Department of Accounting and Financial Sciences

management Control

Lecture Series for Finance Students – Semester 5

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Content

Chapter 1

management control ; context and definitions

Learning Outcomes Objectives

Upon completion of this chapter, learners will be able to:

1. Identify and distinguish the three primary levels of organizational control—strategic, managerial, and operational/tactical—and explain their respective roles in guiding organizational performance.

2. Define the concept of Management Control and articulate its purpose within the broader management process, particularly its contribution to aligning actions with strategic objectives.

3. Describe and analyze the main tools and methods of Management Control—focusing in particular on budgeting systems and the Balanced Scorecard—while providing an introductory overview of managerial accounting techniques that will be developed in subsequent chapters.

4. Explain the structure and functioning of the Management Control System (MCS) and its role as an information and coordination mechanism within the organization.

5. Analyze the integration between the MCS and the planning process, detailing how strategic formulation is translated into business planning, operational programs, and the budgeting system.

6. Examine the mechanisms through which strategy is operationalized, demonstrating how planning tools such as budgets and action plans translate strategic priorities into measurable targets.

7. Assess the complementarities between the Balanced Scorecard and the budgeting system, and explain how their integration enhances strategic alignment, resource allocation, and performance execution within the planning cycle.

8. Demonstrate how coherent planning–control architecture supports the execution of strategy, reinforces accountability, and promotes continuous performance improvement.

Lesson 1
Overview of management control

Since the inception of management sciences, control has remained one of its most fundamental pillars. According to Henri Fayol, management functions revolve around the five key elements: planning, organizing, commanding, coordinating, and controlling. Later scholars further condensed these functions, defining management primarily as planning and control.

1- Definition of control

Control, in its general sense, refers to the power or ability to direct, guide, or influence people or events. According to the Cambridge Dictionary, control is defined as *the power to give orders, make decisions, and take responsibility for something*, as well as *a rule or law that limits what people can do*. It can also describe *the ability to manage a situation successfully*.

Within the modern concept of management, control can no longer be understood through a rigid or mechanistic lens. Contemporary strategic management thinkers such as Mintzberg argue that traditional perspectives—those that reduce management to planning and control—tend to impose a restrictive and overly formalized framework. To overcome this limitation, Mintzberg calls for a shift away from conventional control mechanisms based solely on adherence to predetermined goals and standards, toward a more dynamic and learning-oriented approach. In a rapidly changing environment, organizations are confronted with uncertainties that often render pre-established plans obsolete. Consequently, control should not enforce conformity but should instead promote adaptability by enabling the identification of emerging strategic patterns. In this view, control becomes inseparable from learning, allowing organizations to evolve and incorporate new insights rather than remaining bound to outdated planning assumptions.

As a result, classical management views control as a reactive process designed to enforce predefined rules, whereas modern perspectives conceptualize it as a dynamic, learning-oriented mechanism that supports adaptation to change and prioritizes flexibility over rigid planning. Despite Mintzberg's criticism of the excessive linkage between control and

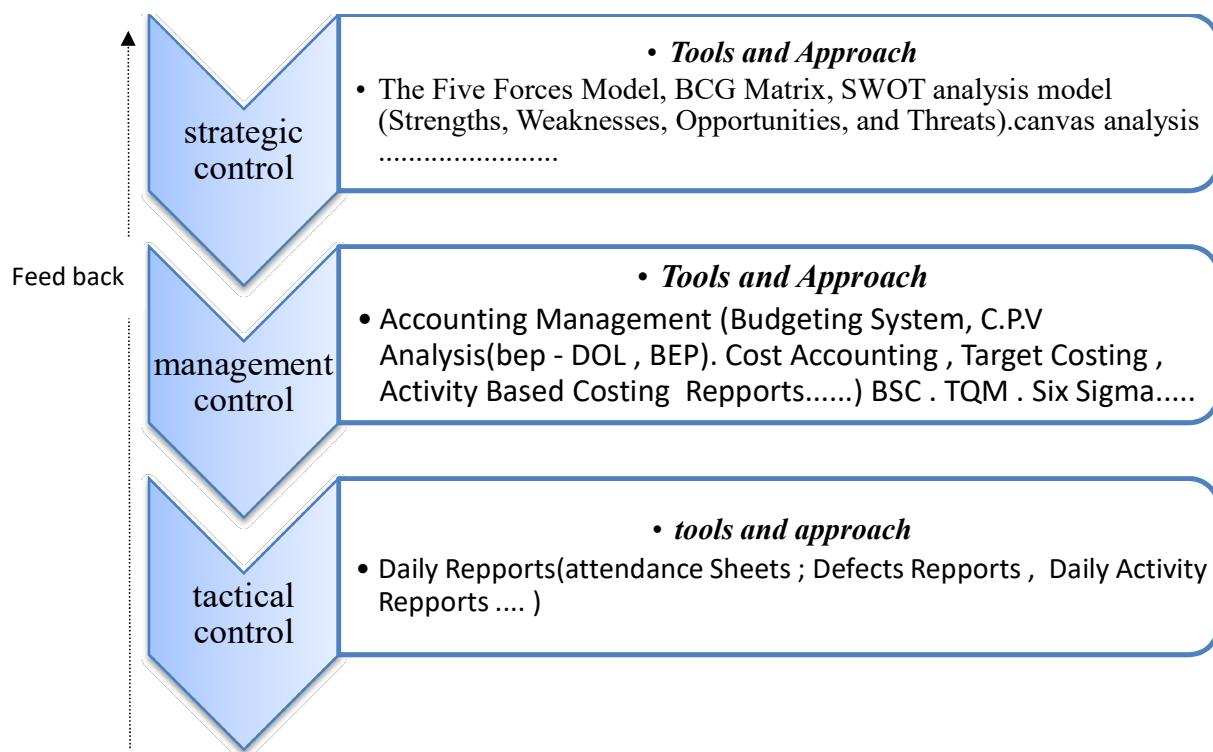planning, the practical concept of control within the management-system perspective remains essential.

Control, as a core managerial function, ensures that organizational activities remain aligned with established goals, standards, and plans. It encompasses the monitoring of performance, the comparison of results against objectives, the identification of deviations, and the implementation of corrective actions—processes that collectively enhance both efficiency and effectiveness

2- Levels of control in the organization

Control within the strategic context of the organization generally falls into three main categories (Figure 1):

• **Top Level:** where strategic control is exercised, focusing on long-term direction and strategic alignment.

• **Middle Level:** where operational or management control takes place, ensuring that processes and activities support the strategic objectives.

• **Lower Level:** where tactical control occurs, dealing with day-to-day execution and short-term adjustments

Figure 1

Feed back

strategic control

- • *Tools and Approach*
- • The Five Forces Model, BCG Matrix, SWOT analysis model (Strengths, Weaknesses, Opportunities, and Threats).canvas analysis ....

management control

- • *Tools and Approach*
- • Accounting Management (Budgeting System, C.P.V Analysis(bep - DOL , BEP). Cost Accounting , Target Costing , Activity Based Costing Repports......) BSC . TQM . Six Sigma.....

tactical control

- • *tools and approach*
- • Daily Repports(attendance Sheets ; Defects Repports , Daily Activity Repports ....)

2-1 Strategic Control

Strategic control, often associated with strategic planning, is a critical component of strategic management. It ensures that an organization's long-term strategies remain aligned with its goals amid changing internal and external conditions. Unlike operational control, which focuses on short-term performance, strategic control involves the continuous monitoring, evaluation, and adjustment of strategies to maintain competitive advantage and organizational relevance.

To facilitate effective strategic decision-making, managers employ analytical frameworks such as:

• **Porter's Five Forces Model** – Assesses industry competitiveness and long-term profitability dynamics.

• **BCG Matrix** – Evaluates portfolio performance by categorizing business units into growth/share segments.

• **SWOT Analysis** – Identifies internal strengths and weaknesses alongside external opportunities and threats.

While the Balanced Scorecard (BSC)**,** developed by Kaplan and Norton, is frequently associated with strategic management, it primarily serves as a management control tool**.** by translating strategy into measurable objectives across financial, customer, internal process, and learning and growth perspectives, the BSC enables managers to monitor performance and take corrective actions, effectively linking strategy to operational execution rather than directly exercising strategic control

Mintzberg emphasizes that strategy is not always fully deliberate; it can emerge from learning and adaptation within the organization. Consequently, strategic control must accommodate emergent strategies, allowing flexibility to recognize patterns and opportunities that were not anticipated during formal planning.

From **A**nsoff's perspective, strategic control involves identifying and managing strategic issues and uncertainties. By monitoring internal and external factors, organizations can proactively adjust strategies to respond to risks, technological changes, and market disruptions, ensuring that long-term objectives remain attainable.

These frameworks and perspectives collectively transform strategic control from a rigid oversight function into a dynamic, learning-driven process, enabling organizations to make informed strategic choices, adapt proactively, and sustain competitive advantage in turbulent environments

2-2 . Management Control

Management control is a critical mechanism for translating strategic objectives into operational action and ensuring that organizational goals are effectively achieved. It serves as a bridge between high-level strategy and day-to-day operations, facilitating alignment and coherence across all levels of the organization. Controller managers play a pivotal role in this process, ensuring that communication and coordination mobilize all personnel—from senior executives to frontline employees—toward the accomplishment of organizational objectives. Frontline employees, in particular, must understand the strategic consequences of their decisions; thus, management control converts business unit missions and strategies into clear, measurable objectives and actionable performance indicators.

The cascading of strategic objectives typically involves four key steps:

1. Clarifying and translating the mission, vision, and strategy to ensure understanding at all levels.
2. Communicating and linking strategic objectives and performance measures to operational responsibilities.
3. Planning, setting targets, and aligning strategic initiatives to guarantee that operational activities support overall strategy.
4. Enhancing strategic feedback and learning by monitoring results, identifying gaps, and fostering continuous improvement.

Management controllers rely on a combination of historical, real-time, and projected data to inform the development of plans, budgets, and forecasts. This ensures that oversight spans past performance, current operations, and future planning, effectively integrating strategy with execution.

At this stage, control becomes an integral part of the planning process, ensuring compliance with established standards and acting as a mechanism of regularity control. The management control process itself encompasses sequential stages of preparation, coordination, decision verification, and organizational action, conventionally structured into three fundamental phases (Figure 2). by systematically linking strategic objectives with operational measures, management control not only monitors performance but also fosters accountability, adaptability, and informed decision-making throughout the organization

As shown in figure 2 The control process in management is commonly structured into **three fundamental phases**, each serving a distinct purpose in ensuring alignment between strategy, operations, and outcomes:

1. **Finalization**
   - Determining the objectives to be pursued and identifying the resources required to achieve them.
   - Assessing the optimal utilization of these resources and evaluating their potential contribution to organizational goals.

2. **Management**
   - During the implementation of decisions, identifying deviations or issues and applying corrective actions to adjust or redirect the course of action.
   - Ensuring that operational activities remain aligned with planned objectives and standards.

3. **Evaluation**
   - Measuring the outcomes of implemented actions in terms of efficiency, effectiveness, and overall utility.
   - Providing feedback for future planning and decision-making, thus closing the control loop and supporting continuous organizational learning.

<u>Figure 2 , Phases of the Management Control Process</u>

finalization management evaluation

As mentioned previously, within this framework, management control is positioned at the interface between strategic control and operational control. Its primary role is to regulate organizational activity over the medium term by translating long-term strategic objectives into concrete operational actions.

The three levels of control can be summarized as follows:

- **Long-term:** Strategy formulation and planning → **Strategic control**.
- **Medium-term:** Coordination and regulation of resources and activities → **Management control**.
- **Short-term:** Day-to-day operations and task execution → **Operational (or execution) control**.

By functioning as a bridge between strategic intent and daily operations, management control ensures that organizational activities remain aligned with overarching goals while allowing flexibility for adaptation and performance optimization.

2-3. Tactical Control

Tactical control represents the lowest level of organizational supervision and serves as a key input source for the management control system. It operates on a short-term, real-time basis, focusing on day-to-day operations and routine processes. The data and information generated at this level—such as attendance records, production reports, and sales performance reports—provide managers with immediate feedback to monitor ongoing activities and ensure compliance with established procedures.

by systematically collecting and processing operational data, tactical control enables organizations to detect deviations promptly, implement corrective actions, and maintain smooth operational performance. In this way, tactical control not only supports management control but also ensures that strategic objectives are translated into effective daily actions.

3- Management Control in the Context of Resource Utilization and Organizational Performance

The Management Control System (MCS) is perceived as a structured set of processes through which managers ensure the efficient and effective use of organizational resources and tools to achieve desired objectives. This procedural definition highlights three key factors that form the general framework of an MCS:
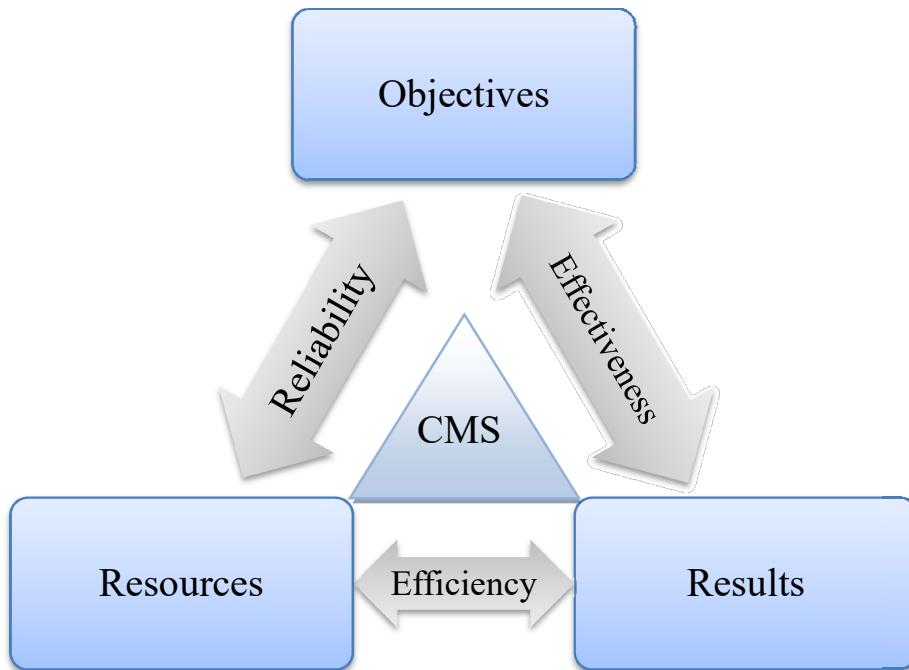
1. **Efficiency and effectiveness** – ensuring that organizational goals are achieved while making optimal use of available resources.

2. **Reliability** – ensuring dependable alignment between resources and objectives, so that resource allocation consistently supports the achievement of organizational goals.

3. **Goal alignment** – linking strategic and operational objectives with actions and performance measures throughout the organization.

Figure 2 illustrates how the MCS balances resources and objectives to achieve performance results, emphasizing both the efficiency of resource utilization and the effectiveness of meeting strategic and operational objectives. By integrating reliable processes, managers can confidently monitor and adjust resource allocation to maintain alignment with organizational priorities, thereby enhancing overall performance.

Effectiveness is defined as the extent to which an organization achieves its desired goals, focusing primarily on outputs, regardless of the resources utilized. **Efficiency**, on the other

hand, refers to achieving results with the least possible use of resources, thereby optimizing the input-output relationship.

Figure2

Achieving both efficiency and effectiveness requires maintaining a high level of reliability between resources and objectives. Within this framework, **reliability** reflects the compatibility and alignment of available resources with the goals set, ensuring that resources are deployed in a manner that consistently supports the attainment of organizational objectives.

Consequently, another definition of the Management Control System (MCS) emphasizes that its purpose is to effectively manage resources and employ appropriate methods to achieve established organizational goals.

4- The Evolving Role of the Management Controller

In recent years, the role of the management controller has evolved from a traditional, technically focused position to a strategic and advisory function. Historically, controllers were primarily responsible for translating general policy into detailed plans and budgets, analyzing variances, and coordinating with other departments. Today, their responsibilities extend far beyond these classical tasks to include continuous improvement, organizational

change management, enhancement of information systems, and advisory support for decision-makers.

To fulfill these expanded responsibilities, the management controller must combine technical mastery, analytical rigor, and synthesis skills with personal qualities such as clarity, pedagogical ability, dynamism, and ethical conduct. Their practice is guided by three core principles:

1. Informing – providing accurate, reliable, and timely information through analytical tools and performance indicators.

2. Animating – actively communicating insights, advising managers, and facilitating decision-making.

3. Organizing – supporting organizational change and aligning resources, processes, and objectives with strategic goals.

Ultimately, the management controller's versatility—integrating technical, functional, and human dimensions—positions them as a strategic actor at the intersection of information systems, organizational processes, and human capital. This role not only enhances operational efficiency but also reinforces the organization's adaptability, strategic alignment, and long-term competitiveness

5- Management Control Tools and Methods

The effectiveness of management control depends not only on the availability of tools but also on the analytical capacity these tools provide to managers for decision-making and resource optimization. Management control tools allow organizations to measure, monitor, and interpret performance data, thereby translating strategic objectives into operational action and ensuring alignment between resources, processes, and outcomes.

Tools such as budgeting systems and the Balanced Scorecard (BSC) serve as analytical frameworks that link performance metrics to strategic and operational planning. By combining quantitative and qualitative indicators, they enable managers to identify performance gaps, evaluate the effectiveness of resource allocation, and take corrective actions in real-time. These tools facilitate not only monitoring but also strategic learning, allowing organizations to adapt to changing conditions and refine priorities based on emerging performance trends.

Accounting tools and cost analysis methods, including Activity-Based Costing (ABC), target costing, and Cost-Volume-Profit (CVP) analysis—incorporating measures such as Break-Even Point (BEP) and Degree of Operating Leverage (DOL)—focus on analytical evaluation of resource efficiency. By providing insights into the cost behavior of products,

services, and operational processes, these methods allow managers to optimize resource utilization, control expenditures, and enhance the overall cost-effectiveness of organizational operations.

In essence, management control tools are not merely instruments for monitoring; they function as analytical lenses through which managers can interpret complex organizational data, assess the alignment of resources with objectives, and make informed decisions that enhance both efficiency and effectiveness. This analytical perspective transforms management control from a procedural mechanism into a strategic enabler of performance and continuous organizational learning

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Lesson 2

Management Control System within the Organizational Planning Process:
From Strategy Formulation to Budgeting

1- Management Control Systems within the Context of Planning

Planning, despite its various definitions, fundamentally aligns with the concept introduced by Henri Fayol, linking it to the dual aspects of forecasting and control. Some definitions view planning as a form of future-oriented thinking, while others describe it as a deliberate effort to manage variables that may influence the future—framing it as "designing the desired future and specifying the means to achieve it" or as "constructing controllable variables within the organizational environment." In practice, planning enables organizations not only to anticipate and influence market conditions but also to exercise control over operational processes, including procurement, sales, and resource allocation.

The Management Control System (MCS) integrates closely with the planning process by providing a structured framework that ensures the alignment of resources, objectives, and performance. Its contributions can be summarized as follows:

1. Establishing Estimates and Objectives – The MCS assists in defining, constructing, and prioritizing organizational goals and desired outcomes in advance. These estimates serve as benchmarks for both operational and strategic decision-making.

2. Information Collection and Processing – Functioning as a comprehensive information system, the MCS gathers, processes, and analyzes data using specialized tools designed for management control. A significant portion of this analysis is linked to

the pre-established estimates, which act as primary system inputs. The outputs generated are crucial for revising and refining future forecasts, enhancing both accuracy and reliability.

3. Ensuring Consistency and Alignment – The MCS monitors and harmonizes objectives and decisions across all units, departments, and centers, ensuring that individual and operational goals are aligned with the organization's strategic priorities. This alignment strengthens coherence between planning, execution, and control, enabling the organization to respond effectively to internal and external changes.

by integrating planning and management control, organizations transform the MCS from a mere monitoring mechanism into a strategic enabler, capable of linking long-term objectives with operational execution, optimizing resource utilization, and supporting adaptive decision-making. This analytical perspective highlights the MCS not only as a tool for control and measurement but also as a central instrument for organizational learning, performance improvement, and strategic alignment.

The diagram 1 represents a cyclical management process consisting of four stages:

1. **(Planning)** – Setting objectives, estimating resources, and designing the desired outcomes.

2. **(Action/Execution)** – Implementing the plans and executing tasks according to the defined objectives.

3. **(Checking/Verification)** – Monitoring performance, measuring results, and comparing them against the planned objectives.

4. **(Corrective Action/Adjustment)** – Taking corrective actions to address deviations, adjust processes, and improve future planning.

The arrows indicate a **continuous feedback loop**, emphasizing that after corrective actions, the cycle restarts with planning. This represents a dynamic and iterative approach to management, ensuring that resources and objectives remain aligned while promoting continuous improvement

2- From strategy to budgeting system

In order to achieve its vision and mission organizations need to build the right strategy , and the more important , managers need to monitor the right cascading process for translating this strategy into action by building specific strategies for marketing, production, human resources, procurement and the like. Each of these strategies will be put into effect in the short term by means of specific plans which is a part of business planning process and budgeting system . Obviously, all of these are forward-looking.

Figure 1 , Planning-Action-Control Cycle
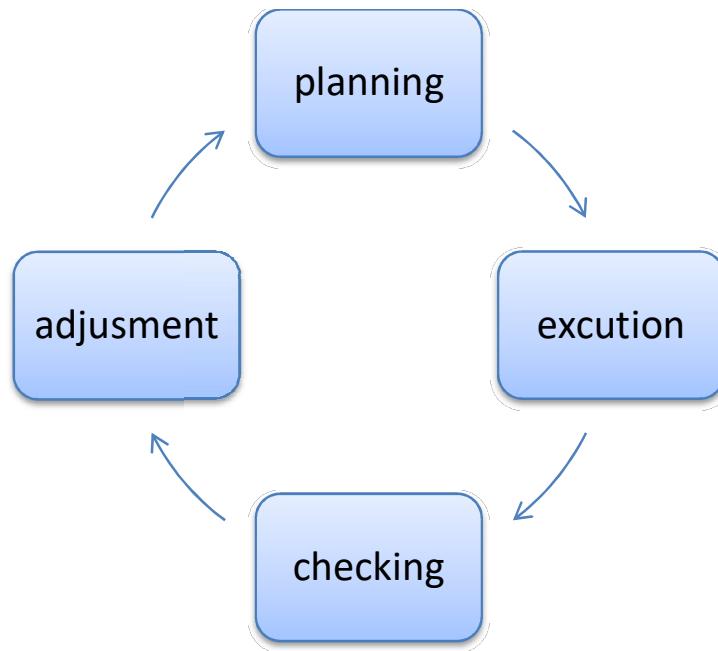
Mangers needs to ensure that such plans and targets are adhered to and, if necessary ,modified to cope with actual conditions. This is where performance monitoring, feedback and reporting takes an important place into the equation.

Figure 2 and 3 illustrates the processes described above.

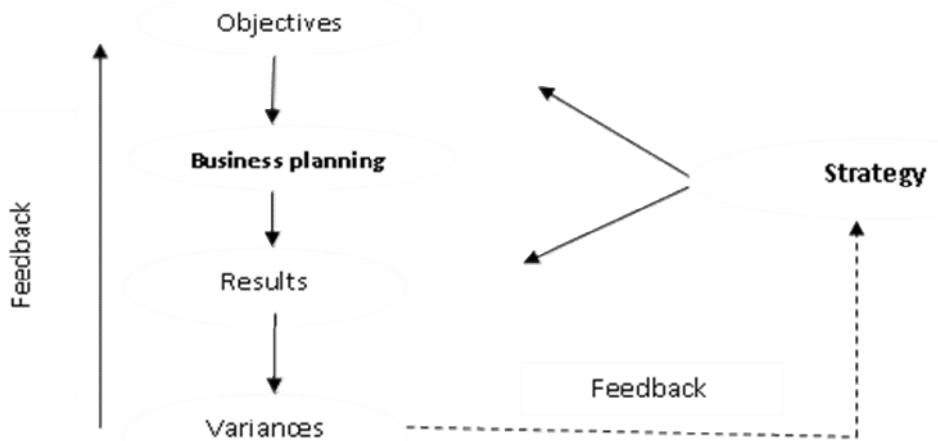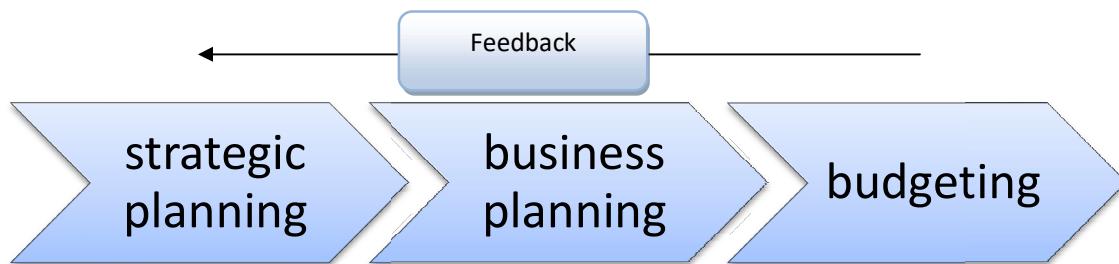**Figure 2 The Strategy And Planning Process**

figure 3 from strategic planning to budgeting

<u>**Note**</u>

Other versions of this diagram may be found in most business management texts. The planning process, then, takes place at many levels – strategic, tactical, operational, etc. and the financial aspects of each type of planning may be known as budgets. Budgets may be applied at any level, although at the higher levels of strategic and tactical planning, the term financial planning tends to be used in preference to 'budgeting'.

A – Strategic Planning

As discussed in the first lecture, strategic control is embedded within the broader concept of strategic planning. Strategic planning involves formulating an organization's strategy by evaluating and selecting the best available options. This process often relies on analytical tools and models such as SWOT analysis, Porter's Five Forces, strategic network analysis, and others.

Once a strategic option is selected, it is translated into long-term plans that outline the broad actions necessary to achieve the defined strategic objectives. These long-term plans are subsequently broken down into medium- and short-term plans through what is commonly referred to as **Business Planning**.

B – From Strategic Planning to Operational Planning

After the strategy is formulated and a strategic course is chosen, the next step is to translate it into actionable operational plans. This involves scheduling the necessary procedures and tasks to implement the strategy effectively.

The initial stage of this translation is represented by the **business plan**, which typically spans a period of three years and encompasses estimates ranging from long-term to short-term horizons. The business plan's primary purpose is to reduce uncertainty by providing a

detailed framework that ensures alignment between long-term strategic objectives and the practical requirements for implementation. In essence, it serves as a bridge connecting strategic direction with budgetary and operational planning.

Operational planning arises from two fundamental needs:

> ➢ To ensure consistency and alignment between all organizational initiatives and the overall strategy within the framework of budgetary estimates. The business plan is the key instrument to establish this link.
> ➢ To maintain this alignment throughout the implementation of programs, initiatives, and operational activities.

B1- Phases of Business Plan Preparation

The preparation of a business plan typically involves three sequential phases:

> ➢ Preparation of Basic Data
> ➢ Development of Sectoral Business Plans
> ➢ Preparation of the Overall Business Plan

B 1-1 . Preparation of Basic Data

Basic data consists of the information that must be communicated to each manager within the organization. This includes:

First, General objectives and strategic outlines: These must be translated into sub-objectives for each responsibility center before developing sectoral business plans. Upon receiving the overall objectives and strategic outlines, each manager formulates specific objectives for their area of responsibility. Conflicts between objectives of different centers may arise, requiring arbitration. A committee of senior managers is often established to facilitate dialogue and coordination. Key considerations in arbitration include:

- The fixed and variable costs and operational capacity of each center
- Previous support, improvements, or reforms provided to each center
- Benchmarking against similar centers in other organizations

Organizations may respond in two ways:

- Revising and reducing the organization's overall objectives
- Allocating additional resources to specific centers according to their importance

Second , Planning assumptions and reference models: These provide essential context for planning and ensure consistency by including data on wages, prices, economic growth, social and political environment, work schedules, regulations, procedures, competitor information, timelines, and necessary reforms.

B-1-2 Development of Sectoral Business Plans

Once managers have a clear understanding of both overall and unit-level objectives and have received work models, they develop sectoral business plans. These plans typically include:

First, Detailed objectives, translated into operational targets, performance goals, and quality standards

Second, Programs required to implement the strategy, with precise details of:

- o Specific tasks and activities for each center
- o Execution schedules
- o Responsibility assignments
- o Required resources, workforce levels, and necessary investments

B1-3 Preparation of the Overall Business Plan

After sectoral plans are finalized, they are submitted to senior management for review and approval. The management controller may consult with center managers to clarify or adjust details, including resource allocation and workforce schedules.

A planning committee, composed of the general manager, management controller, and key center managers, then evaluates and approves the sectoral plans, either as submitted or with necessary modifications.

Following supplementary studies, the overall business plan is finalized, integrating detailed plans for financing, investment, marketing, and development. During publication, care must be taken to protect sensitive information from competitors.

C – From Operational Planning to Budgetary Estimates

After preparing the business plan—which represents the first stage in transitioning from theoretical strategy to practical implementation—the next step is the preparation of the **budgetary estimates**, which constitutes the second and final stage in translating strategy into execution.

Budgetary estimates are prepared based on annual business plans structured as programs derived from the overall plan, following the mechanism described previously. These plans serve two primary purposes:

C1- To confirm or refine the estimates that were initially outlined in the business plan.

C2- To provide detailed specifications for developmental activities

3- Budgeting system

3-1 , Definition

A **budget** is commonly defined as a financial plan; however, it can also be expressed in quantitative terms beyond purely financial measures. Essentially, a budget specifies the anticipated amounts—whether financial or non-financial—that are expected to be incurred or generated as a result of a planned course of action, explicitly considering the timing of these expenditures and revenues.

For decision-makers, budgets serve multiple critical roles:

➢ **Planning and Diagnostic Tool:** Budgets translate strategic plans into specific, measurable performance indicators.

➢ **Management Tool:** They link planning with the control system, ensuring that operations are aligned with organizational objectives.

➢ **Forecasting Method:** Budgets take into account both internal and external factors that influence short-term goals.

➢ **Cascading Tool:** They provide a feedback system that monitors progress toward long-term objectives and translates them into achievable short-term targets.

➢ **Coordination Tool:** Budgets create a common framework for the organization's units and members, guiding their activities in alignment with the overall organizational strategy.

Budgets are essential tools in the management control system, enabling organizations to plan, coordinate, and monitor their activities. They are typically classified into several types based on their purpose and scope. **Functional budgets** focus on specific operational areas, such as **sales,** production, and procurement, helping managers allocate resources effectively and anticipate departmental needs. Functional budgets are grouped into multiple **subsidiary budgets** according to their specific function. Common classifications include:

- Sales budgets
- Production budgets
- Labor budgets
- Overhead budgets
- Purchase budgets

 Investment budgets are concerned with long-term expenditures on assets, projects, or capacity expansion, ensuring that capital resources are used efficiently to support strategic objectives. Additionally, the **cash or treasury budget** monitors the inflows and outflows of cash, providing management with a clear view of liquidity and financial stability. Together,

these budgets form an integrated framework that supports both operational decision-making and strategic planning.

3-2 Budget Preparation and Agenda Setting

Key Questions to Address in Developing an Annual Budget

Sales Budget:

- What products will we sell?
- How much of each product will be sold?
- When will the products be sold?

Purchase Budget – Commercial Organization:

- Where will the products be sold?
- When will the products be purchased?
- Who are the suppliers?
- How much will be paid for the products?

Purchasing Budget – Manufacturing Organization:

- How much of each material is required?
- Where and when will the materials be sourced?
- How much will the materials cost, and when will payments be made?
- What quantities will be purchased versus maintained in stock?

Labor Budget

- How much labor will be required?
- How many employees of each type will be needed?
- When will they be employed?
- When will they be paid?

Figure 4 illustrates the budget preparation process for a manufacturing organization on an annual basis.

A robust budgeting system must be supported by a **strong information system** that links each budget interactively. For example:

- The **sales budget**, based on estimated sales for the upcoming period, requires information from the **production budget**, which estimates the quantity of goods to be produced.
- Conversely, the production budget interacts with the sales budget in relation to inventory management policies.

- Similarly, the **purchases budget**, which determines the amount of goods and raw materials required to achieve production and sales targets, must be developed in coordination with both the production and sales budgets, taking inventory management policies into account.

This interactive approach ensures coherence and alignment across all functional areas.

Figure 4 ; The Budget Preparation Process
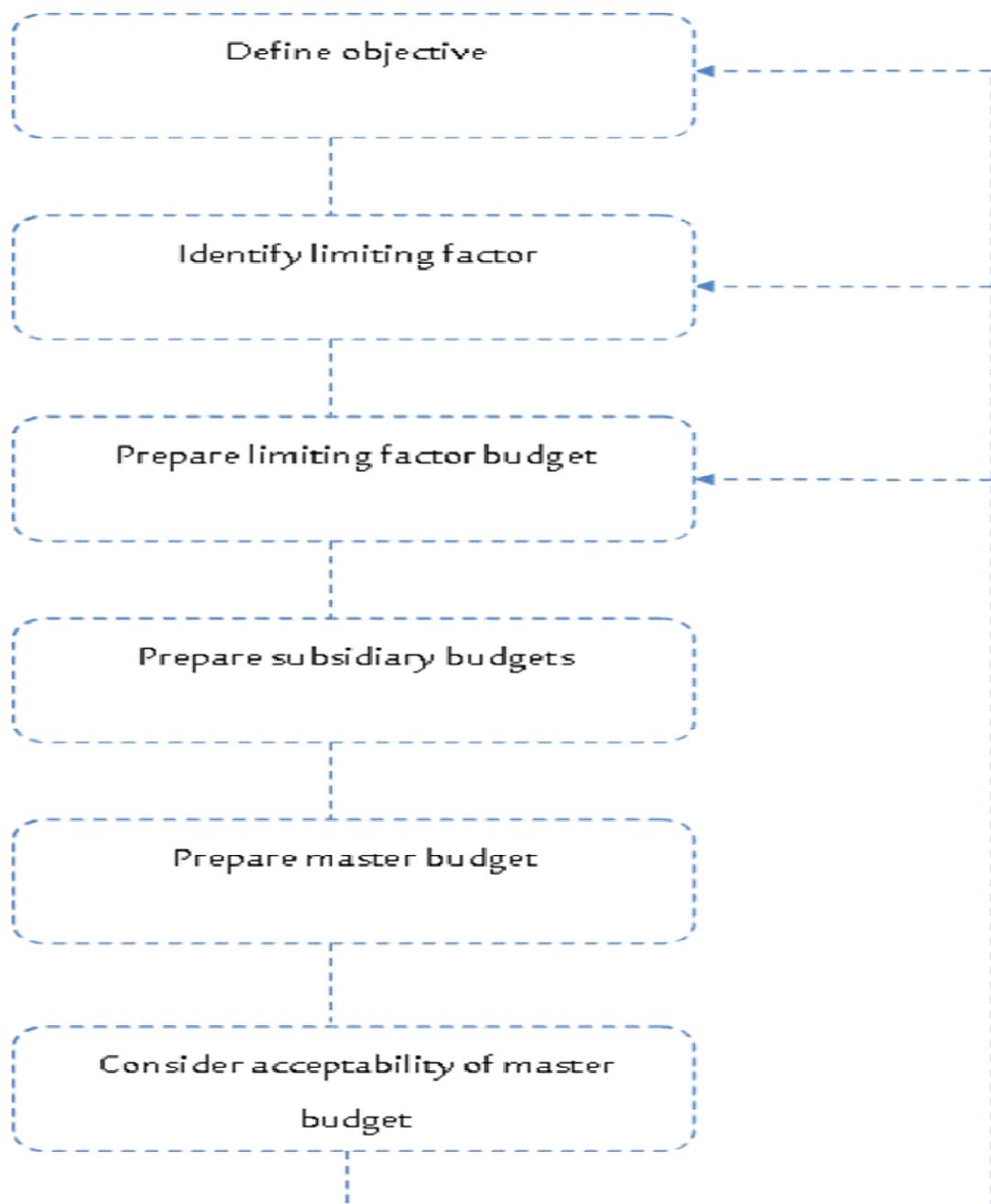
Budgeting Agenda

The preparation timeline for budgets varies according to the size and complexity of the organization, but generally follows an **annual cycle**, typically from September to December. The process usually includes the following stages:

A. Planning and Data Distribution

The planning or management control department distributes general work scenarios, reiterating directives from the strategic planning stage regarding objectives, investments, labor estimates, and operational information. This data provides the framework for budget preparation.

B. Initial Budget Preparation

Departments and branches prepare their preliminary budgets, discuss objectives, and conduct studies to generate estimates and simulate alternatives. These budget documents are then submitted to the management controller for consistency checks and initial approval.

C. Iterative Review – "Navette Budgétaire"

Information is exchanged between branches and central administration through the management controller to reconcile inconsistencies and ensure alignment with the business plan. This iterative communication process, known as **Navette Budgétaire**, facilitates negotiation and adjustment, culminating in a final budget proposal.

D. Final Approval

The finalized budgets are approved by top management, marking the conclusion of the annual budgeting cycle.

Lesson 3

Management Control and Planning Using the Balanced Scorecard

1- The Concept of the Balanced Scorecard:

In the early 1990s (1992), Harvard Business School researchers Robert Kaplan and David Norton introduced, for the first time, their pioneering model for performance measurement. This model emerged as the outcome of a year-long study involving approximately twelve U.S. organizations. The initial aim of the study was to expand the scope of performance assessment beyond the conventional financial and accounting indicators, while ensuring coherence and integration across the various dimensions of performance management.

Kaplan and Norton grouped these dimensions into four essential perspectives, which they incorporated into a unified framework known as the **Balanced Scorecard figure 1** . Despite its apparent simplicity, the concept gained significant traction and was widely adopted by leading corporations around the globe. In some institutions, the Balanced Scorecard even became a foundational pillar for strategy formulation and for reshaping their strategic planning systems. This widespread application encouraged Kaplan and Norton to refine their original conception, transforming the Balanced Scorecard from a mere measurement tool into a comprehensive framework for strategic management and planning

Figure 1 , the balanced scorecard dimensions

Financial

Objectives	Measures	Targets	Initiatives

To Succeed Financially, How Should We Appear To Our Shareholders

Customer

Objectives	Measures	Targets	Initiatives

To Achieve Our Vision ; How Should Appear To Our Customers

Vision and strategy

Internal Business

Objectives	Measures	Targets	Initiatives

To Satisfy Our Shareholders and Customers , What Business Processes Must We Excel At

Objectives	Measures	Targets	Initiatives

To Achieve Our Vision: How Will We Sustain Our Ability To Change And Improve

Learning & Growth

Source; Kaplan and Norton ; using the balanced scorecard as strategic management system; Harvard business review ; 1996 ; p 4 **.**

2. The Balanced Scorecard as a Framework for Strategic Management and Planning

The Balanced Scorecard establishes a fully integrated managerial cycle for measuring and steering organizational performance. This cycle begins with the translation of the organization's mission and strategic intent and ultimately feeds back into them through a

structured learning and feedback process. As illustrated in the figure below, the Balanced Scorecard operationalizes strategy through four interrelated stages:

1. Translating the vision and mission into a coherent strategic architecture;
2. Communicating and cascading strategic objectives and performance indicators across the organizational structure;
3. Planning core processes and formulating operational targets that align with strategic priorities;
4. Reinforcing strategic learning through continuous feedback and performance review

Figure 2 , the balanced scorecard as strategic management system
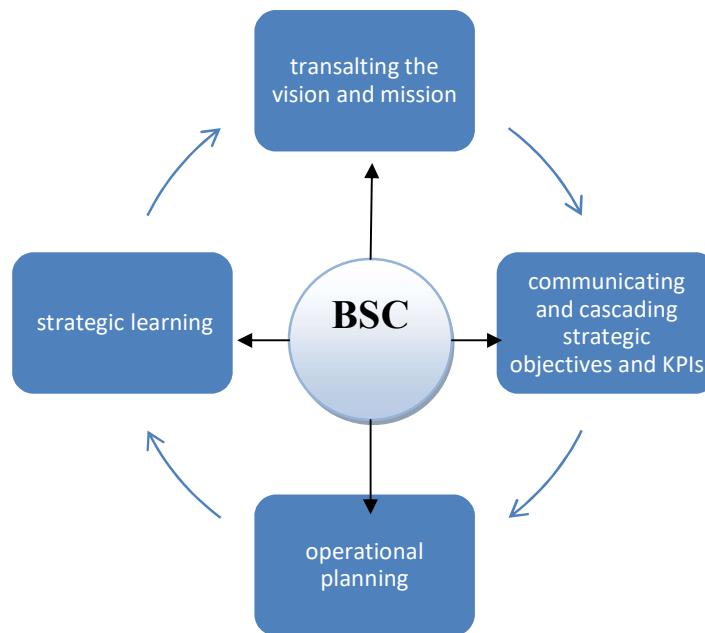
3- The Balanced Scorecard: Linking Strategic Planning and the Budgeting System

Based on the above, it becomes clear that the Balanced Scorecard redefines and reinforces new concepts related to the strategic planning process. In this context, Kaplan and Norton introduced a new notion—the **Strategy Map**, which serves as a tool for planning the causal linkages among the various objectives and measures across the four perspectives of the Balanced Scorecard. This allows organizations to track and understand the cause-and-effect relationships that drive strategic outcomes.

The researchers further proposed integrating the Balanced Scorecard and the Strategy Map with business plans and the budgeting system, reorganizing them in a way that strengthens their alignment with strategic objectives and performance measures, all through the lens of the Balanced Scorecard's four perspectives.

Figure (3) illustrates the different stages through which the Balanced Scorecard is integrated with the budgeting system, following a structured **step-down procedure**. This descending sequence begins with translating the strategy and culminates in the allocation of resources.

Figure 3 step down procedures - strategy to budgeting system -

Strategy (3-5 years)

1-Translate into balanced scorecard

2- set stretch targets

3-Identify strategic initiatives and resource requirement

Step-down procedure (generally a 2-to – 3 year plan)

4-Authorize financial and human resources

budget (1 year)
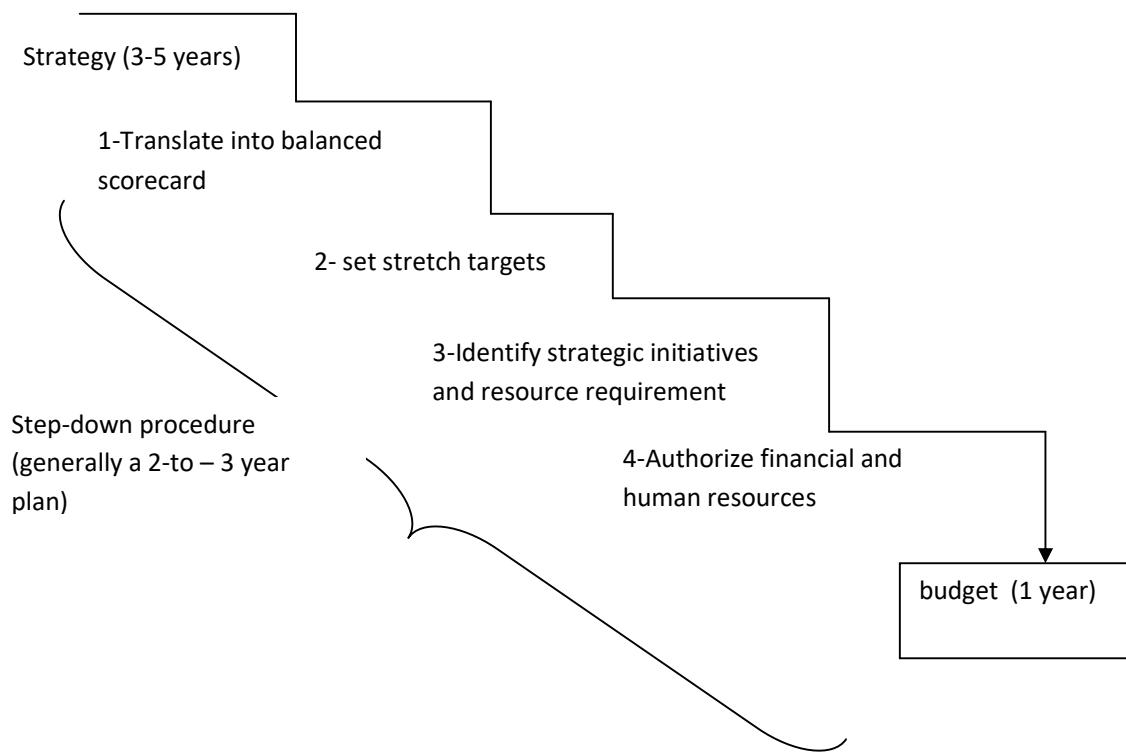
The process of translating strategy through the Balanced Scorecard (BSC) begins with identifying the strategic objectives across its four perspectives, aligned with prevailing competitive requirements. At this stage, the **Strategy Map** is constructed to clarify cause-and-effect relationships between objectives.

Next, **targets** are defined as the annual decomposition of strategic objectives according to the associated performance measures. Following this, a **gap analysis** is conducted to provide motivation and drive performance improvements.

Strategic initiatives are then determined along with the necessary resources to bridge the identified gaps, thereby ensuring the achievement of strategic objectives. Subsequently, **human and material resources** are allocated to these initiatives and integrated into the budgeting process. The budgeting framework operates at two levels: the **strategic budget**, which addresses new strategic requirements, and the **operational budget**, which focuses on managing the efficiency and effectiveness of departments, functions, and production lines.

It is important to note that the sequencing of initiatives and resource allocation requires adjustment. Initiatives should not be viewed as end-points but as tools to achieve objectives. The conventional view:

Strategy → Initiatives → Measures

should be corrected to:

Strategy → Strategic Objectives (BSC) → Establishment of Strategic Objective Measures (BSC) → Setting Targets Based on Measures → Strategic Initiatives

All strategic initiatives are subsequently submitted for financial approval and incorporated into the budget, accounting for required resources and ongoing projects. As a result, the budget reflects an integrated view at both strategic and operational levels.

Figure 3 the management system – plan the strategy

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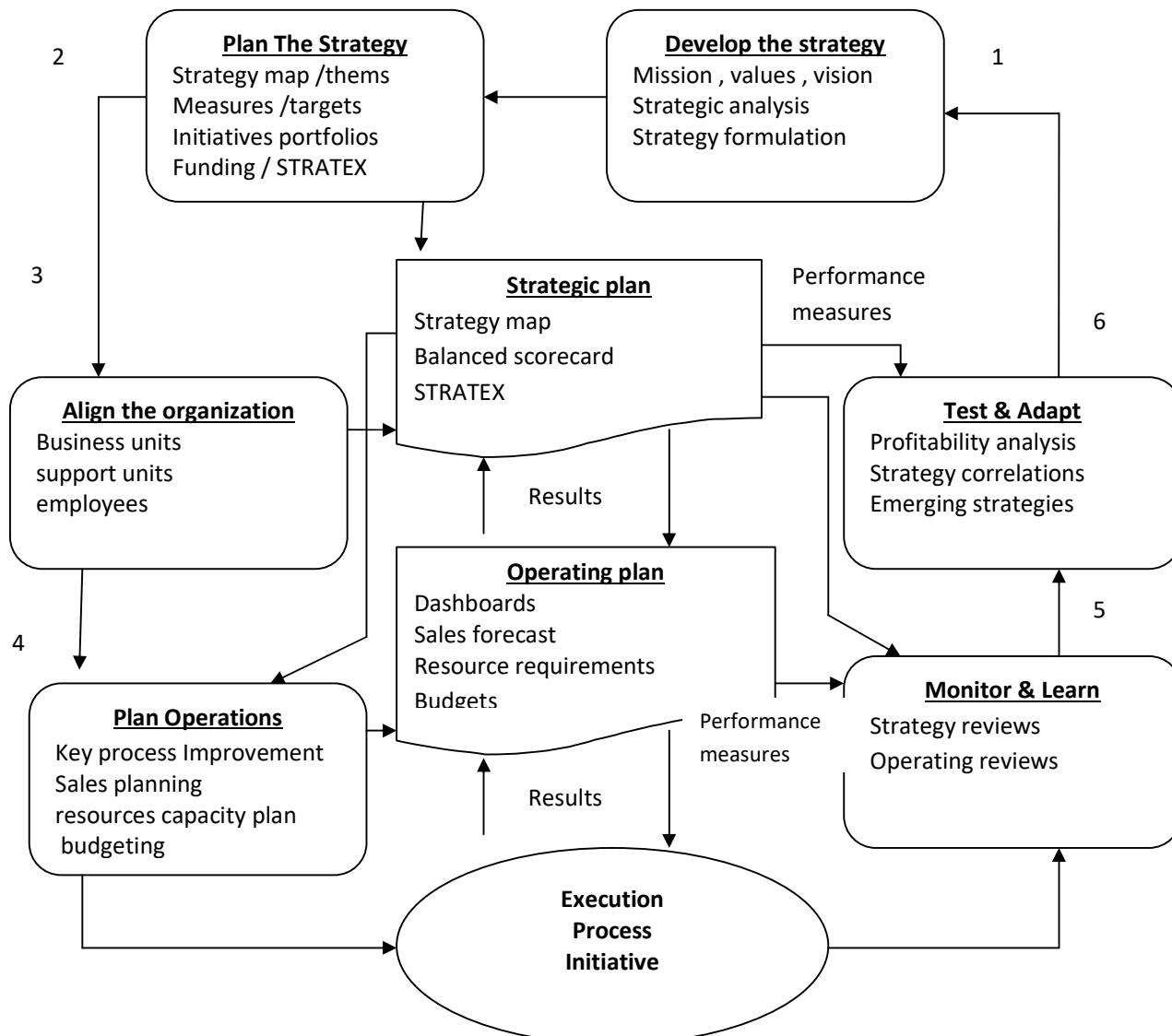
Chapter 2

Variable Costing: Cost behaviour, CPV Analysis (BEP; DOL).

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Learning Objectives

- ✓ Understand and distinguish key cost concepts and classification including variable cost, fixed cost, mixed cost, profit, and contribution margin; and explain their roles in Cost–Volume–Profit (CVP) analysis and managerial decision making.
- ✓ Understand the Break-Even Point (BEP) by calculating it in units and sales value, interpreting its managerial implications, and applying BEP analysis to evaluate risk, cost structure decisions, and pricing strategies.
- ✓ Understand the Degree of Operating Leverage (DOL) by defining and calculating it, interpreting its relationship with fixed costs and BEP, and using DOL to assess how sensitive operating income is to changes in sales volume within the CVP framework

List of abbreviations

CVP	Cost ; Volume ; Profit
P	Price
Q / V	Quantity/ Volume (the same)
TR /R	Total Revenue /Revenue (the same)
VC	Variable Cost
VCPU	Variable Cost Per Unit
FC	Fixed Costs
FCPU	Fixed Cost Per Unit
TC	Total Costs
CM /TCM	Contribution Margin/Total contribution margin
CM PU	Contribution Margin Per Unit
MS	Margin of Safety
BEP	Break- Even Point
Q*	Break- Even Quantity / Break- Even Point in units

E	Earning(Profit)
EBIT	Earnings Before Interest & Taxes
DOL	The Degree of Operating Leverage
TP	Target Profit
TQ	Target Quantity

Lesson 4
Cost Classification

1- cost Definition:

Cost is the monetary value of resources sacrificed or forgone to achieve a specific objective, such as producing a good or delivering a service. It represents the economic resources consumed or committed in exchange for expected future benefits

Cost is the monetary measurement of inputs—such as materials, labor, and overhead—used or consumed in the process of producing goods, providing services, or carrying out activities, systematically recorded and classified to support planning, control, and decision making

2- Cost Classification

Costs can be classified in many different ways. The choice of classification method—and the level of detail used—depends on the purpose of the analysis, whether it is for costing, planning, control, decision making, or performance evaluation.

Costs are commonly classified according to:

1. Purpose or Traceability (Cost Object):

- Direct Costs:
- Indirect Costs:

2. Nature or Element (Cost Elements):

This classification identifies costs based on the type of resource consumed. Common categories include:

- Materials (raw materials, components)
- Labor (wages, salaries)
- Expenses/Overheads (rent, utilities, depreciation, maintenance, services)

This grouping is often used in financial accounting, cost accumulation systems, and budgeting structures.

3. Behavior (Cost Behavior with Activity Level):

Costs are grouped based on how they respond to changes in activity or output levels. Main categories include:

- Variable Costs: change in direct proportion to activity levels.
- Fixed Costs: remain constant within a relevant range, regardless of activity.
- Mixed (Semi-variable) Costs: contain both fixed and variable components.
- Step Costs: remain constant for a range but jump to a new level when activity exceeds certain thresholds

1- classification by nature

Classification by nature groups costs according to the fundamental type of resource or input consumed in the production process or in providing services. This approach answers the question: "What is the cost made of?

It is widely used in financial reporting, budgeting, and cost accumulation systems because it provides a clear breakdown of the primary cost elements.

Under this classification, costs are typically divided into three major categories:

Materials

Material costs include all costs associated with acquiring, transporting, and receiving materials into the organization. These costs cover the purchase price, handling, storage, and any related procurement expenses.

Within the materials category, costs are commonly subdivided into:

- Raw Materials: Basic substances or primary inputs used directly in the manufacturing process.
- Components: Pre-manufactured or fully assembled parts purchased for incorporation into the final product.
- Consumables: Items used in the production process but not incorporated into the final product. Examples: cleaning supplies, small tools, protective materials.
- Maintenance Materials: Supplies necessary for maintaining machinery and equipment.Examples: spare parts, lubricants, oils, filters.

Labour Costs

Labour costs represent the monetary value of human effort required for production or service delivery. They include wages, salaries, bonuses, overtime, and related employment expenses such as social security contributions, benefits, and payroll taxes.

The measurement of labour costs depends on the remuneration system used, which may be based on:

- Time-based pay: determined by hours or days worked.
- Output-based pay: determined by units produced or tasks completed.
- Mixed systems: combining both time and performance measures.

Labour may be further categorized as direct (easily traced to products) or indirect (supporting activities).

Expense Costs

Expense costs refer to external operating costs that are neither materials nor labour. These items are typically documented through supplier invoices and are necessary to support the overall functioning of the organization.

Examples include:

- Rent
- Business rates and taxes
- Electricity and gas
- Telephone and internet services
- Postage and office supplies
- Insurance, cleaning, and security services
- Depreciation and maintenance services

These expenses may be considered part of **overhead costs**, particularly in manufacturing and service environments.

2 – Classification by Purpose (Traceability to a Cost Object)

When costs are classified according to their purpose, they are grouped based on the reason for which they are incurred and the extent to which they can be traced to a specific cost object.

The broadest and most widely used classification under this category is the distinction between direct costs and indirect costs.

2.1 Direct Costs

Direct costs are those costs that can be specifically, directly, and economically traced to a particular cost object.

A cost object may be a product, service, customer, project, activity, or department.

Key characteristics:

- Clearly linked to a single cost object
- Measured without allocation
- Cost-beneficial to trace directly

Examples:

- Direct materials used in a product

- Direct labour hours spent on a specific job

- Specific equipment or tools used exclusively for one project

Direct costs vary depending on the nature of the business and the cost object chosen.

2.2 Indirect Costs

Indirect costs are costs that, although necessary and clearly incurred, cannot be directly or economically traced **to** a specific cost object.

Because they benefit multiple cost objects simultaneously, they require allocation using predetermined overhead rates or cost drivers.

Key characteristics:

- Support multiple cost objects

- Cannot be traced economically to one output

- Allocated rather than directly assigned

Examples:
- Factory rent and utilities

- Indirect labour (supervisors, maintenance staff)

- Depreciation of shared equipment

- General administrative expenses

Indirect costs form part of what is typically known as overhead, such as manufacturing overhead or administrative overhead.

The table follow show us a sample example of direct and indirect cost .In the furniture industry; production of the table. for example,

Direct cost	Indirect cost
direct materials ✓ **crews** ✓ **metal drawer handles** ✓ **timber**	**Indirect labour** Salaries of ✓ supervisory labour ✓ The designer (the table may be entitled to a royalty payment for each table made, and this would be classifi ed as a direct expense)
direct labour costs :wages paid to ✓ the machine operator, ✓ assembler ✓ finisher	**Indirect material** ✓ Lubricating oils ✓ cleaning materials
	Indirect expense ✓ Factory rent ✓ power

Important Note

A particular cost may be classified as direct or indirect depending entirely on the cost object being considered.

The classification is not inherent in the cost itself, but is determined by the relationship between the cost and the object being costed.

For example: The salary of a machining department supervisor is a direct cost of the machining department because it can be clearly and specifically attributed to that department.

However, the same supervisor's salary becomes an indirect cost of the individual cost units processed within the department when multiple products or services are being produced, because it cannot be directly traced to a single product or job and must therefore be allocated among them.

In other words, there may be a conventional or standard definition of indirect costs, such as energy costs, depreciation of specific machines, or supervisory and administrative labour costs.

However, if these costs can be directly assigned to a specific product or cost object without any accounting difficulty, they are treated like direct costs.

Indirect costs only pose a challenge when they are shared across multiple outputs, which requires a systematic method for allocation. The chosen method may vary depending on the accounting system in use, such as the departmental (homogeneous cost centers) approach or the activity-based costing (ABC) system.

3- Cost Grouping and Measurement

Costs can be grouped and measured in relation to units, cost centres, and cost objects, depending on the purpose of the analysis and the type of information required.

1. Cost Unit

A cost unit refers to a unit of product or service for which costs are determined or ascertained. In other words, it is the basic unit to which costs are assigned for the purpose of measurement and analysis.

The selection of a cost unit depends on several factors:

- The purpose of the cost ascertainment exercise (e.g., pricing, inventory valuation, profitability analysis).
- The level of detail required for decision making.
- The availability and reliability of cost data.

Examples of cost units:

- A single product (e.g., a car, a chair)
- A service rendered (e.g., a consultation, a hotel room night)
- A project, batch, or contract, where costs need to be measured per output

by defining an appropriate cost unit, managers can accurately measure, compare, and control costs, and make informed decisions regarding pricing, production, and efficiency.

Cost units can be developed for all kinds of organisations, whether manufacturing, commercial or public-service based.

Some examples are as follows:

Industry sector	Cost unit
Brick-making	1,000 bricks
Electricity	Kilowatt-hour (KwH)
Professional services	Chargeable hour
Education	Enrolled student

Cost Centres

A cost centre is a production or service location, function, activity, or item of equipment for which costs are accumulated and monitored. It serves as a "collecting point" for costs, helping management track, control, and analyze expenses within specific areas of the organization.

Type of Cost Centre	Examples
Service Location	Stores, canteen, maintenance department
Function	Sales representatives, accounting department
Activity	Quality control, research and development
Item of Equipment	Packing machine, printing press, production line

Cost centres are particularly useful for:

- Monitoring departmental or functional costs
- Facilitating budgeting and performance evaluation
- Allocating indirect costs to products or services based on usage

Cost Objects

A cost object is anything for which costs can be measured or ascertained. This could be a product, service, project, customer, department, activity, or distribution channel.

Purpose: Cost objects allow managers to determine the total cost incurred in producing a product, delivering a service, or performing an activity, and to support decisions such as pricing, cost control, and profitability analysis.

Examples of Cost Objects:

- A single product
- A batch of products or a specific project
- A service rendered (e.g., a hotel night, a consultancy session)
- A customer or client account
- A distribution channel or sales region

Lesson 5
cost behaviour

1- Cost Behaviour

In management accounting, cost behaviour refers to the way in which costs change in response to fluctuations in the level of activity. Understanding cost behaviour is essential for planning, budgeting, decision making, and cost control.

The level of activity can be measured in many ways, depending on the nature of the operations or service provided. Examples include:

- Number of units produced
- Miles travelled (for transport or logistics)
- Hours worked (for labour-intensive processes)
- Meals served (for hospitality or catering)
- Percentage of capacity utilised

Costs are generally classified into two main categories based on how they respond to changes in activity level:

2- Fixed Costs

Fixed costs are costs that are incurred for a specific accounting period and remain relatively constant within a relevant range of output or sales volume, regardless of fluctuations in the level of activity.

Unlike variable costs, fixed costs are incurred according to the passage of time rather than the level of activity, which is why they are sometimes referred to as period costs.

Key Characteristics of Fixed Costs:

- Remain constant within the relevant range of activity
- Do not change with the number of units produced or sold
- Incurred regularly over a period (monthly, quarterly, annually)
- Often include administrative expenses, rent, insurance, and depreciation

Examples:

- Rent for factory or office premises
- Salaries of administrative and managerial staff
- Depreciation of machinery and equipment

Fixed cost formula   :   Fc = b

A fixed cost can be represented graphically, as shown in **Figure 1**

fixed costs

FC=b
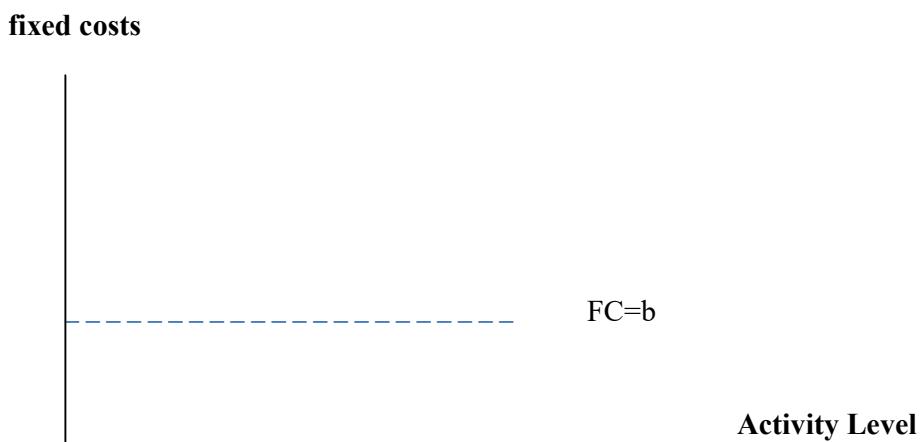
Activity Level

The graph illustrates that a fixed **cost** remains constant across all levels of activity within the relevant range. It is important to emphasize that this constancy only applies as long as activity stays within the capacity limits of the organization. If the organization expands its operations beyond this range, it may be required to incur additional fixed costs.

For example, consider rent expenses. Within the relevant range, an organization can increase production or service activity without requiring additional premises, so the rent cost remains unchanged. However, once activity reaches a critical point where the existing facilities are fully utilized, additional premises may be required, causing the rent cost to rise to a higher level.

This type of cost behavior is referred to as a stepped fixed **cost** or **step cost**, where costs remain constant over a range of activity but jump to a higher level once capacity limits are exceeded, as illustrated in **Figure 2**

This leads us to the first underlying assumption of Cost–Volume–Profit (CVP) analysis: the analysis is conducted within the relevant capacity range and does not extend beyond it.

Consequently, this gives rise to another assumption: the analysis is typically performed for the short term rather than the long term, because capacity generally remains fixed in the short term and only changes over the long term.

figure 2 fixed cost beyond the capacity

fixed costs
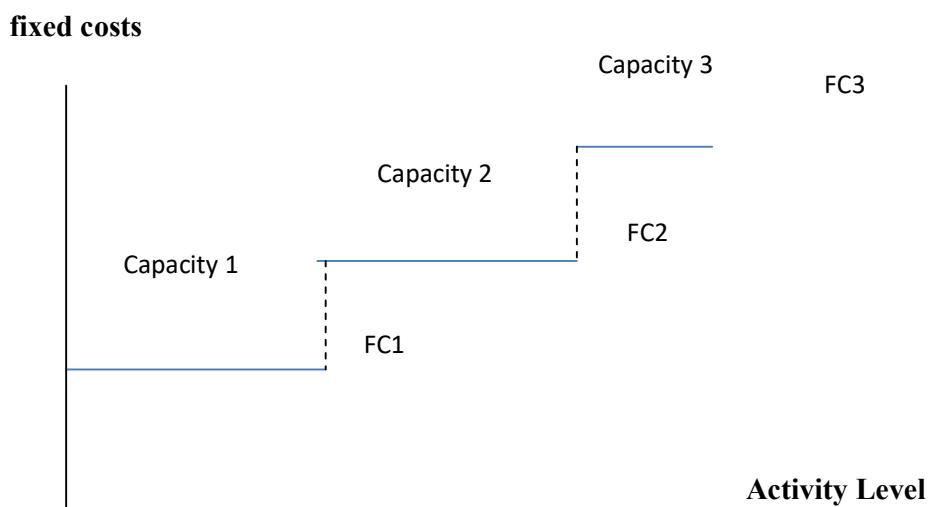
Example

Let us consider an industrial enterprise composed of three production workshops**,** with each workshop containing two production lines**.** Each production line, in turn, is equipped with five automated production machines and is supervised by two workers**.**

At the level of each workshop, the following fixed **costs** were recorded:

- Rent cost**:** estimated at 10,000 monetary units
- Labour cost**:** estimated at 8,000 monetary units
- Depreciation cost**:** estimated at 12,000 monetary units (calculated using the straight-line method)

The total output volume reached 3,000 units, with each workshop producing 1,000 units during the period under study.

Given that the enterprise is operating its workshops at full production capacity, any further expansion—such as an additional 500 units—would require new investments. Specifically,

the enterprise would need to rent a medium-sized workshop to accommodate a single production line at the same cost of equipment as before with one supervisor, which would incur additional costs estimated at :

- Additional fixed labour expenses amounting to: 8,000 / 2 /2= 2000 MU

- Additional depreciation expenses amounting to: 12,000 / 2 = 6,000 MU

- Additional fixed rental expenses – determined according to the lease contract, which will most likely be lower than the rent of the previous workshops since the new workshop is smaller – and let us assume that the lease contract amounts to 7,000 MU.

Accordingly, increasing the production capacity from 3,000 units during the studied period to 3,500 units will require the enterprise to make additional fixed-cost investments amounting to 15000 MU.

Note: The fixed cost per unit decreases as the activity level increases. This occurs because the total fixed cost is spread over a larger number of units, reducing the cost allocated to each unit. It is important to emphasize that this relationship holds only within the given capacity range.

This reduction in unit fixed costs reflects the efficient utilization of available capacity, demonstrating how increased production can improve cost efficiency

figure 3 fixed cost per unit
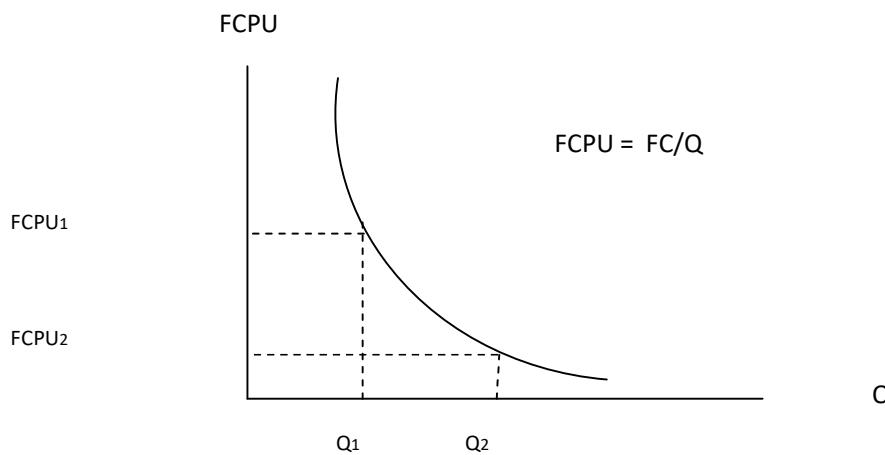
Based on the previous example, let us assume that the expansion decision was within the given capacity, where the capacity limit extends to 4,000 units. In this case, increasing the production volume will not require new investments. Moreover, this decision—raising

production by 500 units—will lead to a reduction in the unit fixed cost from 10 monetary (30000/3,000 = 10) to 8.57 monetary unit (30000/3500).

Accordingly, increasing production by 500 units will lead to a better utilization of fixed costs, resulting in savings of 1.43 monetary units of fixed cost per unit.

3- Variable cost

A variable cost is defined as a cost that changes in direct proportion to changes in the level of activity.

Examples of variable **costs** include:

- **Direct materials** – the raw materials used in production
- **Direct labour** – wages paid based on hours worked or units produced
- **Variable overheads** – costs such as electricity for machinery, packaging materials, and other expenses that increase with production

Understanding variable costs is essential for cost–volume–profit analysis**,** pricing decisions**,** and short-term production planning**,** as these costs fluctuate with output levels.

Figure 4   depicts a linear variable cost. the relationship is represented by a straight line passing through the origin, signifying that no cost is incurred at a zero level of activity. As activity increases, the total variable cost rises proportionally, reflecting a direct linear relationship.

Figure 4 variable cost behaviour

variable cost

VC= aX

.
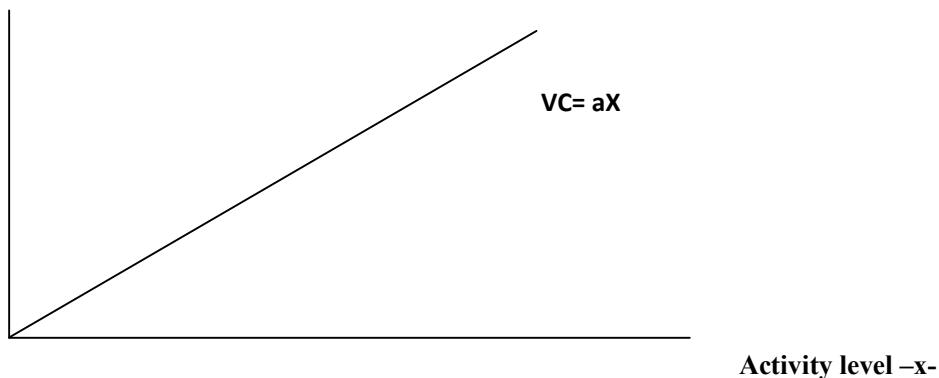
Activity level –x-

The slope (a) mathematically represents the rate at which variable costs change with a change in the level of activity. In accounting terms, this slope is expressed as the unit variable cost, which reflects the variable cost per unit of output or per unit of activity.

The gradient of the line a will depend on the amount of VCPU. So we can refer to VC formula as follow

$$VC = VCPU×Q$$

**Note That**; Unlike their behavior at the total cost level, variable costs at the unit level remain constant, at least in the short term. This leads to another key assumption of Cost–Volume–Profit (CVP) analysis: the unit variable cost is assumed to remain constant within the relevant range of activity.

Figure 5 variable cost per unit behaviour

costs

VCPU

Activity Level
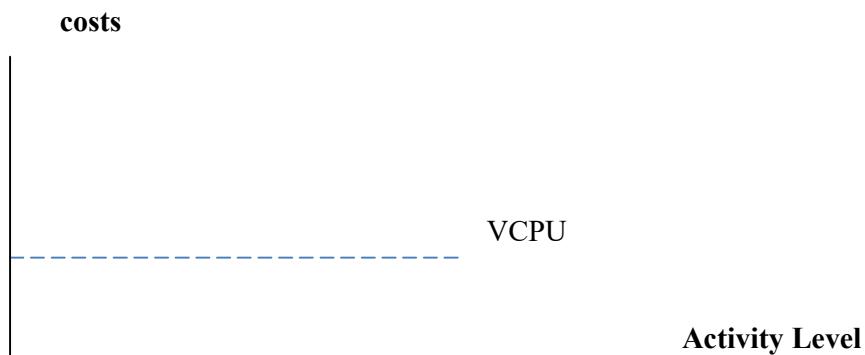
The assumption of a constant unit variable cost is adopted primarily to facilitate the construction of the total cost equation, perform break-even analysis, and measure operating leverage, making calculations manageable over the short to medium term. However, in practice, this assumption is not always realistic. For example:

- Suppliers may offer volume-based discounts, reducing the purchase price per unit.
- Some products may experience short-term price increases, while others may see occasional declines.
- Economies of scale can lower unit costs as production expands.
- Intense supplier competition can also drive prices down, even in the short term.

In summary, a variety of internal and external factors can cause the unit variable cost to fluctuate, either upward or downward, deviating from the simplifying assumption used in CVP analysis

4- The Total Cost Formula

The behavior of total costs is similar to that of semi-variable costs, also referred to as semi-fixed or mixed costs. These costs contain both fixed and variable components, and therefore are partly affected by changes in the level of activity.

- The fixed portion remains constant over the relevant range of activity.
- The variable portion changes in proportion to the level of activi

.

✓ TC = VC+FC

✓ TC = (VCPU ×Q)+ FC

Note: When expressing the total cost formula, the level of activity is represented by quantity (Q), which in this context refers to the number of units produced and sold, assumed to be equal.

This assumption leads to another important premise in constructing the total cost equation for **Cost**–Volume–Profit (CVP) analysis**:** production is assumed to equal sales, meaning that no inventories are considered in the analysis.

The behavior of total costs can be illustrated graphically, as shown in **Figure 6**

 Figure 6 Total Cost Formula

TOTAL COST

TC= (VCPU× Q) +FC

Activity Level (Q)
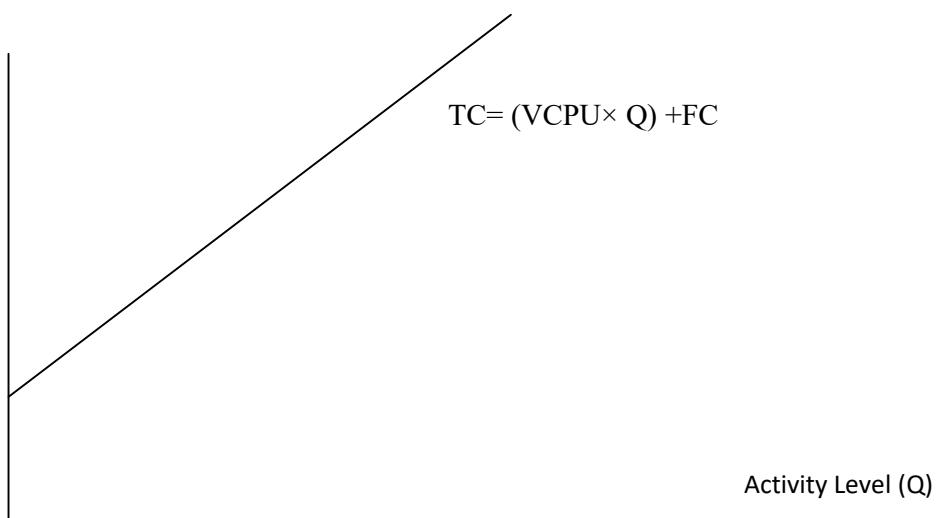
Example: A company has recorded the following data for a total cost as follow

Season	YEAR	Quantity	Total Costs -MU-
S1	n	3400	37000
S2	n	2100	30500
S3	n	4500	42500
S4	n	1500	27500
S1	n+1	4000	40000
S2	n+1	3700	38500

Required ; Determine the Total Cost Formula using

- The high–low method
- The least square method

1- The high–low method

The high–low method identifies the highest and lowest activity levels from the available data and examines the corresponding change in total cost. By selecting the two extreme points, the method ensures that the widest possible range of activity is used, which generally increases the accuracy of the cost estimation.

In this case, the highest activity level occurs in S3 n, while the lowest is observed in S4 n. Because fixed costs remain constant across periods, any difference in total cost between these two activity levels must be attributed to variable costs. Thus, the increase in cost reflects the variable cost associated with the additional activity.

	S3 n	S4 n	Increase
Activity level (units)	**4500**	**1500**	3000
Cost incurred (MU)	42500	27500	15000

The extra variable cost for 3000 units is 15000da. We can now calculate the variable cost per unit:

VCPU = 15000/3000 = 5 MU

Substituting back in the data for S3 n, we can determine the amount of fixed cost:

S3 n : Total cost **42500** Activity level **4500** unit therefore Variable cost 22500

Therefore, fixed cost per month 20000 MU

the fixed and variable cost elements have been identified, total cost formula can be drawn as follow ; **TC= 5Q+20000**

2- The Least Square Method

by using the least square method we determine (a ⇨ VCPU) and (b ⇨ FC) as follow

$$a = \frac{N\sum XY - \sum X \sum Y}{N\sum x^2 - (\sum X)^2}$$

$$b = \bar{Y} - a\bar{X}$$

$$\bar{X} = \frac{\sum X}{n} \ / \ \bar{Y} = \frac{\sum Y}{n}$$

N (Seasons)	(x) Quantity	(y)Cost incurred		
S1 n	3400	37000	11560000	125800000
S2 n	2100	30500	4410000	64050000
S3 n	4500	42500	20250000	191250000
S4 n	1500	27500	2250000	41250000
S1 n+1	4000	40000	16000000	160000000
S2 n+1	3700	38500	13690000	142450000
$\sum$	19200	216000	68160000	724800000

a=(6×724800000)- (19200×216000)/(6×68160000) –(19200×19200) = 5 MU

b= 36000 - 5×3200 =20000 MU

Y= 5x+20000

TC= 5Q+20000

Note :

It is not necessarily expected that the cost-equation parameters obtained from the two methods will be identical. The results derived from the least squares method are generally more accurate because this method uses all available observations, whereas the high–low method relies on only two data points.

In this particular case, the similarity in results arises from the fact that the monthly cost data were relatively homogeneous, which minimized the variation between methods.

Lesson 6

Break Even Point Analysis -B E P-

Before introducing the break-even point, it is important to emphasize that the analysis of both the break-even point and the degree of operating leverage is conducted within the broader framework of cost–volume–profit (CVP) analysis, which serves as a key tool for supporting managerial decision-making

Cost–volume–profit (CVP) analysis is defined as the study of the effects on future profit of changes in fixed cost, variable cost, sales price, quantity and mix

1- Break-Even Point – Definition

The break-even point represents the level of activity at which a company achieves neither profit nor loss. At this point, total revenue equals total costs, meaning that contribution margin is sufficient to cover all fixed costs, but no profit is generated yet

There are several key assumptions underlying the construction of a break-even chart. The most important of these are:

- The linearity assumption: variable costs per unit and sales revenue per unit are assumed to remain constant, meaning both costs and revenues can be represented as straight lines over the activity range.

- Fixed costs remain constant: fixed costs are assumed to stay at the same level throughout the relevant range of activity.

- Although the assumption of linear cost and revenue functions is often viewed as the *Achilles' heel* of the break-even model, the concept of the relevant range helps address this limitation. Within this range, the linearity assumption is considered acceptable and provides useful approximations for managerial decision-making.

2- Break even point formula

To construct Break even point formula . we need to define the total revenue formula – sales revenue formula - . and contribution margin formula

2-1 Total Revenue formula

The total revenue formula consists of two components: **price** and **quantity**. Total revenue is obtained by multiplying the selling price per unit by the number of units sold.
We denote:

- **P** = Price per unit
- **Q** = Quantity sold
- **TR** = Total revenue

Thus, the revenue equation can be expressed as:

$TR = P \times Q$

figure 1 Total revenue chart
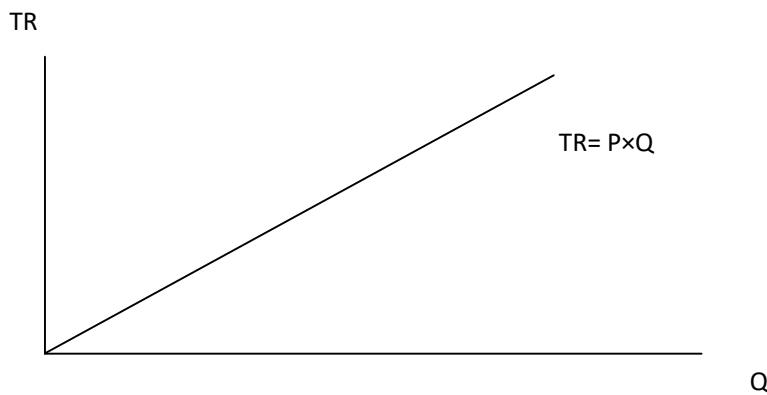
2-2 Contribution margin formula

As discussed in Lesson 2**,** variable costs are those that change in direct proportion to the level of activity. Once the variable costs associated with producing and selling a product or service are identified, we can calculate another important measure: the contribution margin.

Contribution Margin = Total Revenue - Variable Costs

$$CM = R-VC$$

Contribution margin per unit = price- variable cost per unit

$$CMUP=P-VCUP$$

P	Q	TR
-VCPU	Q	-VC
=CMPU	Q	=CM

Since the construction of the break-even equation is based on the assumption of a constant unit selling price, the contribution margin can be expressed using the following formula:

$$CM= CMPU×Q$$
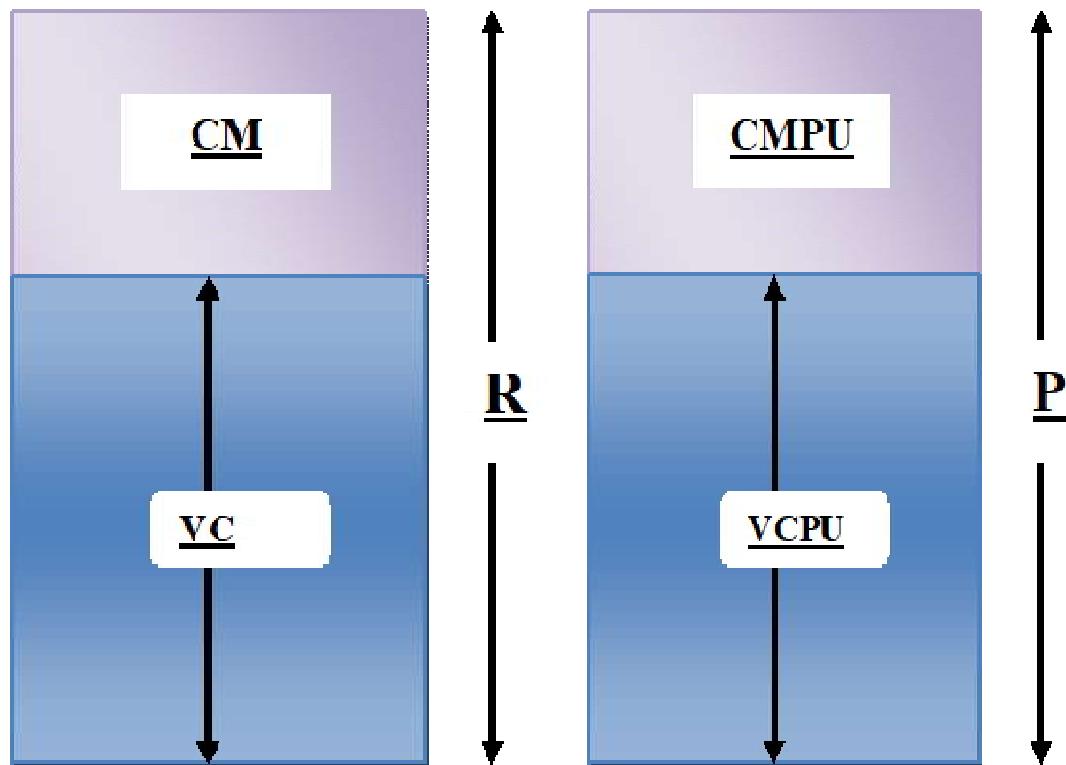
Once the contribution from a product or service has been determined, the associated fixed costs can be subtracted to calculate the profit for the period:

R	P	Q	100%
-VC	VCPU	Q	%
=CM	CMPU	Q	%
-FC			%
=EBIT			%

Note: In break-even analysis, costs related to interest and taxes are excluded. Therefore, the profit considered is the profit before interest and taxes, commonly denoted by the symbol EBIT.

The unit contribution **CMPU** can be used to identify the break-even output of the company. Some references denote the unit contribution margin by CM and the total contribution margin by TCM. Here, we will refer to the unit contribution margin as CMPU.

As total revenue increases from zero, the contribution rises accordingly until it exactly covers the fixed costs **figure 2** . This level of activity represents the **break-even point**, at which the company earns **neither profit nor loss**. It follows that, to break even, the total contribution must be equal to the total fixed costs. If the contribution earned per unit is known, the **number of units required to break even** can be calculated using the following formula

BEP= FC/CMPU

So at the **break-even point**, the **total contribution** exactly equals the total fixed costs.

Figure 2 BEP formula
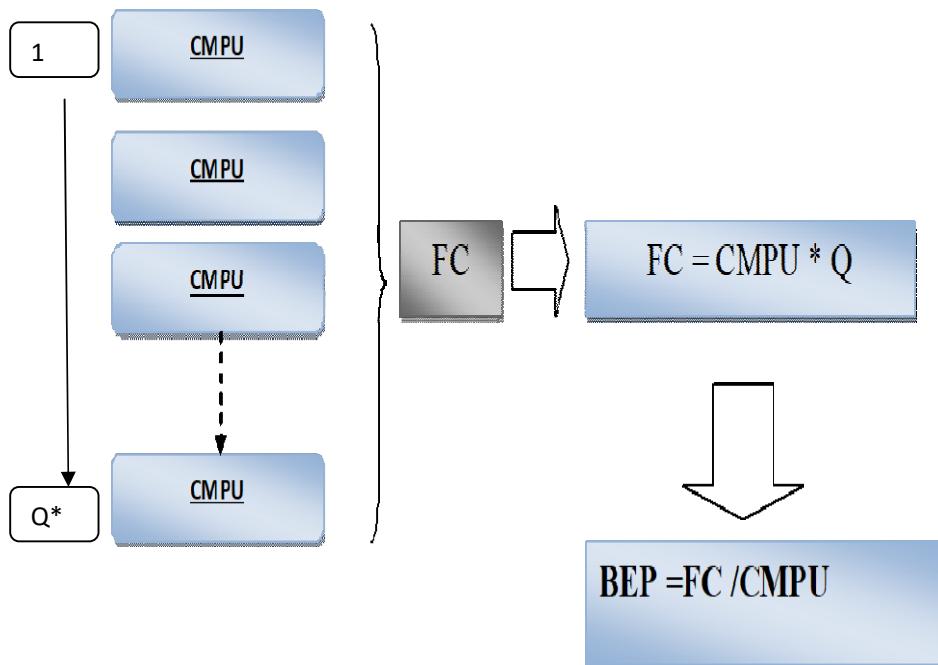
The break-even sales level can thus be calculated easily using the following formula

TR=TC ⟹ **TR-TC=0** ⟹ **P×Q* = (VCPU×Q*) +FC**

⟹ **(P×Q*) - (VCPU×Q*) -FC = 0**

⟹ **(P-VCPU) ×Q* - FC =0**

⟹ **Q*= FC/(P-VCUP)**

⟹ **Q*= FC/CMPU**

<u>BEP Value = P× Q*</u>

⟹ **BEP Value = (P× FC) /CMPU**

⟹ **BEP Value = (P× FC×Q) /CMPU×Q**

⟹ **BEP Value = (TR× FC) / CM**

⟹ **BEP Value = (FC) / %CM**

3- Break-Even Charts

The relationship between revenues, variable costs, and fixed costs can be illustrated using a break-even chart, as shown in the following figure. The chart highlights the break-even point, where total revenue (R) equals total costs (TC). Total costs at any level of output are the sum of variable costs and fixed costs (FC).

4- Target Profit And Target Quantity

The unit contribution also makes it possible to determine the number of units (TQ) that must be sold to achieve a target profit (TP). In this case, the total contribution must not only cover all fixed costs but also generate the desired target profit.

- TR-VC-FC=TP
- $(P×TQ) – (VCPU ×TQ) – FC = TP$
- $(P- VC\ PU) ×TQ – FC = TP$

- $TQ = \dfrac{FC+TP}{P-VCPU}$

- $TQ = \dfrac{FC+T}{CMPU}$

R/TC

R= P*Q

PROFIT

TC= VCPU*Q+FC

BEP

Q
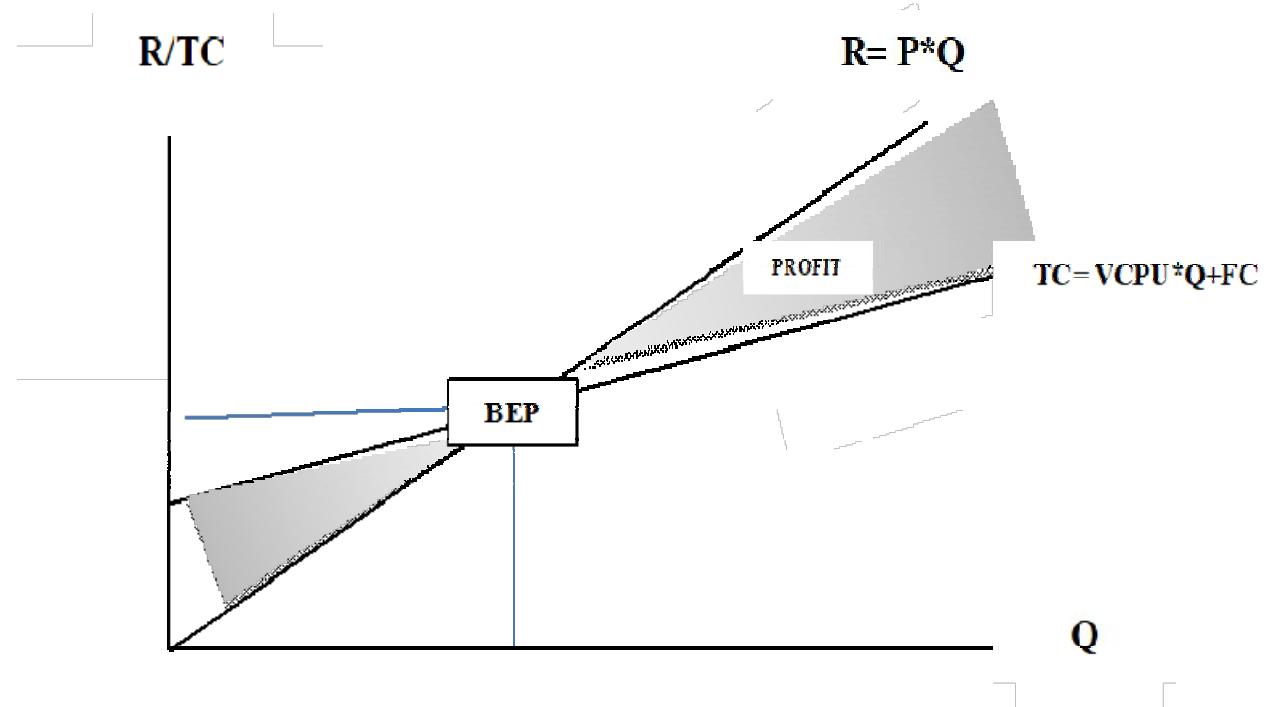
BEP Charts

5- Margin of Safety

The margin of safety is the difference between the budgeted (or actual) output and the break-even output.

Margin of safety= budgeted or actual sales – Break Even Point

The larger the margin of safety, the more secure the profit position, since sales can decline further before the organization faces losses.

MS = TR-BEP

MS= P.Q-(FC/ (CMPU: P))

MS= ((CMPU: P)×(P×Q) –FC) /(CMPU / P)

MS= (CMPU.Q)–FC /(CMPU / P)

$$MS= EBIT /(CMPU/ P)$$

$$MS = \frac{EBIT}{CMPU: P} \qquad MS = \frac{EBIT \times P}{CMPU} \qquad MS = \frac{EBIT \times P \times Q}{CMPU \times Q} \qquad MS = \frac{EBIT \times R}{CM}$$

- $MS = \dfrac{EBIT}{\%CM}$

Upper and Lower Break-Even Limits

The upper break-even limits represent the maximum levels that the firm can tolerate before it returns to the break-even point. This applies to both the maximum variable cost per unit that the firm can bear and the maximum total fixed costs it can support without pushing the break-even point to a risky level. Any further increase in these costs reduces the contribution margin and raises the break-even point, eventually bringing the firm back to the zero-profit position.

On the other hand, the lower break-even limits refer to the minimum operational conditions that the firm must maintain to avoid entering the danger zone associated with the break-even point. This includes the minimum acceptable selling price, below which the contribution margin would shrink to a level that drives the firm directly to break-even or loss. The same applies to the minimum sales volume, as selling below this quantity would prevent the firm from covering its total costs.

The upper break-even limits

- The maximum variable cost per uni (VCPU*)

$$TR\text{-}TC=0 \implies P \times Q - VCUPU^* \times Q - FC = 0 \implies VCUPU^* = \frac{(P \times Q) - FC}{Q}$$

$$\implies VCUPU^* = P - FCPU$$

- the maximum total fixed costs FC*

$$TR\text{-}TC=0 \implies R - VC - FC = 0 \implies FC^* = R\text{-}VC$$

$$\implies FC^* = CM$$

2- lower break-even limits

the minimum acceptable selling price

$$TR\text{-}TC=0 \implies P^* \times Q - VCUPU \times Q - FC = 0 \implies P^* = \frac{(VCPU \times Q) + FC}{Q}$$

$$\implies P^* = VCPU + FCPU$$

```
R/TC

R=P.Q

R

MS

BEP
        PROHI
losSloss
        TC=VCPU .Q+fc

Q*    MS    Q
```
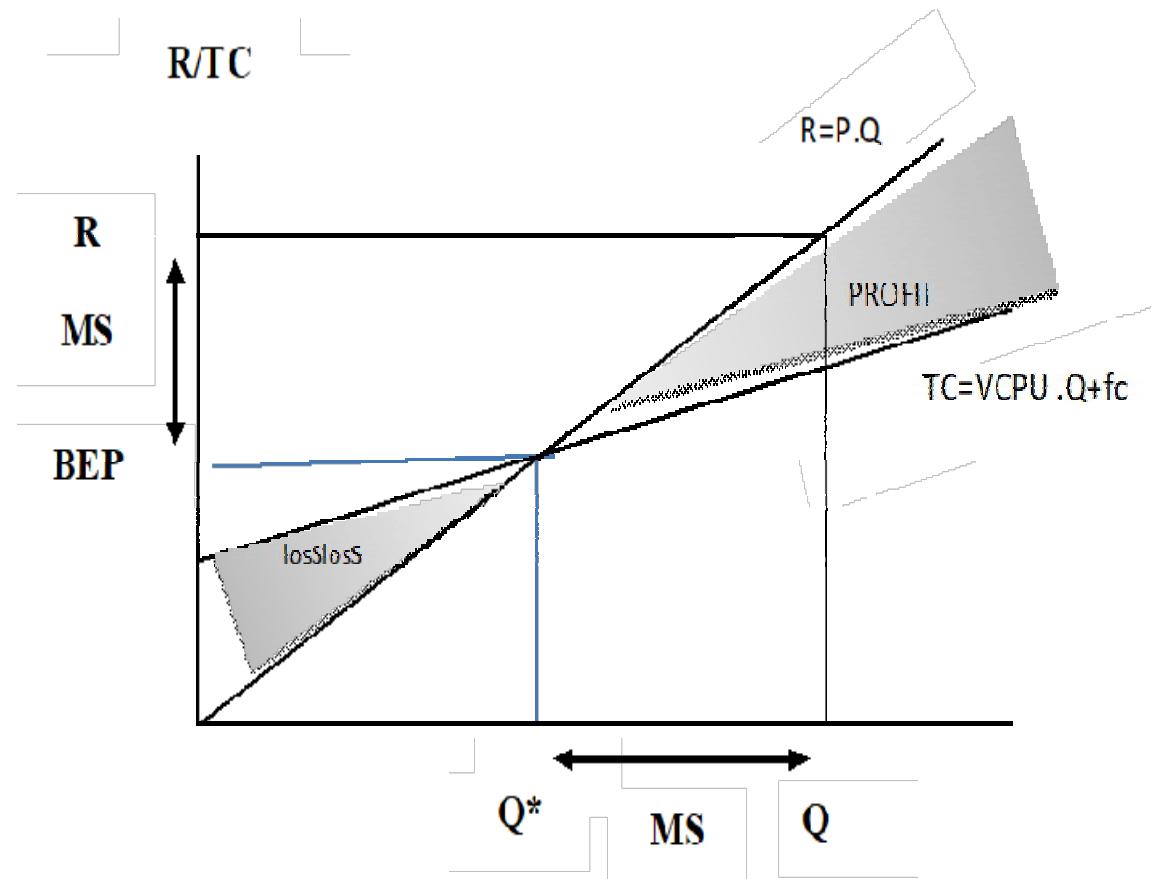
Lesson 7

The Degree Of Operating Leverage DOL

The term leverage generally refers to the force applied to lift weights, and its effect increases whenever the weight carried is several times greater than the applied force.

In control management , operating leverage is defined as the rate in which profit- EBIT- response to the change in the level of activity volume. the greater the degree of operating leverage, the greater this response, and vice versa. figure N01
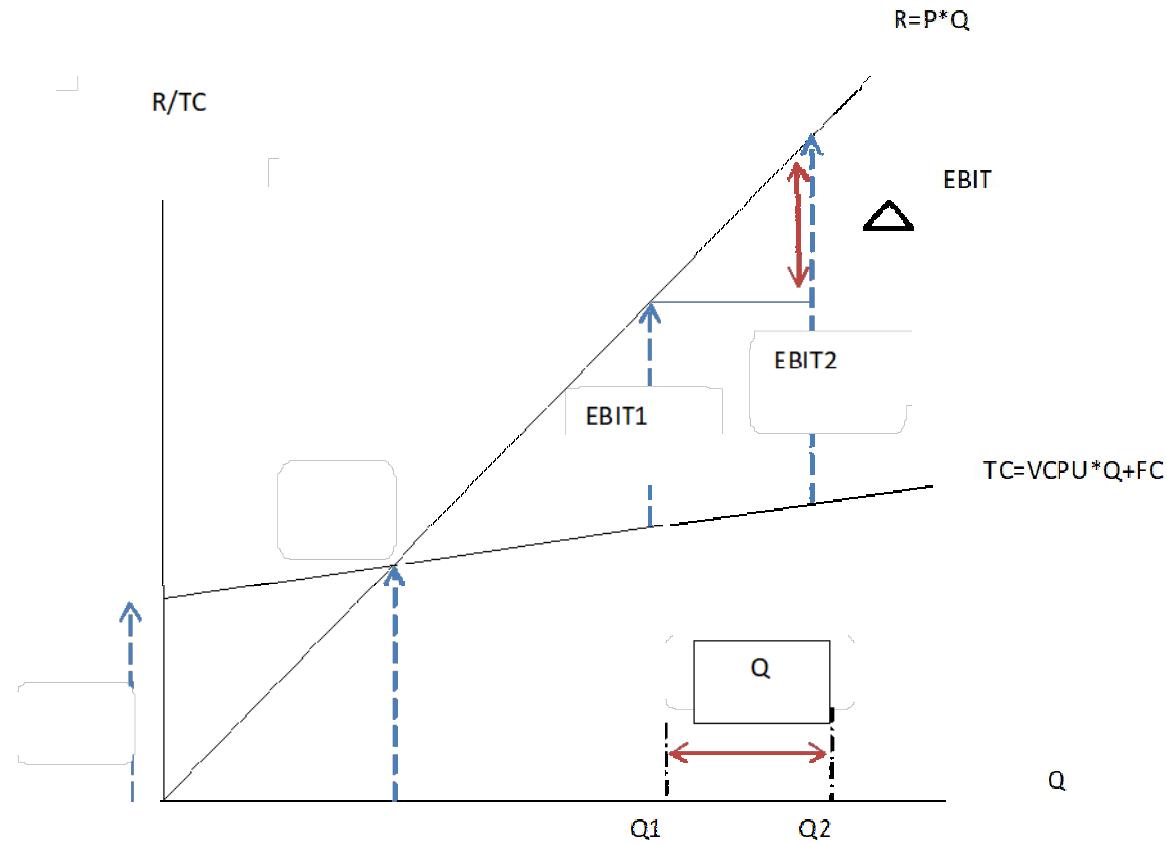
The concept of operating leverage is related to the structure of costs between fixed and variable costs. Higher fixed costs mean higher risk which lead to higher operating leverage rate . Conversely, the more dominant the amount of variable costs is, the lower the degree of operational leverage and that is mean lower risk

As mention above, The structure of fixed and variable costs is related to another concept, which is referred as risk associated with the cost. Fixed costs are associated with a higher degree of risk because the break even point are higher and greater when this type of costs dominates, while the break even point is lower and its requirements are lower if variable costs dominate

DOL   Formula

As mentioned in the definition

$$DOL = \frac{\frac{EBIT2 - EBIT}{EBIT1}}{\frac{Q2 - Q1}{Q1}}$$

Δ EPIT = (TR$_2$-TC$_2$)– (TR$_1$-TC$_1$)

Δ EPIT =P$_2$×Q$_2$-VCPU$_2$×Q$_2$-FC$_2$-P$_1$×Q$_1$+VCPU$_1$×Q$_1$+FC

Δ EPIT =(Q$_2$-Q$_1$)×P - (Q$_2$-Q$_1$)×VCPU

Δ EPIT =(Q$_2$-Q$_1$)× (P-VCPU)

Δ EPIT = Δ Q× (P-VCPU)

$DOL = \dfrac{\Delta Q \times (P-VCPU) \times Q}{\Delta Q \times EBIT}$

$DOL = \dfrac{(P-VCP) \times Q}{EBIT}$

$$DOL = \frac{CM}{EBIT}$$

Example 1

consider The Formula of Revenue And Total Cost As Follow

- TC=10Q+30000

- R= 25Q

Calculate DOL at each level of the table follow

Level	1	2	3	4
Q	10000	15000	22000	25000

Solution

1- using the first formula of dol

$DOL = \dfrac{\frac{EBIT_2-EBIT_1}{EBIT_1}}{\frac{Q_2-Q_1}{Q_1}}$

Level	1	2	3	4
Q	10000	15000	22000	25000
EBIT	120000	195000	300000	345000

Dol1	(195000-120000) : 120000/(15000-10000) :10000=0.625/0.5 = 1.25
Dol2	(300000-195000) : 195000/(22000-15000) :15000= 0.5384/0.4666 = 1.153
Dol3	(345000-300000) :300000/(25000-22000) :22000 =0.15/0.1363= 1.100
Dol4	(345000-300000) :345000/(25000-22000) :25000= 0.1304/0.12= 1.086

2- using the second formula

CM = 15Q

After calculation

- CM1 = 15×10000= 150000

- CM2 = 15×15000= 225000

- CM3 =15×22000= 330000

- CM4 = 15×25000=375000

Applying the formula

- DOL 1 = 150000/120000=1.25

  DOL 2 = 225000/195000=1.153

- DOL 3= 330000/300000=1.1

- DOL4= 375000/345000=1.086

Example 2

Consider The Following Data

- DOL=1.5 , TR=100Q , VC=80Q , EBIT=1000

Required: Calculate the Break-Even Point in Units (Q*) and in Monetary Terms (BEP in currency)

Solution

The data can be reorganized in the table as follows:

EBIT	VCPU	p	DOL
1000	80	100	**1.5**

Given: DOL = CM/EBIT

Therefore: CM = 1500

As we know: TR – VC = EBIT

Thus: FC = 500

Calculating the Break-Even Point in Units (Q*)

Applying the break-even rule using the following equations:

TR – TC = 0

TR – VC – FC = 0

100Q – 80Q – 500 = 0

Thus: Q* = 25 unit

BEP = 25×100=2500 mu

Example 3

The following table presents the cost structure of a production workshop operating at 60% capacity:

Cost Item	Amount
Depreciation (straight-line method)	25,000
Monthly rental expense	10,000
Labor costs – fixed wages	8,000
Labor costs – performance-based wages	4,000
Raw material costs	15,000

Required

I.

1. Derive the total revenue and total cost equations based on the data above, given that the unit selling price is 120 monetary units, and the operating result (profit) amounts to 10,000 monetary units.

2. Compute the Degree of Operating Leverage (DOL) and provide an interpretation of this measure.

II.

It is anticipated that operating capacity will expand next year to 80%, without affecting either the cost structure or total revenue parameters. Using the Degree of Operating Leverage, calculate:

1. The expected percentage increase in operating profit.

2. The projected total operating profit for the upcoming year — and verify your results using the total revenue and total cost equations.

III.

The marketing manager proposes increasing production capacity to 95%, accompanied by a reduction in the unit selling price to 115 monetary units. This adjustment will also lead to an increase in rental and depreciation expenses by 5,000 and 3,000 monetary units, respectively.

1. Based on profitability considerations and the risk associated with the break-even point, do you support this proposed decision? Justify your answer

Solution

Derivation of the Total Revenue and Total Cost Equations

The total revenue equation, based on the given data, takes the form:

$TR = P \times Q$

$TR = 120Q$

To derive the total revenue and total cost equations, we calculate the quantity Q. We have

- TR-TC=10000
- 120Q-62000= 10000
- 120Q= 72000
- Q=600

Calculating the variable cost per unit -VCPU –

- VCUP=VC/Q
- VCPU= 19000/600
- VCPU=31.6666

Accordingly, the total cost equation takes the form:

TC= 31.666666Q+43000

Calculation of the Degree of Operating Leverage (DOL)

- DOL= CM/EBIT
- DOL =53000/10000
- DOL= 5.3

The Degree of Operating Leverage (DOL) measures the sensitivity of operating profit to changes in the level of activity. The above DOL value indicates that a one-unit change in activity leads to a 5.3-fold change in operating profit, i.e., more than five times.

calculation of the Expected Profit Growth Using DOL

First, determine the new level of activity:

• New activity level = (600 / 0.6) × 0.8 = 800 units

Next, calculate the expected increase in profits as follows

$$DOL = \frac{\frac{EBIT2 - EBIT}{EBIT1}}{\frac{Q2 - Q1}{Q1}}$$

The objective is to measure the change in profits, denoted by the unknown X. Thus, we have

$$\frac{\frac{X}{10000}}{\frac{200}{600}} = 5.3$$

X= 17666.6666666

Calculation of the New Profit Level

- EBIT2=EBIT1+X
- EBIT2 = 27666.6666

Verification Using the Equations

EBIT2= 120Q-31.66666..Q - 43000

by substituting the new activity level (and keeping all decimals), we obtain:

EBIT2= 27666.6666

III. Comparison Between Maintaining Current Capacity or Increasing It to 95% Using the Results and Break-Even Point

1. Result Table for the Two Decisions

Decision	Increase capacity to 95%	Maintain 60% capacity
TR	115 × 950 = 109,250	120 × 600 = 72,000
VC	31.6666 × 950 = 30,083.33	31.66 × 600 = 19,000
CM	79,166.66	53,000
FC	51,000	43,000
EBIT	28,166.66	10,000

As shown in the table above, the new decision is more profitable for the company.

Comparison in Terms of Break-Even Point (BEP)

BEP1= 43000/88.333333= 486.792

BEP2= 611.9999=612

The new decision will lead to **a** higher break-even point, thus increasing the risk factor, but in return it will generate higher profits for the company

Example 4

A production company manufactures a semi-finished product and sells it at a price of 220 monetary units, achieving a profit of 2,000 monetary units. The company now has the opportunity to complete the production process to obtain the final product and sell it in the market at a price of 300 monetary units.

It should be noted that this additional processing will result in:

- An increase in the unit variable cost by 30 monetary units
- An increase in fixed costs by 5,0000 monetary units

Required:

 Determine to what extent this decision will be profitable for the company. Justify your answer using the total cost and total revenue equations.

Solution

This decision will be profitable if the additional revenues cover the total additional costs while achieving a profit greater than 2,000 monetary units.

In other words, the company must reach a sales volume at which the total additional unit contributions—calculated as 300−220−30 =50 monetary units per unit—cover the additional fixed costs of 5,0000 monetary units, while maintaining profits above 2,000 monetary units.

Accordingly, the company must sell at least 1,040 units, which represents the break-even point in this case. Reaching this level of sales ensures that the decision yields a higher profit for the company than the previous situation.

Rationale Based on the Total Cost and Total Revenue Formulas

- $(TR2\text{-}TC2) - (TR1 - TC1) \geq 2000$
- $(P2 \times Q^* \text{-} VCPU2 \times Q^* - FC2) - (P2 \times Q^* - VCPU1 \times Q^* - FC1) \geq 2000$
- $((300 \times Q^* \text{-} (VCPU1 + 30) \times Q^* - (FC1 + 50000)) - (220 \times Q^* - VCPU1 \times Q^* - FC1) \geq 2000$
- $300 \times Q^* \text{-} VCPU1 \times Q^* - 30 \times Q^* - FC1 - 50000 - 220 \times Q^* + VCPU1 \times Q^* + FC1 \geq 2000$
- **$(300\text{-} 30 \text{-} 220) \times Q^* \geq 2000 + 50000$**
- **$Q^* \geq 1040$**

Recommended Exercises for Solution

Exercise 1

The data below represents the operational activity of a manufacturing organization:

P	Q	VCPU	FC
120	3000	84	**9000**

Required:
> ➢ determine the result including the contribution margin
> ➢ Calculate the operating leverage ratio, - costs above exclude taxes and interest -. Provide an interpretation of this ratio.

Sales are expected to increase next year to 7,500. Using the operating leverage ratio, calculate the following:
> ➢ The expected growth in profits,
> ➢ Total profit for the next year - verify the results by using total cost formula,

Exercise 2;

Consider the following information about the selling price and unit cost indicators for an organization producing and marketing a single product.

Fixed cost	Variable costs	Labor cost	Materiales cost	Price
12	**14**	**36**	**22**	120

- The Total Revenue reached 240,000DA;
- The estimated budget for next month is equal to 2200 units.

Required: Based on the assumptions underlying the break–even point, you are required to:

1 – Calculate the break–even point and represent it graphically;

2 – The estimated safety margin MS during the next month;

3 – The planned profit – TP– for the next month;

4 – The sales required –TQ– to achieve an estimated profit volume of 96,000 DA during the month.

Exercise 3;

The information below represent the estimates made by an industrial organization for the upcoming cycle, knowing that these estimates were built on the basis that the organization operates at 75% of its production capacity.

Estimates	Values
estimated Sales – Q -	unit900
Price	32 DA
Direct Materiales	5400DA
Direct Labor – Variable Cost -	72000DA
Fixed Production Cost	42000DA
Variable Production Cost	18000DA
Fixed Overhead Cost	36000DA
Variable Overhead Cost	27000DA

In addition to this budget, the company can adopt one of the following options:

1. Reduce the unit selling price to 28 DA per unit, which will lead to an increase in demand, allowing the company to utilize 90% of its production capacity without any additional advertising expenses.

2. Attract sufficient demand to achieve full capacity utilization (100%) by:
   - Reducing the unit price by 15% from the current selling price,
   - Spending an additional 5,000 DA on advertising.

Required:

1. Calculate the break-even point based on the original budget.

2. Calculate the profit and break-even point resulting from each of the above options separately and compare them with the original budget.

Chapter 3

Indirect Costing - ABC Method-

Learning Outcomes:

by the end of this chapter, students will be able t

- Describe the fundamental principles and components of the Activity-Based Costing **(ABC)** model.
- Identify and classify organizational activities
- Determine appropriate cost drivers for each activity.
- Construct an activity cost pool and assign overhead costs to activities.
- Calculate activity rates using cost pools and cost drivers.
- Allocate indirect costs to products, services, or customers using ABC.
- Compute product-level profitability using ABC allocation

Lesson 8

Activity Based Costing –ABC-

Definition

The Activity-Based Costing (ABC) model represents a comprehensive economic map of an organization's expenses and profitability, structured around the activities that consume resources. Unlike traditional costing methods—which focus primarily on allocating indirect costs for financial reporting and departmental cost control—ABC requires a shift in managerial thinking. Conventional cost systems seek to answer the question: *"How should the organization allocate costs to products and departments?"* In contrast, ABC systems address a deeper set of analytical questions that aim to reveal the true behavioral patterns of indirect costs. These include:

1. What activities are being performed using the organization's resources?
2. What is the cost of performing each activity and the underlying business processes?
3. Why are these activities necessary, and what drives their occurrence?

4. How much of each activity is consumed by the organization's products, services, and customers?

ABC is fundamentally an indirect costing method because it does not assign indirect costs arbitrarily; instead, it traces them to activities and then to cost objects based on actual consumption. Through this approach, ABC provides a more accurate and causally meaningful allocation of overheads, especially in complex environments with diverse products or services.

Difference Between ABC and Direct Costing

While direct costing assigns only direct costs (such as direct materials and direct labor) to products and treats all indirect costs as period expenses, ABC recognizes that many indirect costs are driven by identifiable activities. Therefore:

- Direct costing supports short-term decision-making but ignores the real consumption of overhead resources.
- ABC, by contrast, offers a detailed understanding of how indirect costs are generated and how they vary with activity levels, enabling more precise product costing, profitability analysis, and process improvement decisions

Figure 1 and figure 2 show us the different between abc method and traditional costing method

Figure 1 traditional costing method
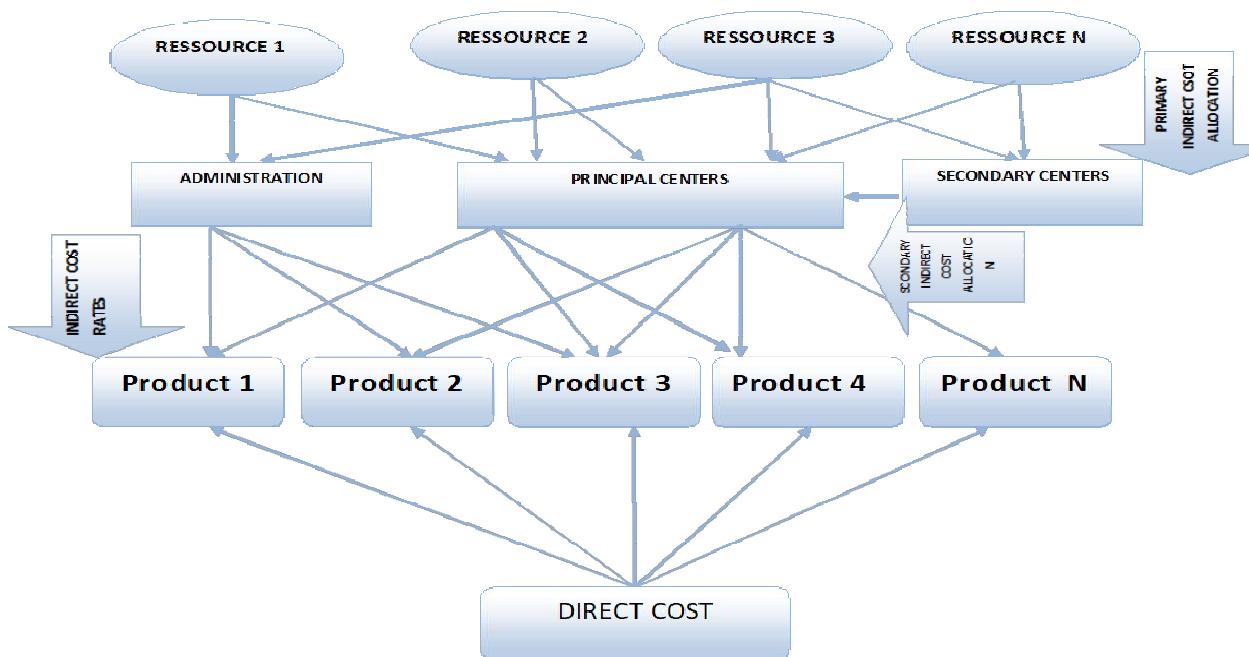
Figure 2 ABC method
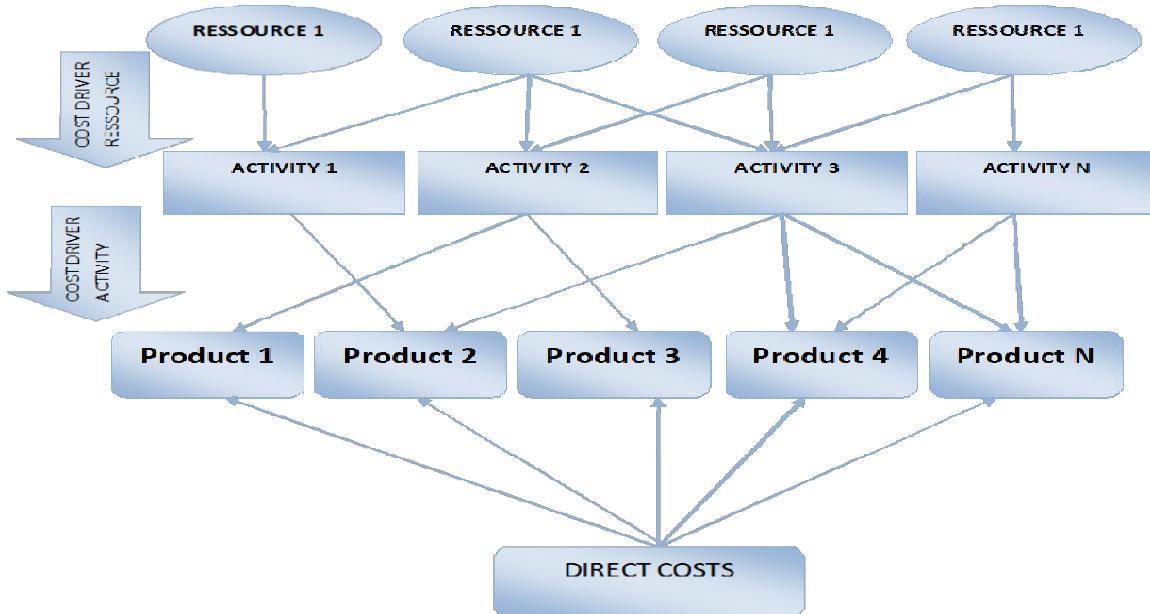
Allocating Costs To Their Subjects According To The Activity-Based Costing System Are As Follows:

1. Identify activities; ex :Run machines; Set up machines Schedule production jobs; Receive materials; Support existing product. Introduce new product; Maintain machines; Modify product characteristic

2. Evaluating the resources consumed through each activity – indirect costs -;

3. Identifying cost drivers is a critical step in the Activity-Based Costing (ABC) methodology. A cost driver measures the amount of resources consumed by each activity, serving as the essential link between inputs (resources) and outputs (activities, products, or services). In this sense, the cost driver represents the *direct causal factor* behind the costs incurred in each activity. By accurately selecting cost drivers, organizations can trace indirect costs to activities in a way that reflects actual resource usage, thereby ensuring a more precise and meaningful allocation of overheads

table 1 gave us some examples of cost drivers for each activity mentioned above

Activities	Activities cost driver
Run machines	Machine hours
Set up machines	Setups or setup hours
Schedule production jobs	Production runs
Receive materials	Material receipts
Support existing product	Number of products
Introduce new product	Number of new products introduced
Maintain machines	Maintenance hours
Modify product characteristic	Engineering change notice

4. Identify activity cost pools; for each activity pool there are one or more of activities that shared the same cost driver

Cooper (1990) classified manufacturing activities into four distinct levels:

4-1 Unit-level activities. These are performed each time a unit of the product or service is produced. They consume resources directly in proportion to production output.

An example is given by machine running costs with a cost driver of machine hours as the increase or decrease in costs is caused directly and proportionately by changes in production.

4-2 Batch-level activities. These are performed each time a batch of goods is produced – for example, each time a machine is set up for a different production run. Batch level activities are fixed for all units within the specific batch and must be averaged over the number of units produced to produce a cost per unit.

4-3 Product-sustaining activities. These are performed so that production of a specific product can take place, for example, maintaining or upgrading product specifications, or product design. These costs will be incurred irrespective of the number of batches or units that are produced.

4-4 Facility-sustaining activities. These are incurred in order that, for example, the factory can engage in manufacture, and this includes things like the plant manager and factory rents. Such costs cannot be traced to individual products and, in ABC, they are shown as a deduction from the total gross profits of production.

5 calculating the cost drivers volume

6 allocate the activity cost pools to the cost drivers ; Each cost driver will be associated with a cost driver rate that will be used to calculate the amount of activity pool resource cost to be charged to each cost subject .

A cost driver rate is calculated by:

The costs of the activity cost pool /Number of cost drivers for the activity

7 allocate the activity cost pools to the cost subjects by using the cost driver rate

Example1 :

 In order to upgrade its costing system from the traditional method to the Activity-Based Costing (ABC) approach, the organization restructured its cost system by disaggregating its five cost centers into twelve distinct activities, as presented below:;

Canters	Procurement	Methods	Maintenance	Machining	Shipment
Activities	A7-Supplier Management A3-Supply Control A10-Handling	A8-B.O.M Management A11-Scheduling A6-Technical Change Management	A5-Equipment Maintenance A9-Equipment Implementation	A1-Machining A12- Monitoring Of Implemented Equipment	**A2- Shipping Controls** **A4-Delivery**

2-the process of Allocating the resources to the activities resulted in the table follow

	Centers				
Activities	Procurement	Methods	Maintenance	Machining	**Shipment**
.	**404300**	**624500**	**119100**	**563700**	**328000**
A1	.	.	.	**348400**	.
A2	.	.	.	.	**97900**
A3	**115000**	.	.	.	.
A4	.	.	.	.	**230100**
A5	.	.	**75600**	.	.
A6	.	**237500**	.	.	.
A7	**132500**	.	.	.	.
A8	.	**208000**	.	.	.
A9	.	.	**43500**	.	.
A10	**156800**	.	.	.	.
A11	.	**179000**	.	.	.
A12	.	.	.	**215300**	.

3 –The Analysis of all The Supposed Cost Drivers   Concluded as Follow

Activity	Cost drivers
A1	Machining Hours
A2	Number of Batches Shipped
A3	Number of Components /Number of Suppliers
A4	Number of Batches Shipped /Number of Clients
A5	Number of Production Lines
A6	Number of Products /Number of Components
A7	Number of Suppliers / Number of Components
A8	Number of Products / Number of Components
A9	Number of Production Lines
A10	Number of Receptions /Number of Batches Produced
A11	Batch Production
A12	Number of Production Lines

As shown in the table above, each activity may have one or more associated cost drivers, and conversely, a single cost driver may relate to multiple activities. Figure 1 illustrates this **many-to-many relationship** between activities and cost drivers, highlighting the complex interdependencies in the allocation of indirect costs under the Activity-Based Costing (ABC) system

Figure 1
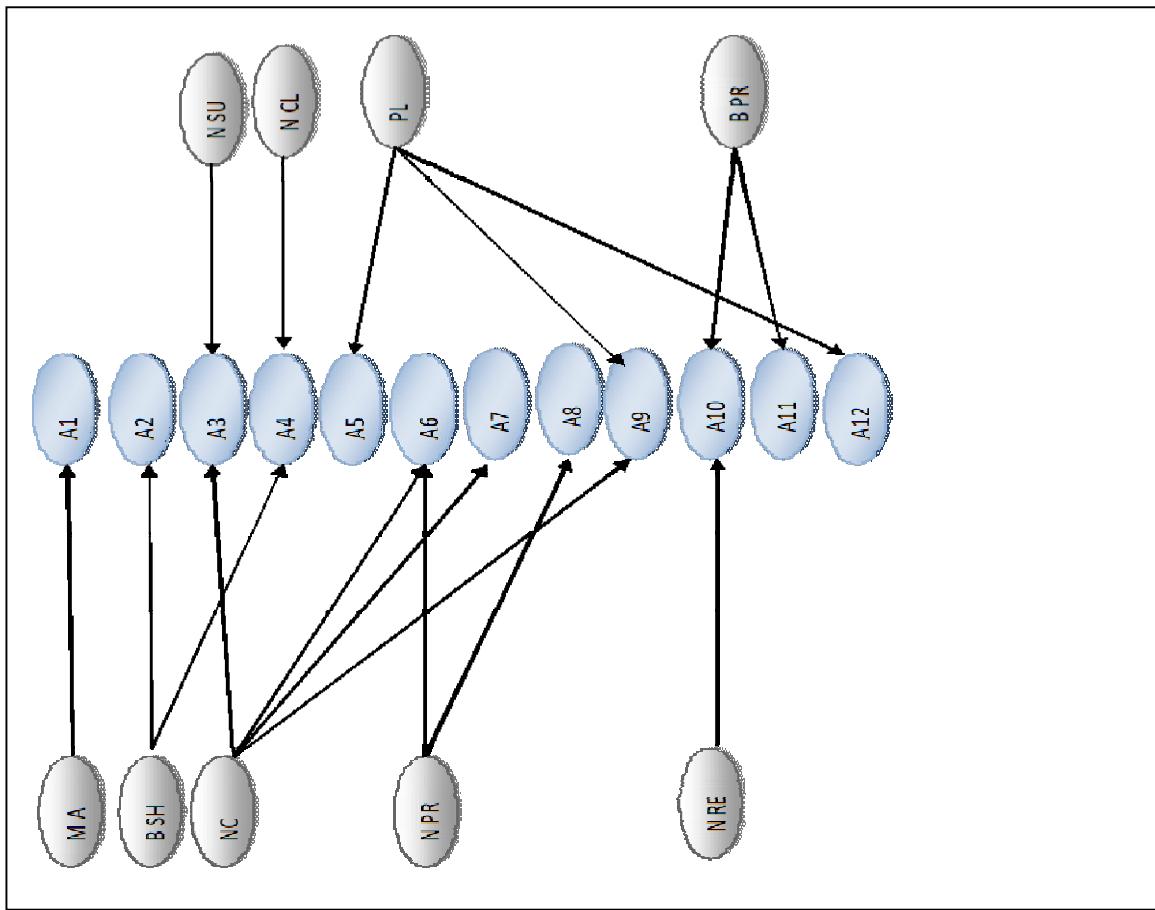
identify the activity cost pools ;the table 3 represent the matrice that used to transfer **many to many relationship** between cost drivers and activities to **one to many relationship**;where each cost driver allocate to one or more activities but not vice versa

figure 2 shows the results of the activity cost pools

Table 3

Cost Drivers / Activities	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Machine Hours (MH)	×											
Number of Production Lines (PL)					×				×			×
Number of Batches Shipped (B SH)		×		×								×
Number of Receptions (NR)										×		
Number of Clients (NC)				×								
Number of Products (NP)						×		×				
Number of Components (NC)			×			×	×	×				
Number of Suppliers (NS)			×							×	×	
Batch Production (BP)												

M H

A1 348400

Activity Cost Pool 1
348000

PL

A5 75600

A9 43500

A12
215300

Activity Cost Pool 2
334400

B SH

A2 97900

A4 230100

Activity Cost Pool 3
328000

N C

A3 115000

A6 237500

A7 132500

A8 208000

Activity Cost Pool 4
693000

B P

A10
156800

A11
179000

Activity Cost Pool 5
335800
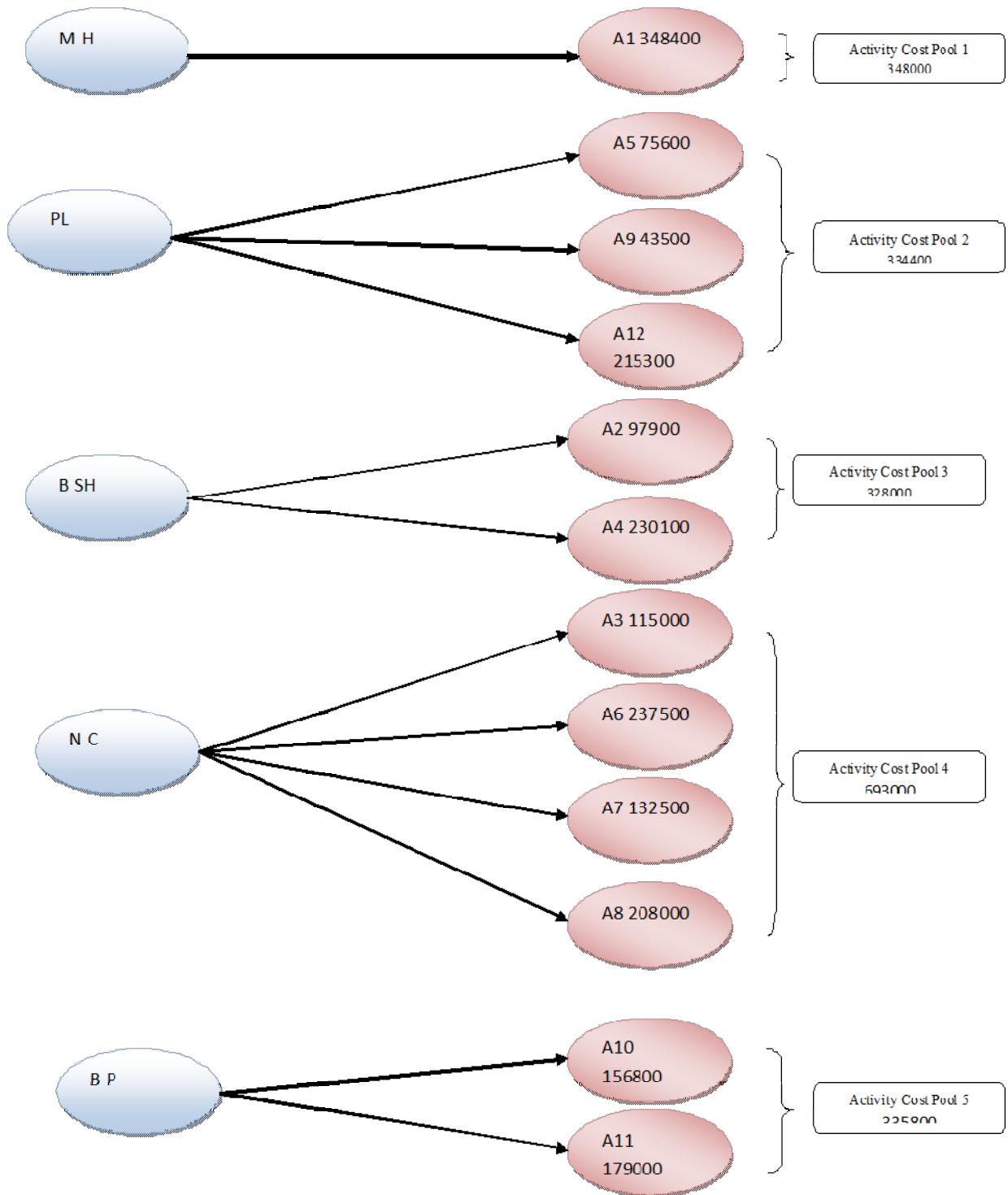
5- Calculating The Cost Drivers Volume
The table 4 represent the B O M & Production

B.O.M BILL oF MATERIALS & PRODUCTION				
Products	**P1**	**P2**	**P3**	**Cost per unit**
Quantity	**1000**	**2000**	**5000**	**Direct cost**
Component 1	**1**	**1**	**1**	**12€**
Component 2	**-**	**2**	**1**	**18€**
Component 31	**2**	**2**	**-**	**30€**
Component 4	**-**	**-**	**1**	**27€**
Direct Labor	**0.2**	**0.8**	**0.5**	**30€**
Indirect hours	**0.3**	**1.2**	**0.8**	**-**
Production Lignes	**L1**	**L2**	**L1**	**-**
Number of Batches Shipped	**08**	**05**	**25**	**-**
Number of Batches Produced	**2**	**4**	**50**	**-**

-

Cost Driver Volume

· M H = (0.3*1000)+(1.2*2000)+(0.8*5000)= 6700

· N PL = 2

· B SH = 8+5+25=38

· N C = 4

· B P = 2+4+50=56

6- Calculate The Cost Driver Rate

a. Machining Hour 348400/6700 =52

b. Production Ligne 334400/2=167200

c. Batches Shipped =328000/38=8631.57

d. Component Cost = 693000/4=173250

e. Batch Production = 335800/56=5996.42

7- Allocate The Activity Cost Pools To The Products Using The Cost Driver Rate

-

A C P2 334400

A

(167200/6000)*1000 = 27866.66

B

1*167200=167200

C

(167200/6000)*5000=139 333.33

A C P3 328000

A

8631.57*8 = 69052.56

B

8631.57*5=43157.85

C

8631.57*25=215789.25

–

173250

A → (173250/8000)*1000=21656.25

B → (173250/8000)*2000= 43312.5

C → (173250/8000)*5000=108281.25

173250

A → -

B → (173250/9000)*4000=77000

C → (173250/9000)*5000=96250

173250

A → (173250/6000)*2000=57750

B → (173250/6000)*4000=115500

C → -

A C P 4
693000

173250

A → -

B → -

C → 173250

-

Costs	Total	Product 1	Product 2	Product 3
Indirect costs				
Activity cost pool 1	348400	15600	124800	208000
Activity cost pool 2	334400	27866.66	167200	139333.33
Activity cost pool 3	328000	69052.56	43157.85	215789.25
Activity cost pool 3	693000	79406.25	235812.5	377781.25
Activity cost pool 5	335800	11992.84	23985.68	299821
Direct cost				
Direct materials	573000	72000	216000	285000
Direct labor	129000	6000	48000	75000
Total cost	**2741600**	**281918.31**	**858956.03**	**1600724.83**

Note

Sometimes, sufficient information is available to allocate an activity's costs among the different cost drivers associated with that activity. In such cases, the activity cost is distributed across the relevant cost drivers, rather than selecting or prioritizing a single driver for the construction of the activity cost pool to which the activity belongs

Example 2

The following data related to a production company that manufactures three products: P1, P2, and P3, as detailed in the attached appendices.

Appendix 1; direct cost

	P1	P2	P3
Direct materiales	50000	40000	30000
Direct labor cost	15000	25000	20000

Appendix 2; indirect cost

Division	Cost Driver Volume	Cost Driver	Amount	Activity	Amount
Maintenance Department	4	Production Lines	20000	Production Equipment Maintenance	50000
	/	Production Lines	30000	Monitoring & Follow-Up System	
Production Unit	12	Production Batches	20000	Setup	80000
	300	Machine Hours	20000	Assembly	
	210	Labor Hours	40000	Final Product Inspection	
Procure ment Department	60	Raw Material Weight	35000	Storage	70000
	6	Material Type	35000	Materials Inspection	
Comercial Department	19	Number Of Client	10000	Invoicing	60000
	03	Customer Complaints	20000	Client Support	
	45	Distribution Lines	30000	Distribution	

Appendix 3; **Nomenclature**

Cost driver	P1	P2	P3	Re marks
Production Lines	2	1	1	Production Lines Are Separate From Each Other
Production Batches	5	4	3	/
Machine Hours	90	110	100	/
Labor Hours	80	80	50	/
Material Type	2	2	2	No shared materials
Raw Material Weight	30	20	10	Zero Starting/Ending Stock
Number of Client	4	5	10	No shared customers for the same product
Customer Complaints	3	0	0	/
Distribution Lines	15	10	20	No shared distribution lines between products

Appendix 4; **total revenue**

	P1	P2	P3
TR	300000	200000	150000

Required;

Calculate the result using the ABC method

Solution: Calculate the result using the ABC method.

1- Identify activity cost pools and calculate the cost driver rates

N	Activities	activity cost pools	cost (1)	Cost driver volume (2)	Cost driver rate 1/2
1	A1+A2	production lines	50000	4	12500
2	A3	Production Batches	20000	12	1666.66
3	A4	Machine Hours	20000	300	66.66
4	A5	Labor hours	40000	210	190.476

5	A6	Raw Material Weight	35000	60	583,33
6	A7	Material Type	35000	06	5833.33
7	A8	Number of Client	10000	19	526.315
8	A9	Customer Complaints	30000	03	10000
9	A10	Distribution Lines	20000	45	444.44

2- Allocate indirect costs using cost driver rate

Number	P1	P2	P3
1	25000	12500	12500
2	8333.3	6666.64	4999.98
3	5999,4	7332.6	6666
4	15237.6	15237,6	9523.5
5	17499.9	11666.6	5833.3
6	11666.66	11666.66	11666.66
7	2105.26	2631,5	5263.15
8	30000	0	0
9	6666.6	4444.4	8888.8
Total indirect cost	122508.78	72145.94	65341.39
Direct cost	65000	65000	50000
Total cost	187508.78	137145.94	115341.39

Result

	P1	P2	P3
TR	300000	200000	**150000**
TOTAL COST	187508.78	137145.94	**115341.39**
RESULT	112491.22	62854.06	**34658.61**

Chapter 4

standard costing

Learning Outcomes: Standard Costing and Variance Analysis

by the end of this chapter , students will be able to:

1. Conceptual Understanding

- Explain the concept and objectives of standard costing.
- Differentiate between standard costs and actual costs.
- Define cost variances

2. Types of Variances

- Identify and classify cost variances into material, labor, variable overhead, and fixed overhead variances.
- Distinguish between price (rate) variances and efficiency (usage) variances.
- Explain the causes of favorable and unfavorable variances.

3. Calculation Skills

- Calculate material price and material usage variances.
- Compute labor rate and labor efficiency variances.
- Determine variable and fixed overhead variances, including spending and volume variances.
- Reconcile standard costs with actual costs using variance analysis.

Lesson 9

standard Costing   and variances analyses

Definition

A standard cost represents the planned unit cost of a product or service and is typically composed of two key elements: a physical component (the standard quantity of inputs required) and a financial component (the standard price or rate per unit of input). Beginning with cost forecasting and extending through budgeting and variance analysis, standard costing plays a crucial role within the budgeting framework. It enables a systematic and

detailed comparison between standard (planned) costs and actual costs. This comparison supports effective managerial performance evaluation by identifying and analyzing both fixed and variable cost variances. Consequently, standard costing serves as a vital feedback and control mechanism, facilitating corrective actions and continuous improvement within the organization

Objectives of Standard Costing

The primary objectives of standard costing are to:
- Facilitate planning and budgeting by providing predetermined cost benchmarks for materials, labor, and overheads.
- Enhance cost control through systematic comparison between standard and actual costs, enabling timely identification of variances.
- Support performance evaluation by assessing the efficiency of managers, departments, and responsibility centers.
- Motivate employees by setting clear and attainable performance targets.
- Improve cost awareness across the organization by highlighting cost behavior and resource consumption patterns.

Role of Standard Costing in Decision-Making

Standard costing plays a critical role in managerial decision-making by providing structured and relevant cost information. Through variance analysis, management can:
- Identify inefficient operations and determine their root causes.
- Support pricing decisions by estimating expected production costs.
- Evaluate alternative production methods and cost reduction opportunities.
- Assist in make-or-buy decisions by comparing standard internal costs with external purchase prices.
- Guide corrective actions and continuous improvement by distinguishing between controllable and uncontrollable cost deviations.

Thus, standard costing transforms cost data into actionable managerial insights.

Difference Between Standard Costing and Actual Costing

Aspect	Standard Costing	Actual Costing
Cost Determination	Predetermined (planned) costs	Costs recorded after occurrence
Purpose	Planning, control, and performance evaluation	Historical cost recording
Time Orientation	Forward-looking	Backward-looking
Cost Control	Enables variance analysis and control	Limited control usefulness
Managerial Usefulness	High for decision-making	Mainly for financial reporting

While actual costing records what *has happened*, standard costing focuses on what *should have happened*, making it more suitable for managerial control.

Limitations of Standard Costing

Despite its advantages, standard costing has certain limitations:

- Time-consuming and costly to implement, especially in complex or dynamic environments.

- Standards may become outdated if there are frequent changes in technology, processes, or input prices.

- Less suitable for highly customized or service-based operations, where standardization is difficult.

- Behavioral issues, such as employee resistance or dysfunctional behavior when standards are perceived as unrealistic.

- Limited relevance in rapidly changing markets, where actual costs may fluctuate significantly from standards.

 A standard costing system subdivide into three common cost variances analysis

1.   direct material variances

2.   direct labour variances

3.   variable production overhead and fixed production overhead variances .

Note

All the variances in this lesson based on the flexible budget, a flexible budget is designed to change as the underlying volume of activity changes. It does this by considering the factors that cause costs to change as the volume of activity changes.

1- Direct Materials Variance - Materials Usage Variance -

 Direct material variances measure the efficiency of the production process with respect to raw material consumption. The total direct material cost variance for a given period is

calculated by comparing the cost that *should* have been incurred to produce a specified level of output (the standard cost) with the cost that was *actually* incurred. This comparison is expressed as the difference between standard material costs and actual material costs, as follows:

Direct materials variance = (actual Quantity * actual Price)- (standard Quantity * Standard Price)

When actual costs exceed standard costs, the variance is considered unfavorable (adverse); conversely, if actual costs are lower than standard costs, the variance is favorable. This total variance can be further subdivided into two sequential components: the materials price (rate) variance and the materials quantity (usage) variance, as follows:

Material Price Variance = (Actual Price – Standard Price)* Actual Quantity

When the actual price exceeds the standard price, the variance is unfavorable (adverse); otherwise, it is favorable.

Material Quantity Variance = (Actual Quantity – Standard Quantity)* Standard Price

When the actual quantity exceeds the standard quantity, the variance is unfavorable (adverse); otherwise, it is favorable

Direct Labor Variance

Direct labor variances are calculated by comparing the amount that should have been paid to the labor force (based on standard hours and standard wage rates) with the actual labor costs incurred. In this calculation, costs are determined with reference to the hours worked to produce a given output and the wage rate per hour, as follows:

Direct Labor Variance = (Actual Labor Hours * Actual Rate)-(Standard Labor Hours * Standards Rate)

This variance can be subdivided into two components**:** the labor rate (wage) variance and the labor efficiency (time) variance

Rate Variance = (Actual Rate – Standard Rate)* Actual Labor Hours

A rate variance is considered unfavorable (adverse) when the actual hourly rate paid to labor exceeds the standard hourly rate. Labor rate (wage) variances can arise due to several factors, including:

- Recruiting an inappropriate grade or skill level of labor.
- Insufficient supply of the required grade of labor in the labor market.
- Unplanned overtime work.
- Increases in wage rates since the beginning of the period or year.

The Wage Efficiency Variance = (Actual Labor Hours – Standard Labor Hours)* Standard Rate

The labor efficiency (wage) variance is considered unfavorable (adverse) when the actual labor hours exceed the standard labor hours. Conversely, the variance is favorable when the actual hours worked are less than the standard hours.

Labor efficiency variances can arise from a variety of factors, including:

- Recruiting workers with an inappropriate skill level or inadequate training.
- Machine breakdowns or interruptions in the production process.
- Wasting time handling poor-quality materials.
- Low levels of employee motivation, which may result from factors such as insufficient pay, high stress levels, or poor working conditions.

Overhead Variances

indirect cost – overhead- refer to the cost that cannot be directly attributed or linked to a particular product or service , and it subdivide into variable overhead and fixed overhead .

Variable Overhead Variance

Variable Overhead Variance = Actual Variable Overhead – Standard Variable Overhead

As the actual variable overhead exceed the standard variable overhead, there is an adverse variance, otherwise, there is an favourable variance.

Variable overhead variance subdivide into two sequential sub-variances , Variable overhead spending variance and Variable overhead efficiency variance

Variable Overhead Spending Variance = (Actual Cost Driver Rate – Standard Cost Driver Rate)* Cost Driver Volume

Variable Overhead Efficiency Variance = (Actual Cost Driver Volume – Standard Cost Driver Volume)* Standard Cost Driver Rate

Fixed Overhead Variance

The Fixed Overhead Variance (FOH Variance) is calculated as:

Fixed Overhead Variance =Actual Fixed Overhead − Standard Fixed Overhead When the actual fixed overhead exceeds the standard fixed overhead, the variance is considered unfavorable (adverse); otherwise, it is favorable.

The fixed overhead variance can be subdivided into two components:

Fixed Overhead Spending (Expenditure) Variance

FOH Spending Variance=Actual Fixed Overhead−Standard Fixed Overhead for Actual Activity

Fixed Overhead Volume Variance

FOH Volume Variance = Standard Fixed Overhead for Standard Activity −

Standard Fixed Overhead for Actual Activity

 Example , given below is a cost standard table for 1500 unit and the actual cost achieved for 1200 unit within a given period

Actual		Standard		
Activity level – unit -	1200	1500	Activity level – unit -	
Direct materials	DA58000	kg7	Materials consumption per unit	
Material raw -unit price/kg	DA10	DA 8	Material raw -unit price/kg -	
hours per unit	H4	H2.5	Hours per unit	
Rate	DA21	DA 25	Rate	
Variable overhead	DA35000	DA 10	Cost driver for variable overhead / hours	
Fixed cost overhead	DA50000	DA60000	Fixed cost overhead	

Required: Calculate all possible variances.

Solution

Direct Materials Variance	**9200-=((8*7*1200)-58000)**
· **materials quantity sub- variance**	· **20800-=8*(8400-5800)**
· **materials price sub-variance**	· **11600=5800*(8-10)**

Direct Labor Variance	**25800= (25*2.5*1200)-(21*4*1200)**
· **Rate sub-variance**	· 19200-=4800*(25-21)
· **The wage efficiency sub-variance**	· 45000=25 * (3000-4800)

Variable Overhead Variance	**5000=30000-35000**
· **Variable overhead spending variance**	· 13000- = 1200*4 * (10-7.29)
· **Variable overhead efficiency variance**	· 18000 = 10 *(3000-4800)

Fixed Overhead Variance	**2000=48000-50000**
· **fixed overhead spending sub-variance**	
	· 10000-=60000-50000
· **fixed overhead volume sub-variance**	
	· 12000 = 48000-60000

```
                          ┌─────────────────────┐
                          │   Total variance    │
                          │       23600         │
                          └─────────────────────┘
```

Total variance 23600

Direct Materials Variance 9200-

Overhead Variance 7000

Direct Labor Variance 25800

materials quantity sub-variance 20800-

materials price sub-variance 11600

The wage efficiency sub-variance 45000

Rate sub-variance -19200

Variable Overhead Variance 5000

Fixed Overhead Variance 2000

Variable overhead spending variance -13000

Variable overhead efficiency variance1 18000

fixed overhead spending sub-variance 10000-

fixed overhead volume sub-variance1- 12000

Chapter 5

Quantitative Budgeting Methods and Variance Analysis

Sales, Production, and procurement Budgets

Learning Outcomes

by the end of this chapter , students will be able to:

- Understand the conceptual foundations of the Sales Budget and its role within the overall budgeting system.

- Apply quantitative methods to prepare the Sales Budget using the Least Squares Method in both linear and non-linear cases.

- Analyze Sales Budget variances and interpret their managerial and accounting implications.

- Explain the concept of the Production Budget and its linkage to the Sales Budget and inventory policy.

- Prepare the Production Budget using the graphical method and the Simplex Method within a linear programming framework.

- Develop the Procurement (Input) Budget, including direct materials, direct labor, and manufacturing overhead costs.

- Apply inventory management techniques to achieve an optimal balance between holding costs and stock-out risks.

Lesson 10

Budgeting system ; sales budget , forcasting sales

The sales budget can be regarded as the cornerstone of the budgeting system. It represents a formal, quantitative plan that estimates the expected sales volume and revenue for a given future period, expressed in both physical units and monetary terms. In practice, the preparation of all other functional budgets depends directly or indirectly on the sales budget. For instance, the cash flow budget cannot be prepared without reference to the sales budget, as projected cash inflows are largely determined by expected sales. Similarly, the procurement budget cannot be developed independently; it is derived from the production

budget, which itself is established based on the sales budget while taking inventory policies into consideration.

Accordingly, the budgeting system may be viewed as an interrelated cycle of estimates that essentially begins with sales forecasting and ultimately feeds back into sales outcomes, highlighting the central role of the sales budget in planning, coordination, and control within the organization

```
                    ┌─────────────────────┐
                    │     Sales budget    │
                    └─────────────────────┘

┌──────────────────┐ ┌─────────────────────┐ ┌──────────────────┐
│ Cash –flow budget│ │  Production budget  │ │ Investment budget│
└──────────────────┘ └─────────────────────┘ └──────────────────┘

                    ┌─────────────────────┐
                    │  Procurement budget │
                    └─────────────────────┘
```
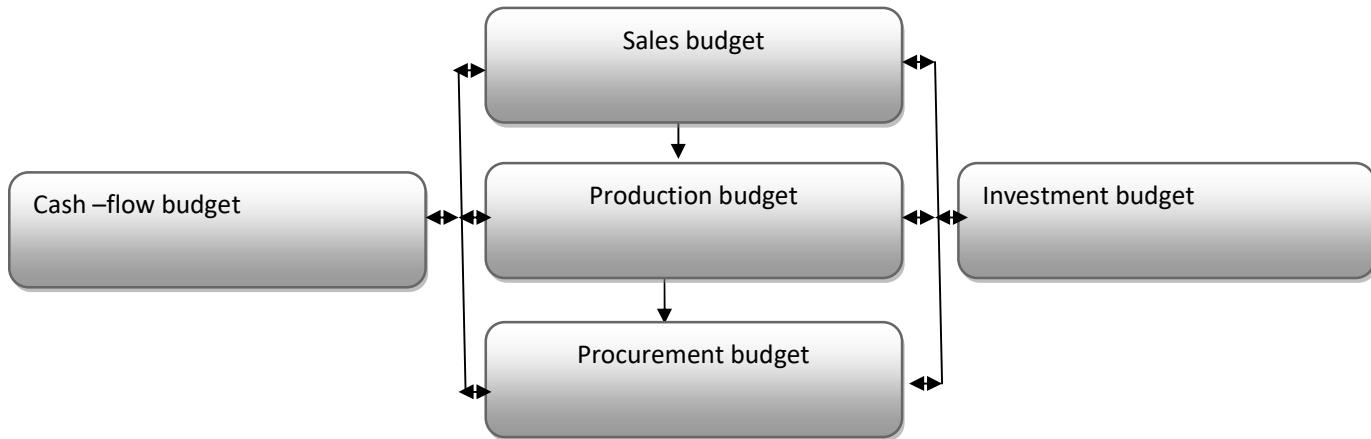
In the previous lesson, we discussed the relationship between the planning process and the budgeting system, whereby budgets are considered annual operational plans derived from broader business and strategic plans. However, the process of adopting these plans and translating them from the long term into medium- and short-term actions should not, under any circumstances, be carried out without a thorough reassessment of the organization's competitive requirements and environmental conditions. These factors must be carefully analyzed and aligned with the organization's capabilities and available resources, while taking into account its objectives and past performance, in order to anticipate and guide future performance.

Several analytical tools may be employed to examine historical performance and behavior over time. Some of these tools are quantitative, relying primarily on statistical techniques such as time series analysis, while others are qualitative, including methods such as the Delphi technique, which is based on expert judgment. Additional approaches include the analysis of historical market data and competitive intelligence information, among others.

Among quantitative techniques, time series analysis is considered one of the most important methods for estimating future sales. This approach explicitly incorporates the time dimension to derive sales forecasts based on observed historical patterns. Various statistical techniques

may be used to analyze time series data, including curve fitting and smoothing methods. Curve fitting techniques may involve linear regression as well as non-linear regression models, such as exponential or power functions. Smoothing techniques include moving averages and exponential smoothing, which aim to reduce random fluctuations in the data.

Curve fitting methods are commonly implemented using the Least Squares Method, where the objective is to minimize the sum of squared deviations between observed and predicted values. In cases involving non-linear relationships that cannot be solved analytically, iterative algorithms are employed to obtain approximate solutions.

Linear regression

Linear Regression Linear regression is a statistical method used to model the relationship between a dependent variable (Y) and one or more independent variables (X) by fitting a linear equation to observed data. In the case of a single independent variable, the relationship is represented by a straight line, while in higher dimensions it takes the form of a hyperplane.

The least squares method is the most widely used technique for estimating the regression coefficients, as it determines the parameter values that minimize the sum of squared differences between the observed values and the values predicted by the model
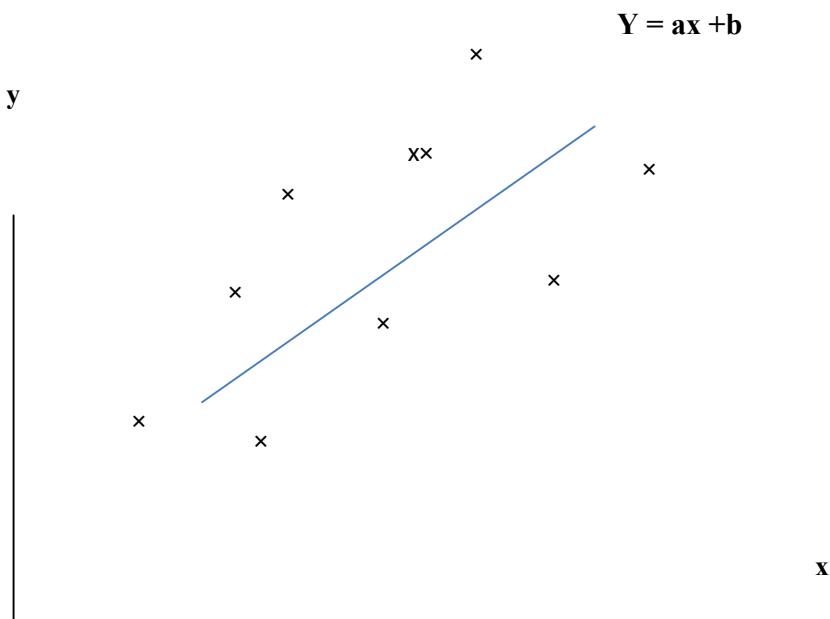
The least square method formula :

$$Y = ax + b$$

$$a = \frac{N\sum XY - \sum X \sum Y}{N\sum x^2 - (\sum X)^2}$$

$$b = \bar{Y} - a\bar{X}$$

$$\bar{X} = \frac{\sum X}{n} \Big/ \bar{Y} = \frac{\sum Y}{n}$$

☐ **Y**: Forecasted demand (or sales) for period X.

☐ **a**: Slope of the regression line, representing the rate of change in demand per time period.

☐ **x**: Time variable, measured as the specific time period.

☐ **N**: Number of observed (historical) data points.

☐ **b**: Intercept of the regression line, representing the estimated demand at time period zero $(X = 0)$

Non-linear Models

Non-linear curve fitting is the process of identifying a mathematical function (curve) that best describes the relationship between an independent variable (X) and a dependent variable (Y) based on observed data.

Common forms of non-linear models include

exponential function:

$Y = a.\, b^X$
where:

a = initial value or scale factor ,

b = base representing the growth (b), (b>1) or decay (0<b<1) factor

power function :

- $Y = a.\, X^b$

  where:

☐ a = scale factor

☐ b = exponent determining the rate of change

These models are particularly useful when the relationship between variables cannot be accurately described by a straight line, such as in cases of accelerating growth or diminishing returns.

Exponential Smoothing

Exponential smoothing is a technique used to reduce noise and highlight trends in time series data by applying a weighted moving average where weights decrease exponentially over time. It is particularly useful for forecasting sales or other sequential data.

The general form of simple exponential smoothing is:

$$Y_{t+1} = \alpha \cdot \beta_t + (1-\alpha) \cdot Y_t$$

<u>Where:</u>

- Y_t = Smoothed (forecasted) value at time t
- β_t = Observed value at time t
- α = Smoothing factor ($0 < \alpha < 1$)

A higher α gives more weight to recent observations, resulting in less smoothing and faster responsiveness to changes. A lower $\alpha\backslash alpha\alpha$ emphasizes long-term trends, producing a smoother series

<u>Forecasting Sales with Seasonal Adjustment</u>

Some products, especially seasonal ones, exhibit significant fluctuations over time, with increases during specific seasons and decreases in others. These recurring patterns can be clearly observed and analyzed by examining historical sales data over successive years, months, seasons, or even weeks and days. Such regular up-and-down movements occur around a long-term tendency known as the general trend.

While the general trend reflects the overall growth or decline in sales over time, it does not capture these systematic seasonal variations. For this reason, forecasting models incorporate seasonal adjustment to separate the long-term trend from short-term, recurring fluctuations. The analysis of historical behavior makes it possible to calculate seasonal indices, also referred to as seasonal coefficients (SC), which quantify the expected seasonal effect associated with each period of the year.

A seasonal coefficient measures how sales in a given season typically deviate from the level predicted by the general trend. In a multiplicative framework, these coefficients indicate

whether sales during a specific period are above, equal to, or below the trend level. Once estimated, seasonal coefficients are combined with the trend equation to adjust forecasts, thereby improving their accuracy by explicitly accounting for predictable seasonal variations. Accordingly, seasonally adjusted forecasting is based on the following general relationship:

Forecasted Sales = General Trend × Seasonal Coefficient

The figure below illustrates how observed sales values are distributed according to a seasonal pattern, highlighting recurring fluctuations around the trend. These systematic deviations provide valuable information for the estimation of seasonal coefficients and for the formulation of more reliable future sales estimates

A seasonal coefficient measures the systematic deviation of sales from the general trend during a specific season (month, quarter, or week).
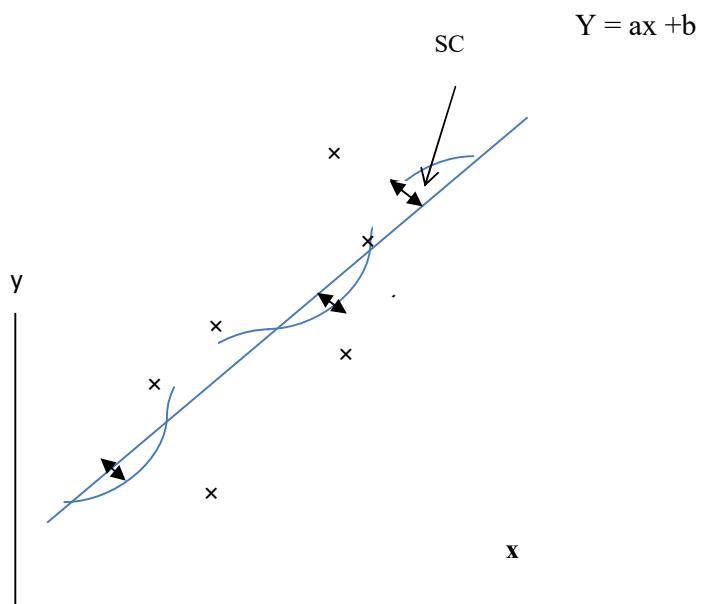
In the multiplicative model, which is commonly used in sales forecasting:

A coefficient equal to 1 indicates that sales coincide with the trend,

A coefficient greater than 1 indicates sales above the trend,

A coefficient less than 1 indicates sales below the trend.

Simple Average Method

The simple average method is the most basic approach to estimating seasonal coefficients. It is based on comparing sales in each season to the overall average sales. First, the average of all sales observations is calculated. Then, the average sales for each season are computed. The seasonal coefficient for a given season is obtained by dividing the seasonal average by the overall average:

$$S_s = \frac{\text{Average sales in season s}}{\text{Overall average sales}}$$

Once the coefficients are obtained, forecasts are adjusted using the general trend:

$$Y_t = (ax + b) \times S_s$$

Although this method is easy to apply and understand, it does not explicitly remove the trend before estimating seasonality.

Ratio-to-Trend Method (Main Reference Method)

The ratio-to-trend method provides a clearer link between seasonality and the general trend and is therefore highly suitable for instructional purposes.

This method assumes that seasonal effects should be measured relative to the trend, not relative to raw sales.

First, the general trend is estimated using the linear trend equation:

$$\hat{Y}_T = ax + b$$

Next, actual sales Y_t are divided by their corresponding trend values $\hat{Y}_T$:

$$\text{Ratio}_t = \frac{Y_t}{\hat{Y}_T}$$

These ratios represent how much sales deviate from the trend in each period. The ratios are then grouped by season, and an average ratio is calculated for each season.

The resulting averages constitute the seasonal coefficients, which are usually normalized so that their mean equals one.

The final forecast equation becomes:

$$\text{Forecast}_t = (ax + b) \times S_s$$

This approach clearly demonstrates that:

- the trend explains long-term growth or decline,
- seasonal coefficients explain systematic deviations around that trend.

Ratio-to-Moving-Average Method

The ratio-to-moving-average method is part of classical time-series decomposition.

In this method, moving averages are first calculated to eliminate the trend component. Actual sales are then divided by the moving average, producing values that mainly reflect seasonal effects.

These values are averaged by season to obtain seasonal coefficients, which are later applied to the trend equation:

Correlation Coefficient (Pearson)

The correlation coefficient is a statistical measure that indicates the strength and direction of the linear relationship between two quantitative variables. Its value ranges from -1 to $+1$, where:

- $+1$ indicates a perfect positive linear relationship,
- -1 indicates a perfect negative linear relationship, and
- 0 indicates no linear relationship.

Formula (Pearson's Correlation Coefficient)

$$r = \frac{\sum (xi - \bar{x})(yi - \bar{y})}{\sqrt{\sum (xi - \bar{x})^2 \sum (yi - \bar{y})^2}}$$

$$r = \frac{N \sum XY - \sum X \sum Y}{\sqrt{N \sum x^2 - (\sum X)^2 \, N \sum y^2 - (\sum y)^2}}$$

.Sales budget variances

Sales budget variances measure the difference between actual sales performance and budgeted (expected) sales performance. They are used in managerial accounting to evaluate the effectiveness of sales planning and control.

Sales budget variances are subdivided into two main components:

- Sales quantity variance, and
- Sales price variance.

Total Sales Variance;

The total sales variance represents the overall difference between actual sales revenue and budgeted sales revenue.

Sales Variance=Actual Sales−Budgeted Sales

In expanded form:

Sales Variance=(Actual Price×Actual Quantity)−(Budgeted Price×Budgeted   Quantity)

A favorable variance occurs when actual sales exceed budgeted sales.

An unfavorable (adverse) variance occurs when actual sales are less than budgeted sales.

Sales Price Variance

Sales price variance measures the effect of differences between the actual selling price and the budgeted selling price, for the actual quantity sold.

Sales Price Variance=(Actual Price−Budgeted Price)×Actual Quantity

Sales Quantity Variance;

Sales quantity variance measures the effect of differences between the actual quantity sold and the budgeted quantity sold, valued at the budgeted price.

Sales Quantity Variance=(Actual Quantity−Budgeted Quantity)×Budgeted Price

Relationship Between Variances ; The total sales variance can be expressed as:

Sales Variance=Sales Price Variance+ Sales Quantity Variance

This decomposition helps management identify whether deviations from the sales budget are caused mainly by price changes or sales Quantity changes.

decomposition of Sales Quantity Variance

The sales Quantity variance measures the effect on sales revenue of selling a quantity that differs from the budgeted quantity, valued at the budgeted selling price. However, this variance can be further analyzed to identify the specific causes of the difference in sales Quantity.

Accordingly, the sales Quantity variance is commonly decomposed into two sub-variances:

Sales mix variance, and **Sales global volume variance**.

This decomposition is especially useful when a firm sells more than one product.

1. Sales Mix Variance: The sales mix variance arises when the composition of products sold differs from the budgeted sales mix, even if the total sales volume remains unchanged. In other words, the sales mix variance measures the effect of changes in the composition of sales compared to the budgeted sales mix

The sales mix variance can be calculated at the individual product level, with the resulting variances then aggregated to determine the total effect. Alternatively, the variance can be computed directly based on total sales of all products.

Formula: Sales Mix Variance

At individual product level

Sales Mix Variance=$\sum$ (AQi−AMQi)×SPi

Where:

$A\,Q_i$ = Actual quantity sold of product i

$A\,MQ_i$ = Actual quantity of product i if total sales were distributed according to the budgeted mix

$$\text{AMQ i} = \text{Total Actual Quantity} \times \frac{BQ\,i}{\sum BQ}$$

SP_i = Budgeted selling price

Note, Some references refer to AMQi as the revised quantity, which represents the total actual quantity sold, redistributed according to the budgeted sales mix

At the total sales level

Alternatively, when using weighted average selling prices for all products, the formula can be expressed as follows:

Sales mix variance = (Budgeted selling prices weighted by actual quantities- budgeted weighted average selling price) × Total actual quantity sold

Sales Mix Variance=($S\bar{P}$a(b) − $S\bar{P}$ (b))×TAQ

Where:

$S\bar{P}$a(b); Budgeted selling prices weighted by actual quantities.

$S\bar{P}$a(b) = $\frac{\sum AQi \times SPi(b)}{T\,AQ}$

$S\bar{P}$ (b) /or $WASPb$; budgeted weighted average selling price

$TA\,Q$ = Total actual quantity sold

Interpretation: A favorable variance occurs when a higher proportion of high-margin products is sold.

An adverse variance occurs when a higher proportion of low-margin products is sold.

2. Sales Volume Variance ; Total volume Variance (sometimes called "Volume Effect") measures the impact of selling more or fewer total units than originally budgeted, while maintaining the budgeted sales mix. At the total level, this variance reflects how deviations in the overall quantity sold affect sales revenue, assuming the planned product mix is unchanged

Formula: Volume – effect- Variance

At individual product level

Volume   per product variance =(AMQi −BQi)×SPi

Here, $AMQ_i - BQ_i$ represents change in quantity due to total volume, not mix.

Aggregating over all products gives:

Total vlume Variance $= \sum (AMQ_i - BQ_i) \times SP_i$

At the total sales level

Total sales volume variance $= (TAQ - TBQ) \times S\overline{P}$ (b)

Total Sales Volume Variance $=$ (Total Actual Quantity$-$Total Budgeted Quantity) $\times$Weighted Average Budgeted Selling Price

Example ;

A company sells two products, A and B. The following information relates to actual and budgeted sales data for the period:

Given Data

Product A:

• Actual quantity sold: 2,000 units

• Actual selling price: 20 per unit

• Budgeted quantity: 1,800 units

• Budgeted selling price: 21 per unit

Product B:

• Actual quantity sold: 1,500 units

• Actual selling price: 15 per unit

• Budgeted quantity: 1,800 units

• Budgeted selling price: 13 per unit

Required:

1. Calculate the sales price variance for each product and in total.

2. Calculate the sales quantity (volume) variance for each product and in total.

3. Decompose the total quantity variance into sales mix variance and sales volume (quantity) sub-variance, at the product level and in total.

Solution

1. Preliminary Calculations

Total actual quantity sold (TAQ) $= 2,000 + 1,500 = 3,500$ units

Total budgeted quantity (TBQ) $= 1,800 + 1,800 = 3,600$ units

Budgeted sales mix:

• Product A: 50%

• Product B: 50%

2. Sales Price Variance

Formula: Sales Price Variance = (Actual Price − Budgeted Price) × Actual Quantity

Product A: (20 − 21) × 2,000 = −2,000 (Adverse)

Product B:(15 − 13) × 1,500 = +3,000 (Favorable)

Total Sales Price Variance: −2,000 + 3,000 = +1,000 (Favorable)

3. Sales Quantity Variance

Formula:Sales Quantity Variance = (Actual Quantity − Budgeted Quantity) × Budgeted Selling Price

Product A: (2,000 − 1,800) × 21 = +4,200 (Favorable)

Product B: (1,500 − 1,800) × 13 = −3,900 (Adverse)

Total Sales Quantity Variance: +4,200 − 3,900 = +300 (Favorable)

4. Decomposition of Quantity Variance

To decompose the quantity variance, we compute the Actual Mix Quantity (AMQ), which represents the total actual quantity redistributed according to the budgeted sales mix.

AMQ for Product A = 3,500 × 50% = 1,750 units

AMQ for Product B = 3,500 × 50% = 1,750 units

4.1 Sales Mix Variance

Formula: Sales Mix Variance = (Actual Quantity − AMQ) × Budgeted Selling Price

Product A: (2,000 − 1,750) × 21 = +5,250 (Favorable)

Product B: (1,500 − 1,750) × 13 = −3,250 (Adverse)

Total Sales Mix Variance: +5,250 − 3,250 = +2,000 (Favorable)

4.2 Sales Volume Sub-Variance

Formula:Sales Volume Sub-Variance = (AMQ − Budgeted Quantity) × Budgeted Selling Price

Product A:(1,750 − 1,800) × 21 = −1,050 (Adverse)

Product B: (1,750 − 1,800) × 13 = −650 (Adverse)

Total Sales Volume Sub-Variance: −1,050 − 650 = −1,700 (Adverse)

5. Final Consistency Check

Total Quantity Variance = Sales Mix Variance + Sales Volume Sub-Variance

$+300 = +2{,}000 - 1{,}700$

Market variances

When market (industry) data are available, the sales volume variance can be decomposed as follows:

Sales volume Variance=Market Size Variance+Market Share Variance

1. Market Size Variance (MSZV)

Market Size Variance (MSZV) Measures the effect on sales revenue of the overall market being larger or smaller than expected, assuming the firm maintained its budgeted market share.

Formula; Market Size Variance=(AQm−BQm) ×MSb × WASPb

Where:

- AQm = Actual total market (industry) quantity
- BQm = Budgeted total market quantity
- MSb = Budgeted market share of the firm
- WASPb = Budgeted weighted average selling price

2. Market Share Variance (MSHV)

Market Share Variance (MSHV)Measures the effect on sales revenue of the firm's actual market share differing from the budgeted market share, given the actual size of the market.

Formula ; Market Share Variance=(MSa−MSb) × AQm × WASPb

Where:

- MSa = Actual market share
- MSb = Budgeted market share
- AQm = Actual total market quantity

Example 2 , Given below are the historical sales registered over the years 2021 to 2023

	Season1	Season 2	Season 3	Season 4
2021	30	30	45	60
2022	48	42	57	74
2023	52	50	64	80

100 tons

Required

Task: Estimate the sales for Year 2024 by applying a linear regression trend model and incorporating seasonal adjustments.

Solution

Sales Forecasting with Seasonal Adjustment

1-Trend Line Formula – Least Squares Method

Y=ax+b

X2	X×Y	Y	X
1	30	30	1
4	60	30	2
9	135	45	3
16	240	60	4
25	240	48	5
36	252	42	6
49	399	57	7
64	592	74	8
81	468	52	9
100	500	50	10
121	704	64	11
144	960	80	12
650	**4580**	**632**	**78**

Following the calculations, it was determined that

a = (12×4580)- (78×632)/ (12×650)- (78×78)

a = 54960-49296/7800-6084

a = 5664/1716

a = 3.3

b= (52.66)-(3.3×6.5)

b= 31.21

$$y=3.3x+31.21$$

2- Calculate Ratio t =y/y*

Ss	Y*	y	x
0.8693	34.51	30	1
0.7934	37.81	30	2
1.0946	41.11	45	3
1.3510	44.41	60	4
1.0060	47.71	48	5
0.8233	51.01	42	6
1.0495	54.31	57	7

1.2844	57.61	74	**8**
0.8537	60.91	52	**9**
0.7786	64.21	50	**10**
0.9480	67.51	64	**11**
1.1297	70.81	80	**12**

3- Calculate Ss = ∑ **Ratio t for season / N**

Season 4	Season 3	Season 2	Season 1	
1.35	1.09	0.79	0.86	**1**
1.28	1.04	0.82	1.00	**2**
1.12	0.94	0.77	0.85	**3**
1.25	**1.02**	**0.79**	**0.9**	Ss

4- seasonal forcasting for 2024 -

Y*	Ss	y	
66.69	0.9	74.11	Season 1 2024
61.15	0.79	77.41	Season 2 2024
82.32	1.02	80.71	Season 3 2024
105.01	1.25	84.01	Season 4 2024
315.17			total

Budgeted sales for 2024 = **31517 TON**

Example 3 :

The following table contains the historical quarterly sales figures over the last three years for a commercial enterprise.

Quarter4	Quarter3	Quarter2	Quarter 1	
10	7	4	3.5	**n-2**
51	35	22	16	**n-1**
259	173	115	77	**n**

Required

1. Determining the Appropriate Smoothing Method Examine the historical sales trend and decide which smoothing approach is most suitable:

- Linear regression (fitting a straight line)
- Nonlinear regression (using an exponential function)

2. After Selecting the Appropriate Method Calculate the parameters of the selected model:

- a
- b

3. Forecasting Next Year's Sales

- Using the chosen model, project the sales for the upcoming year (Year n+1).

4.Calculating the Correlation Coefficient (R)

- Compute the correlation coefficient R R to measure the strength and direction of the relationship between observed and estimated values.
- Interpret the result in terms of how well the model fits the historical data

Solution

First: Estimating Sales for the Last Quarter of Product A Based on the tabulated data, the sales trend suggests that smoothing should be performed using an exponential curve.

Exponential Smoothing Model:

$Y = a.\ b^X$

Where:

Y = estimated sales

X = time period (e.g., quarter)

a = initial sales value (intercept)

b = growth factor (rate of increase per period)

- This model captures nonlinear growth and is suitable when sales increase or decrease at a variable rate over time.
- Converting to Linear Form Using Logarithms To simplify estimation, the exponential model:
- $\log y = \log b^X + \log a$
- $\log y = x \log b + \log a$

using

$\log y = Y$, $\log b = B$, $\log a = A$

Converting to Linear Form

$Y = B x + A$

Finding the Coefficients (a and b) Using the Following Formulas:

$$B=\frac{N\sum_{i=0}^{n}XiYi-\sum_{i=0}^{n}Xi\sum_{i=0}^{n}Yi}{N\sum_{i=0}^{n}Xi^2-\sum_{i=0}^{n}Xi^2}$$

$$A=\vec{Y}-B\vec{X}$$

x	y	$\log y$	x^2	$x\ \log y$	$(\log(y))^2$
1	4	0.602059	1	0.602059	0.362475
2	11	1.041392	4	2.082784	1.084497
3	27	1.431363	9	4.294089	2.048800
4	48	1.681241	16	6.724964	2.826571
5	77	1.886490	25	9.43245	3.558844
6	104	2.017033	36	12.102198	4.068422
7	147	2.167317	49	15.171219	4.697262
28	418	10.826895	140	50.409763	18.646871

$$B=\frac{(7\times50.409763)-(28\times10.826895)}{(7\times140)-(28\times28)}$$

$$B=\frac{49.715281}{196}$$

B= 0.253649

$$A=\frac{10.826895}{7}-0.253649\times\frac{28}{7}$$

A= 1.546699- (0.253649×4)

A= 0.532103

Linear Form

$$Y=0.253649\ x + 0.532103$$

exponential function

- Exp 0.253649=1.793283
- Exp0.532103= 3.404889

$Y= 3.404889\times1.793283^X$

Calculating the Forecasted Sales for the Last Quarter of Year n

$Y= 1.793283^8\times3.404889=$ **364.16**

Since the exponential model can be transformed into a linear form, it is also possible to apply linear regression techniques to estimate the parameters aaa and b.

$$Y=(0.253649\times\ 8) + 0.532103$$

Y=2.561295

- **y= Exp 2.561295**
- **y=364.16**

The estimated sales for the last month of Year N is 364.16 tons.

Note: The parameters of the model, , can be determined by substituting the known values and solving the system of two equations provided below.

- $\sum_{i=0}^{n} yi = n*A + B\sum_{i=0}^{n} Xi$

- $\sum_{i=0}^{n} XI*YI = A\sum_{i=0}^{n} Xi + B\sum_{i=0}^{n} xi^2$

Calculation of the correlation coefficient

$$R = \frac{N\sum_{i=0}^{n} XiYi - \sum_{i=0}^{n} Xi \sum_{i=0}^{n} Yi}{\sqrt{\left(N\sum_{i=0}^{n} Xi^2 - \sum_{i=0}^{n} Xi^2\right)\left(N\sum_{i=0}^{n} yi^2 - \sum_{i=0}^{n} yi^2\right)}}$$

$$R = \frac{49.715281}{\sqrt{(196)\left((7*18.646871) - (10.826895)^2\right)}}$$

$$R = \frac{49.715281}{\sqrt{(196)\left((7*18.646871) - (10.826895)^2\right)}}$$

- R=49.715281/51.069193

- **R=0.973488**

There is a strong correlation between the time variable and sales (97%), and therefore it can be said that the formula obtained can be relied upon to estimate future sales based on the time variable.

Part II

Revenue variance Calculation:

Table of Calculations:

budget		actual		
P/kg	**ton//Q**	**kg/P**	**ton/Q**	
80	364	100	350	A
110	250	120	200	B

Note: When calculating deviations, it is essential to account for the units of measurement. For consistency, the sales quantity (originally in tons) should be converted to kilograms so that it aligns with the unit of measurement used for price

First: Sales variances

1- Sales variances recorded at the product A:

SV= (350×100×1000)-(364×80×1000)=5880000 mu fav

Product A has a sales positive variance.5880000 mu

2- sales variance recorded at the product B:

SV = (200×120×1000)-(250×110×1000)=-3500000 mu unfav

Product b has a negative variance 350000mu

the sum of variance of total revenue a and b

SV A+B = 5880000-3500000=2380000 mu fav

The sales variance recorded for Products A and B amounts to **+2,380,000**.

Secondly: Disaggregation of the sales variance into price variance and quantity variance

1- Calculating price variances

1-1 Calculating the price variances for product A

PVa= (100-80) ×1000×350 =7000000mu fav

Product A has a positive price variance. 7000000mu

1-2 Price variance product b

PVb= (120-110) ×200×1000=2000000

Product b has a positive price variance , 2000000 mu fav

1-3 golbal price variance

PV a+b = 7000000+2000000= 9000000

2- Quantity variances

2-1 quantity variance - product a -

QVa= (350-364) ×1000×80 = -1120000 mu

2-2 quantity variance - product b -

QVb = (200-250)*1000*110= -5500000

2-3 quantity variance for products a and b

QV a+b= -1120000-5500000=-6620000

Verifying Total Revenue Variance

- TSV=TQV+TPV   9000000-6620000=**2380000**

Checking variance a

- SVa=QVa+PVa   7000000-1120000= **5880000**

 Checking variance b

- SVb=QVb+QVb   2000000-5500000= **-3500000**

SV	QV	PV	
5880000	–1120000	7000000	P1
3500000–	5500000–	2000000	P2
2380000	–6620000	9000000	TOTAL

Third:

Breakdown of Quantity Variances into Mix Variance and Volume Variance Step 1: Using the Total Method

Calculate the weighted average standard price by actual quantities and the average standard price.

Calculate the weighted average standard price by actual quantities $S\overline{P}_{a(b)};$

$$S\overline{P}_{a(b)}; = \frac{(350\times80)+(200\times110)}{350+200} = 90.909090 \text{ mu}$$

Calculating the estimated average price for estimated quantities. Pmb

$$S\overline{P}_{(b)} = \frac{(364\times80)+(250\times110)}{364+2} = 92.214983 \text{ mu}$$

by applying the mix variance formula, we obtain the following result:

MV= (90.909090-92.214983) ×1000×550=**-718241.15 mu unfa**

2- Calculate total volume variance

TVV= (550-614)×1000×92.214983=**-5901758.912 mu unfa**

Results Verification

TQV= MV+TVV ; TQV= -718241.15 +-5901758.912=**-6620000 mu unfa**

Fourth:

Breaking down total volume variances into market variances

To calculate this variance, the actual and estimated market size must be calculated from the given market share ratios.

Market share ratio = Market share / Market size, accordingly:

• Actual market size for product A = 350 / 0.2 = 1750 tons

• Estimated market size for product A: 364 / 0.25 = 1465 tons

• Actual market size for product B = 200 / 0.4 = 500 tons

• Estimated market size for product B = 250 / 0.5 = 500 tons

1- Market Share variance

MSHV a =(0.2-0.25)× 92.214983×1750×1000= -8068811.0125 mu

E/MSH b= (0.4-0.5)×92.214983×500×1000=-4610749.15 mu

Total Market Share variance

MSHVa+b = -8068811.0125-4610749.15=-12679560.1625 mu

2- Global Market SIZE Variance

MSZVa= (500-500)×1000×0.5×92.214983=0

MSZVb =(1750-1465)×1000×92.214983×0.25=6570317.53875 mu

Total market size variance equals

MSZVa+b= 6570.317538mu

Checking the results.

The sum of divergent market size and market share equals the total size variance:

-12679560.1625+6570317.53875= -5901758.912 mu

Part 3

First ; calculate DOL

$$DOL = \dfrac{\dfrac{EBIT2-EBIT1}{EBIT1}}{\dfrac{Q2-Q1}{Q1}}$$

we have:

- EBIT 2= 0.01× (350×1000×100)= 350000 mu
- EBIT1= 300000 mu
- Q1=350 unit

Account Q1 ; (X).

by applying the quantity variance formula :

(X-147) ×1000×80=480000

Substituting the given values

1000x-147000= 480000

X= 627

Operating leverage rate: Dol =0.166666 /-0.441786= -0.37

Interpretation:

The degree of operating leverage (DOL) was calculated at −37%, indicating an inverse relationship between sales volume and operating income during the third and fourth quarters. Despite the significant decline in sales volume, the organization achieved an increase in profits of 50,000 monetary units. This outcome can be attributed to a strategic increase in product prices, which compensated for the reduction in quantities sold.

The observed pattern suggests that the products may be luxury or semi-essential goods. While some consumers reduced or stopped purchasing due to higher prices, others continued buying either because the products remained affordable for them or because of their necessity. Consequently, the company was able to maintain sufficient sales to generate additional profits despite the overall decrease in volume.

Exercise 1

The following table presents the real quarterly sales figures for a commercial company over the period 2020–2024.

2024	2023	2022	2021	2020	
160	154	150	142	135	ACTUAL
				140	BUDGET

Required

Calculate the expected sales for 2025 using the exponential smoothing method, knowing that the exponential smoothing factor = 20%.

Exercise 2

The following two tables present a summary of the actual and forecasted quantities , prices, variable cost per unit for a commercial enterprise dealing with two products.

Actual Data

	VCPU	P	Q
PRODUCT A	60	70	1000
PRODUCT B	45	50	700

Estimated Data

	VCPU	P	Q
PRODUCT A	55	60	1200
PRODUCT B	45	60	650

Required ; Calculate Variances based on CMPU

Lesson 11

production budget

A production budget represents a quantitative expression of the optimal production program for an upcoming operating cycle. It is formulated by taking into account a set of internal constraints, such as production capacity, labor availability, and inventory and storage policies, as well as external constraints, which are primarily driven by market conditions and are determined through the sales budget.

When market demand and inventory policies are considered, the production budget must satisfy the following equilibrium relationship:

Planned production volume + Planned beginning inventory = Expected sales volume + Planned ending inventory

Accordingly, the planned production volume can be expressed as:

Planned production volume = Expected sales volume + Planned ending inventory − Planned beginning inventory

Planned production volume = Expected sales volume + Planned inventory variation.

Reconciling internal production capabilities with external market requirements requires the use of quantitative optimization techniques in order to determine an optimal production program under the existing constraints on production quantities. Among the most significant of these techniques is **linear programming**, which allows all relevant constraints to be expressed in a unified and coherent mathematical form.

In linear programming, the solution is typically directed toward the optimization of an objective function, whether through **maximization** or **minimization**, subject to the imposed constraints. Applied to the production budget—where the decision variable is the production quantity Q—the objective function may involve maximizing performance measures such as total revenue (R), contribution margin (CM), operating profit, or earnings before interest and taxes (EBIT).

Alternatively, the objective function may be formulated as a **cost minimization problem**, based on minimizing variable costs (VC) or total costs (TC). Since the unknown variable in this context is expressed in terms of production quantities, all objective functions can be rewritten explicitly as functions of Q, whether the goal is to maximize results or minimize costs. As discussed in previous lectures, this analytical framework enables management to

identify the optimal production levels consistent with both operational constraints and strategic objectives.

- R=P.Q
- VC=VCUPU.Q
- CM=CMPU.Q
- TC=TCPU.Q

Example:

Assume a manufacturing company that produces and markets two products, X and Y, using two principal production workshops, A1 and A2. For the forthcoming operating period, the maximum available capacities of workshops A1 and A2 are estimated at 1,000 hours and 1,500 hours, respectively.

In workshop A1, the processing time required to manufacture one unit of product X is 15 minutes, whereas product Y requires 30 minutes per unit. In workshop A2, the corresponding production times are estimated at 45 minutes for product X and 15 minutes for product Y. These production times reflect the technological constraints governing the transformation process in each workshop.

From a market perspective, the absorption capacity for product Y during the coming period is limited to a maximum of 1,500 units, constituting an external demand constraint. With regard to cost and price data, the unit variable production costs for products X and Y are estimated at 5 and 7 monetary units, respectively, while their unit selling prices are projected at 10 and 12 monetary units.

The objective is to determine, under the stated operational and market constraints, the optimal production budget that maximizes the company's operating result, assuming that the optimal solution does not require the elimination of either product in favor of the other

Solution

CMPUx : 10-05=5
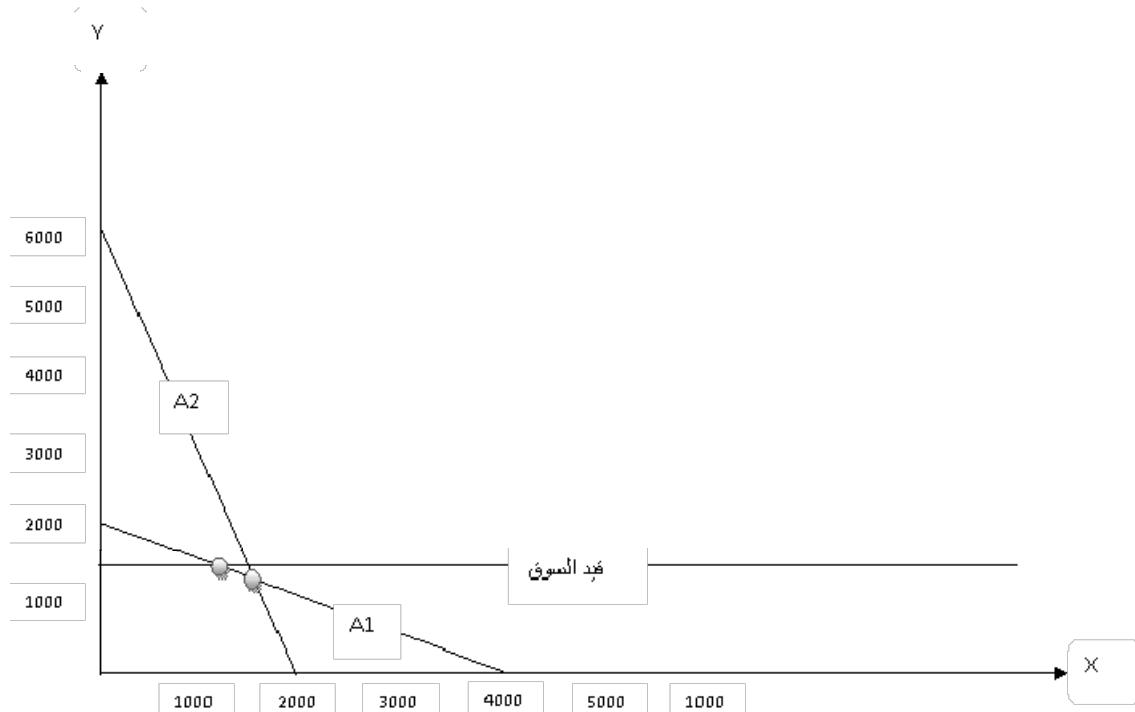
CMPUy: 12 -07 = 5

To achieve optimal production balance, we need to solve the following model: Maximize the profit function:

Max f (x y) : 5x+5y

That is under the restrictions:

$$\begin{cases} 025x + 0.5y \le 1000 & \longleftarrow \quad A1 \\ 0.75\ x\ +0.25\ y\ \le\ 1500 & \longleftarrow \quad A2 \\ Y \qquad\qquad \le 1500 & \longleftarrow \qquad\qquad MARKET \end{cases}$$

$$X \neq 0 \qquad\qquad y \neq 0$$

From the graph, after excluding the corner solutions, the following feasible solutions are obtained.

x	y	Max f (x y)
1600	1200	14000
1000	1500	12500

From the graphical analysis (after excluding corner solutions), the production plan that maximizes profit is (x,y) = (1600, 1200).

Note on excluding corner solutions: a corner solution (producing only one product and completely abandoning the other) is excluded here because real-world constraints or managerial considerations — such as market commitments, diversification requirements, capacity interdependencies, or strategic obligations — make it infeasible to cease production of one product even if it might appear optimal mathematically. These qualitative constraints cannot be captured easily in the linear model, so we restrict attention to interior feasible solutions.

Using the simplex method yields the same optimal point; the graphical method is convenient and intuitive when there are only two decision variables, but it cannot be applied when the number of products exceeds two. For larger problems (three or more products) we rely on the simplex algorithm or other LP solvers.

Example

A company produces three products x_1, x_2 and x_3 using three distinct production units, A1_ _A2, and A3. The following data summarize the production requirements and capacities associated with each product across the three units

VCPU	P	
100	170	**X1**
40	80	**X2**
30	90	**X3**

Part 1: The available capacity in the three production units is 1,000 hours for A_1, 800 hours for A_2, and 400 hours for A_3. The production times required for each product on these units are as follows:

Product X_1 : 4 hours on A_1, 2 hours on A_2, and 1 hour on A_3.

Product X_2 : 2 hours on A_1, 2 hours on A_2, and 3 hours on A_3.

Product X_3 : 4 hours on A_1, 1 hour on A_2, and 1 hour on A_3.

Required: Determine the optimal production program that maximizes the contribution per unit (CMPU).

Note: One of the products may be omitted if its production conflicts with maximizing the objective function.

Part 2: The data below pertain to the standard and actual costs of the three cost elements—raw materials, labor, and indirect costs—for product X_1.

Note that the actual activity volume has reached 80% of the previously estimated standard activity corresponding to the optimal production plan determined in Part 1

	Actual		budget
DA20000	Direct materials	kg8	**Consumption for unit**
12	p/kg	10	**p/kg**
10560	Indirect variable cost	10	**Cost driver rate**

- The actual labor requirement per unit was 5 hours, compared to the standard of 4 hours per unit, while the standard hourly wage rate was 30 monetary units, versus an actual rate of 20 monetary units.
- The overhead allocation is measured based on labor hours.
- Actual fixed costs amounted to 50,000 monetary units, while the standard fixed costs were estimated at 40,000 monetary units.

Required: Calculate the various possible cost variances, distinguishing between favorable and unfavorable outcomes.

Solution

Step 1: Formulate the objective function and constraints

Maximize total contribution**:**

$\text{MaxZ} = 70X1 + 40X2 + 60X3$

Subject to the production capacity constraints:

- $4X1 + 2X2 + 4X3 \leq 1000$ (A1)
- $2X1 + 2X2 + 1X3 \leq 800$ (A2)
- $1X1 + 3X2 + 1X3 \leq 400$ (A3)

Step 2: Convert to standard form

Introduce slack variables $S1, S2, S3 \geq 0$ to convert inequalities into equalities:

$4X1 + 2X2 + 4X3 + S1 = 1000$

$2X1 + 2X2 + 1X3 + S2 = 800$

$1X1 + 3X2 + 1X3 + S3 = 400$

The objective function in standard form becomes:

$\text{Max } 70X1 + 40X2 + 60X3 + 0S1 + 0S2 + 0S3$

Initial Simplex Tableau

	X1	X2	X3	S1	S2	S3	Rhs
S1	4	2	4	1	0	0	1000
S2	2	2	1	0	1	0	800
S3	1	3	1	0	0	1	400
Z	-70	-40	-60	0	0	0	0

Iteration 1

	X1	X2	X3	S1	S2	S3	Rhs
X1	1	0.5	1	0.25	0	0	250
S2	0	1	-1	-0.5	1	0	300
S3	0	2.5	0	-0.25	0	1	150
Z	0	-5	10	17.5	0	0	17500

Iteration 2

	X1	X2	X3	S1	S2	S3	Rhs
X1	1	0	1	0.3	0	-0.2	220
S2	0	0	-1	-0.6	1	-0.4	240
X2	0	1	0	-0.1	0	0.4	60
Z	0	0	10	17	0	2	17800

Final Solution

- X1=220
- X2=60
- X3=0

Max z = 17800

Part 2

You may complete the solution by consulting the principles and methods presented in the Standard Costing lesson.

Lesson 12

Budgeting system ; Procuerment Budget

The term "supplies" refers to the process of providing an institution with the necessary resources to fully carry out its production and commercial activities. The nature and quantity of supplies vary depending on the type of institution. For instance: In a commercial institution, supplies primarily include purchased goods and other materials such as packaging, office supplies, and various operational expenses. In a production institution,

supplies mainly involve providing the essential elements for production and commercial activities, such as raw materials, maintenance materials, and other indirect costs.

Given that working hours are among the most critical resources for carrying out production and commercial activities, the labor budget can be considered an integral component of the institution's supply system, developed in parallel with the supply budget.

1. Raw Material Supply Budget Preparing a budget for raw material purchases depends on several variables, including the institution's storage policy, the production budget, order processing times, purchase costs, and storage costs. Among these, the storage policy and the production budget are particularly significant.

The raw material supply budget can be formulated as follows:

Raw material purchases+Beginning inventory=Ending inventory+Consumption   Or

equivalently:

Raw material purchases=Consumption+Ending inventory−Beginning inventory   This relationship shows that the raw material supply budget is established after determining the required consumption based on the production budget, as well as calculating the initial and final inventory levels according to the institution's storage policy.

Example: The following data represent the estimated production quantities (in units) for the next two years, broken down by season:

Quarter 4	Quarter 3	Quarter 2	Quarter 1	
2200	1800	1200	1000	N+1
4000	3500	3000	2400	N+2

Each unit produced requires 5 kg of raw material M. According to the company's storage policy, 20% of the next period's consumption must be maintained as ending inventory for the current period.

Required: Prepare the raw material supply budget, given that:

The purchase cost of one kilogram of raw material M is 8 monetary units.

The estimated consumption for the first quarter of year $n + 3$ is 25,000 kg

Solution

8	7	6	5	4	3	2	1	
4000	3500	3000	2400	2200	1800	1200	1000	**Producton /unit**
20000	17500	15000	12000	11000	9000	6000	5000	**Consumption /kg**
5000	4000	3500	3000	2400	200	1800	1200	**Inventory 1**
4000	3500	3000	2400	2200	1800	1200	1000	**Inventory 2**
21000	18000	15500	12600	11200	7400	6600	5200	**Purchases /kg**
168000	144000	124000	100800	89600	59200	52800	41600	**Purchase Cost**

Note:

For a commercial enterprise, the purchases budget is constructed using the following relationships:

Purchases+Beginning Inventory=Sales+Ending Inventory or equivalently:

Purchases=Sales+Ending Inventory−Beginning Inventory

2. Labor Requirements Budget
The labor requirements budget is prepared after determining the hourly labor needed for each unit produced. The working hours budget is calculated using the following formula:

Labor Requirements (hours)=Hourly Requirement per Unit×Estimated   Production Volume The labor cost budget is then obtained by multiplying the total labor hours by the hourly labor cost:

Labor Requirements Budget (value)=Labor Requirements (hours)×Hourly Cost

 Example: Based on the previous production example:

Each unit requires 1.5 hours of labor.

The estimated labor cost per hour is 100 monetary units in the first year and 120 monetary units in the second year.

Required: Prepare the labor budget for both years.

Solution:

8	7	6	5	4	3	2	1	
4000	3500	3000	2400	2200	1800	1200	1000	**Production /unit**
6000	5250	4500	3600	3300	2700	1800	1500	**Hours**
720000	630000	540000	432000	330000	270000	180000	150000	**Hours cost**

Note:

It is possible to translate the required labor hours into the number of workers needed by

calculating the standard monthly hours per worker and then multiplying by three to determine the total hours for the quarter. The labor cost is then computed based on the wage per worker.

$$\text{Required number of workers} = \frac{\text{Available hours for activities}}{\text{Standard hourly volume per worker for the quarter}}$$

3. Budgeting Other Indirect Expenses

This budget accounts for all expenses other than labor and raw materials, including:

- Depreciation expenses
- Maintenance costs
- Supplies and miscellaneous operational expenses

The budget is typically prepared on a quarterly or annual basis, with each expense item clearly specified according to its nature.

Lesson 13

Budgeting system ; Procuerment Budget – stock management –

Procurement departments play a central role in ensuring the efficiency of supply chain operations. Their primary objective is to minimize total inventory management costs while maintaining the availability of materials required for production and operations, taking into account the conflicting behavior of the individual cost components.

Procurement departments sit at the intersection of logistics, finance, and production functions. Since optimization calculations themselves incur costs, they are generally applied only to selected inventory items. The main goal of these methods is to identify which items require precise monitoring. This involves classifying stocked items by decreasing value as a percentage: a small number of items typically represents a significant portion of total inventory value, while the remaining items account for a minor share. Items are then grouped for uniform inventory monitoring, usually into two or three categories.

Inventory Management Models: **Wilson Model**

 To ensure optimal inventory management and avoid shortages, it is essential to know the procurement frequency, delivery lead times, and safety stock levels. While there are numerous inventory management models, they are all fundamentally based on the Wilson Model.

The Wilson Model provides a foundational framework for inventory management, aiming to minimize total inventory costs by optimizing the order quantity.

Let C represent the annual consumption of a material in volume. The level of active stock depends on the supply frequency (see Table 1).

Table 1. Active Stock Calculation

Number of Supplies (N)	1	2	3	X
Active Stock Level - AS-	C	C/2	C/3	C/X
Average Stock	C/2	C/4	C/6	(C/X)/2

The active stock level decreases as the number of orders increases. Consequently, more frequent deliveries result in lower active stock levels, reducing holding costs. However, this also leads to an increase in ordering costs.

The behavior of active stock over time is typically illustrated using "sawtooth" graphs (see Figure 1), which show how stock levels decline between deliveries. In Figure 1, three graphs depict stock levels with different delivery frequencies: N=1, N=2, and N=3, demonstrating how increasing the number of orders reduces the average inventory.

Figure 1
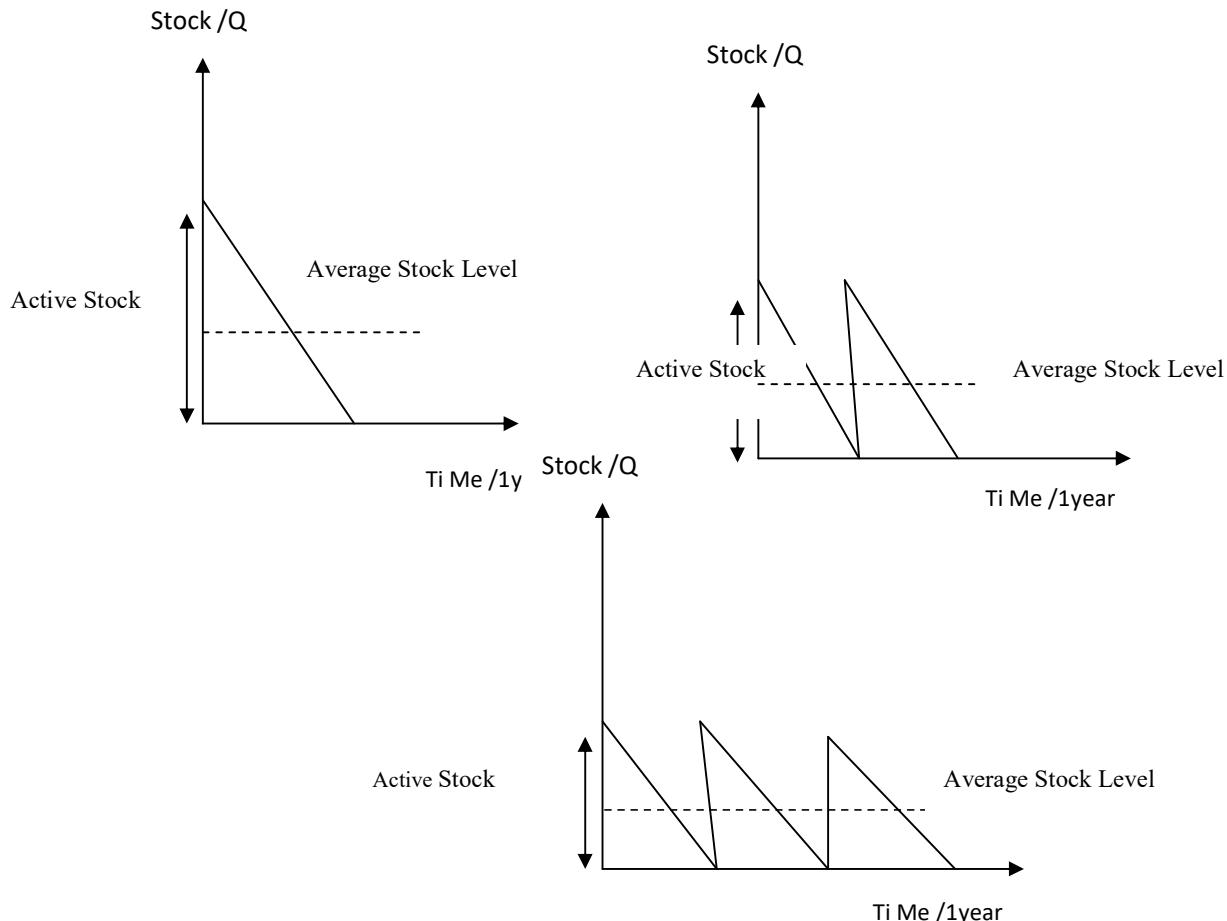
Minimize the total cost of inventory management (K), which comprises:

o   Ordering Costs (K1):

Fixed costs per order (e.g., administrative, shipping).

o   Holding Costs (K2):

Costs to store inventory (e.g., warehousing, insurance, obsolescence).

Derivative of k (K')

$$K'(N) = K1 - \frac{K2 \times Cu \times C}{2N^2}$$

Where:

- C = Annual consumption/demand (units),
- $C\,u$ = Unit cost of the item,
- $k\,1$ = Cost per order,
- $k\,2$ = Annual holding cost rate (as a % of unit cost).

Holding costs $K2 = k\,2 \times Cu \times \frac{C}{2N}$

Ordering Costs (K1)= : $k\,1 \times N$

Management stock cost = K1+K2 = $(k\,1 * N) + k\,2 \times Cu \times \frac{C}{2N}$

Graph 1

The minimum of function K is reached when its derivative is zero

$$K'(N)=0 \quad K1 - \frac{K2 * Cu * C}{2N^2} = 0 \quad K1 = \frac{K2 * Cu * C}{2N^2}$$

When K'(N)=0   The optimal order quantity (Q∗) and optimal number of orders (N∗) are derived as:
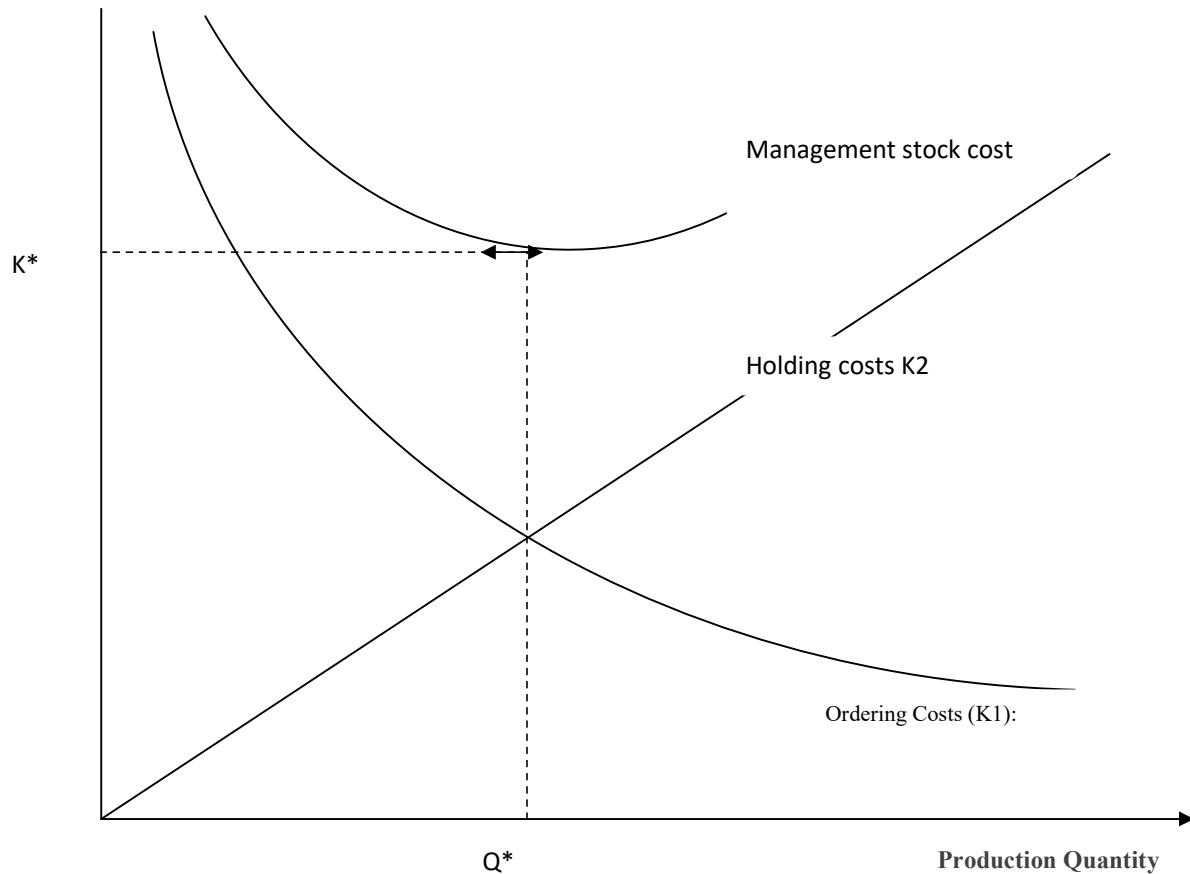
- $N* = \sqrt{\frac{K2 \times Cu \times C}{2 \times k1}}$
- $Q* = \frac{C}{N}$

Optimal Order Interval:

Time between orders $= \frac{360}{N*}$ days

Graph 1 wilson model

Cost Amount

Wilson model

Example

Economic Order Quantity (EOQ) Calculation An organization forecasts an annual consumption of 10,800 units of product X X. The relevant cost parameters are:

Unit purchase price (C_u): 10 mu

Annual holding cost rate (k_2): 8% of unit cost

Cost per order (k 1): 20 mu

Required:

Optimal order quantity (Q_*)

Optimal number of orders (N_*)

Time between two orders

Solution

- K1=20×N=20N

- K2=0.08×10×$\frac{10800}{2N}$

- K=20N+$\frac{4320}{N}$

- K′(N)=20−$\frac{4320}{N^2}$

- K′=0 $\qquad$ N*=$\sqrt{\frac{4320}{20}}$ $\qquad$ N*=14.70
- Q*=$\frac{C}{N}$ $\qquad$ Q*=$\frac{10800}{14.70}$ $\qquad$ Q*=735

Time to next order ;

360/14.7=24.5 days

<div align="center">

Time Between Two Orders 24.5 days

</div>

Total cost

K=K1+K2=$\frac{216000}{735}$ + 0.4×735=588

<div align="center">

Total cost = 588

</div>

2. Safety Stock (SS)

Safety stock is a buffer inventory maintained for two main purposes:

- To accommodate fluctuations in consumption during the replenishment period.

- To mitigate risks associated with extended delivery lead times, such as delays or temporary stock-outs.

The level of safety stock is typically determined using historical data from previous periods (e.g., customer demand, production requirements) and can also be calculated using predictive models to anticipate future variability in demand or supply.

References

1. Kaplan, S. R., & Norton, P. D. (2008). The Execution Premium; Linking Strategy to Operations for Competitive Advantage . Boston USA : Harvard Business School Publishing Corporation .
2. Kaplan , R., & Norton , D. (2008,b, January). Mastering The Management System. *Harvard Business Review(Leadership And Strategy For The Twenty-First Century)*(R0801d), 63-77.
3. Kaplan, R., & Norton, D. (1992, January- February). The Balanced Scorecards - Measures That Drive Performance. *Harvard Business Review*, 70-79.
4. - Alain, B., & Claud, S. (1997). *Le contrôle de Gestion* . Paris: Edition La Découvert.
5. Alain Fernandez .(2006). l'essentiel du Tableau de bord , Troisième Tirage , éditions d'organisation , Paris ,
6. Cambridge University Press . (2020, 5 1). Retrieved From Cambridge Dictionary: Https://Dictionary.Cambridge.Org/Dictionary/English/Control
7. . Caroline Silmer .(2003) .*Concevoir Le Tableau de Bord; Outil de Controle de Pilotage et d'aide a La Décision*.Paris: Dunon.
8. . Charles, H., Alnoor, B., Srikant, D., & George, F. (2003). *contrôle de Gestion et Gestion Budgétaire.* (L. Georges, Trans.) France: Pearson Edcation.
9. . Sabine, S., & Claude, A I.(2010). , Contrôle de Gestion , Corriges Du Manuel Dunon, France
10. Romaric, D., & Sabine , S.(2021). , Contrôle de Gestion , dunon , France.
11. . Hugh, c., David, H., & Ellis, J. (2005). *management accounting ; Principles and applications* . oxford, Great Britain : Alden Press.
12. . Henry Bouquin .(1998) .*Le Contrôle De Gestion*.Paris.
13. . Henry Bouquin .(2000) .*Comptabilitéde gestion*.Paris: Economica.
14. . Hélene , L., Véronique , M., Jérom, M., Yvon, P., Eve, C., Daniel, M., et Al. (2008). *Le Controle de Gestion ; Organization, Outils et Pratiques* (ed. 3). Paris: Dunon.
15. . Isabelle Kerviler , & Loic Kerviler . (1994). *Le Contrôle de Gestion A La Porteé de Touts*. Paris: Economica.
16. . Janet Walker.(2009). Fundamentals of Management Accounting. CIMA Certificate In Business Accounting. Elsevier. UK .
17. . Jean, C. G., & Jaque, D. G. (1998). *Contrôle de gestion et choix strategiques.* paris: delmas.
18. . Kaplan , R., & Norton , D. (2001).*The Strategy Focused Organization ; How Balanced Scorecard Companies Thrives in The New Business Environment.* Boston USA: Harvard Business School Press.
19. . Kaplan, S. R., & Norton, P. D. (2008). The Execution Premium; Linking Strategy to Operations for Competitive Advantage . Boston USA : Harvard Business School Publishing Corporation .
20. . Kaplan , R., & Norton , D. (2008,b, January). Mastering The Management System. *Harvard Business Review(Leadership And Strategy For The Twenty-First Century)*(R0801d), 63-77.

21. . Kaplan, S. R., & Norton, P. D. (1996,A). *The Balanced Scorecard Translating Strategy into Action.* USA: Harvard Business Scholl Press.

22. . Michel Gervais .(1989) .*Contrôle de Gestion et Planification de L'entreprise.* Paris : Economica.

23. . P.L. Boscos et al .(1997) .*Contrôle de Gestion et Management.*Paris: Edition Montchrestien.

24. . -Peter   F.   Drucker,2002**,**Management :Tasks   ;   Responsibilities   ; Practices ,HarperCollins ,USA

25. . Françoise Giraud et al , Contrôle de Gestion et Pilotage de la Performance**,** 2édition **,**Gualino édition, Paris , 2004 .

26. . Robin Cooper .(1995) .*When Lean Enterprises Collide.*USA: Harvard Business School Press.

27. . Robert S. Kaplan & Robin Cooper (1998). Using Integrated Cost Systems to Drive Profitability And Performance , Harvard Business School Press , USA , .

28. . sabine, s., & claude, a. (2004). *controle de gestion ; manuel & applications .*Paris: dunon.

29.   walker, j. (2009). *fundamentals of management accounting.* oxford: Elsevier Ltd.