Opening inventory of finished goods
  - Wardrobes: 20.680,00 euros
  - Tables: 3.311,50 euros

The closing inventories of finished goods are valued based on FIFO (first in, first out).

Required

1. Distinguish the total manufacturing costs for wardrobes and tables from the non-manufacturing costs by completing the overhead analysis sheet.
2. Calculate the net income of wardrobes and tables by preparing an income statement by function.
3. Recalculate the net income of wardrobes and tables using LIFO (last in, first out).
4. Recalculate the net income of wardrobes and tables using weighted average valuation.

CHAPTER 3

Overhead Allocation

1. Problem Statement

In the cost calculation of our example with a Type I and Type II motorcycle, the fixed production overheads (512.000,00 euros) are allocated to the 2 products in proportion to the number of machine hours. Of the general and administrative overheads (245.000,00 euros), 50% is distributed across the products in proportion to the number of direct labour hours, as these costs are incurred in the production. The remaining 50% is distributed in proportion to the number of units sold. The central question in this chapter is thus: why are the indirect costs (here, production and general and administrative costs) allocated in this manner? In other words, how can indirect costs be allocated to products as accurately as possible?

2. Rational Versus Irrational Allocation of Indirect Costs

In cost allocation, we can base our decisions on either objective (rational) criteria or subjective (irrational) criteria.

When developing a cost allocation system based on **rational** criteria, the aim is to establish objectively verifiable relationships between costs (resource consumption) and influencing variables. The allocation of 512.000,00 euros of fixed production overheads based on the machine hours used is rational if a **cause-and-effect** relationship exists between the number of machine hours and the fixed production overheads. This means that indirect labour, depreciations of the factory building and machinery, and the cost of capital increase as the number of machine hours rises. In this case, a rational basis is established to allocate more of these costs to products that consume more machine hours.