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Management Accounting Concepts and Techniques

Dennis Caplan
University at Albany, State University of New York, dcaplan@albany.edu

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MANAGEMENT ACCOUNTING CONCEPTS AND TECHNIQUES

Dennis Caplan
University at Albany (State University of New York)

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Management Accounting Concepts and Techniques
Table of Contents

PART 1

INTRODUCTION

The important thing is we're the same company we were on Friday, except our market value has dropped by half.

- Stephen Wiggins
Chairman of Oxford Health Plans
1997

CHAPTER 1: Management Accounting Defined, Described, and Compared to Financial Accounting

Prologue:

We all face the fundamental economic problem of how to allocate scarce resources. This is a problem that confronts every company, every government, and us as a society. It is a problem that we each face in our families and as individuals.

In the United States and throughout most of the world, there are institutions that facilitate this allocation of scarce resources. The New York Stock Exchange is one such institution, as is the London Stock Exchange, the Chicago Board of Trade, and all other stock, bond and commodity markets. These financial markets are sophisticated and apparently efficient mechanisms for channeling resources from investors to those companies that investors believe will use those resources most profitably.

Banks and other lending institutions also allocate scarce resources across companies, through their credit and lending decisions. Governments allocate scarce resources across segments of society. They collect taxes from companies and individuals, and allocate resources to achieve social and economic goals.

All of these institutions use **financial accounting** as a primary source of information for these allocation decisions. Investors and stock analysts review corporate financial statements prepared in accordance with **Generally Accepted Accounting Principles**. Banks review financial statements as well as projections of cash flows and financial performance. The Internal Revenue Service taxes income that is calculated only slightly differently from income for financial reporting purposes. In effect, the same set of financial accounting rules is used by these different users, with only minor modifications.

However, this is only part of the story, because when I buy stock in Microsoft, whether my investment turns out to be profitable depends largely on the operational, marketing and strategic decisions that Microsoft's managers make during the time that I hold my investment. And when Microsoft's management team sits down to decide what products to develop, which markets to enter, and how to source production, they are not, almost certainly, looking at the company's most recent annual report or any other financial accounting report. By the time the annual report is available, the information is too old, and in any case, it is too highly summarized; there is not enough detail and not enough forward-looking data. Rather, when Microsoft's management team makes decisions, it bases these decisions on ***management accounting*** information. This is definitional. *By definition*, management accounting is the information that managers use for decision-making. *By definition*, financial accounting is information provided to external users.

Hence, both financial accounting and management accounting are all about allocating scarce resources. Financial accounting is the principle source of information for decisions of how to allocate resources among companies, and management accounting is the principle source of information for decisions of how to allocate resources within a company. Management accounting provides information that helps managers control activities within the firm, and to decide what products to sell, where to sell them, how to source those products, and which managers to entrust with the company's resources.

* * * * * *

> *In other news, General Motors' common stock rose $1.10 today following the announcement that the company has successfully installed an improved management accounting system.*

* * * * * *

If management accounting so important, why are we not likely to see a headline like the fictional announcement shown above? There are two reasons. First, management accounting information is proprietary; public companies are generally not required to disclose management accounting data nor much detail about the systems that generate this information. Typically, companies disclose very little management accounting information to investors and analysts beyond what is imbedded in financial reporting requirements. Even very basic information, such as unit sales by major product category, or product costs by product type, is seldom reported, and when it is reported one can be sure that management believes voluntary disclosure of this information will be viewed as "good news" by the marketplace.

The second reason we are not likely to see a headline like the one above is that most management accounting systems seem to work reasonably well most of the time. Hence, it is difficult for a company to gain a competitive advantage by installing a better management accounting system than its competitors. However, this observation does not imply that management accounting systems are not important. On the contrary, as the following news story indicates, poor management accounting systems can significantly affect the investment community's perception of a company's prospects.

NEW YORK TIMES
OCTOBER 28, 1997

> Oxford Health Plans said yesterday that it had been losing money because it fell behind in sending bills to customers and underestimated how much it owed doctors and hospitals. Shares fell 62%. Stephen Wiggins, chairman of Oxford, said the company had belatedly discovered that many customers were not paying premiums, often because the company was late in sending bills.
>
> Oxford acknowledged that it had fallen behind in payments to hospitals and doctors as it struggled with a new computer

> system. With incomplete information in its computers, it had to advance money to doctors and hospitals without verifying that they were obeying Oxford's rules. Mr. Wiggins said Oxford would add about 0.5% to spending on administration next year in an effort to insure there are no similar problems. “The important thing," he added, "is we're the same company we were on Friday, except our market value has dropped by half.”

Health insurance is a relatively stable industry. 1997 was the middle of a strong bull market. What was the problem with Oxford such that in this environment it should lose half its stock value almost overnight? The answer is that its management accounting system was broken, big time. Management accounting is something like indoor plumbing. When it functions properly, we tend to take it for granted, but when it breaks down, we quickly develop a greater appreciation for it.

Definition and Scope of Management Accounting:

Management accounting is the process of measuring and reporting information about economic activity within organizations, for use by managers in planning, performance evaluation, and operational control:

- Planning: For example, deciding what products to make, and where and when to make them. Determining the materials, labor, and other resources that are needed to achieve desired output. In not-for-profit organizations, deciding which programs to fund.

- Performance evaluation: Evaluating the profitability of individual products and product lines. Determining the relative contribution of different managers and different parts of the organization. In not-for-profit organizations, evaluating the effectiveness of managers, departments and programs.

- Operational control: For example, knowing how much work-in-process is on the factory floor, and at what stages of completion, to assist the line manager in identifying bottlenecks and maintaining a smooth flow of production.

Also, the management accounting system usually feeds into the financial accounting system. In particular, the product costing system is usually used to help determine inventory balance sheet amounts, and the cost of sales for the income statement.

Management accounting information is usually financial in nature and dollar-denominated, although increasingly, management accounting systems collect and report nonfinancial information as well.

The mechanical process of collecting and processing information poses substantial and interesting challenges to large organizations. Also, there are important conceptual issues about how to aggregate information in order to measure, report, and analyze costs. Issues of how to allocate costs across products, services, customers, subunits of the organization, and time periods, raise questions of substantial intellectual content, to which there are often no clear answers.

Management accounting is used by businesses, not-for-profit organizations, government, and individuals:

- Businesses can be categorized by the sector of the economy in which they operate. Manufacturing firms turn raw materials into finished goods, and we also include in this category agricultural and natural resource companies. Merchandising firms buy finished goods for resale. Service sector companies sell services such as legal advice, hairstyling and cable television, and carry little if any inventory. Businesses can also be categorized by their legal structure: corporation, partnership, proprietorship. Finally, businesses can be categorized by their size.

- Not-for-profit organizations include charitable organizations, not-for-profit health care providers, credit unions, and most private institutions of higher education.

- Government includes Federal, state and local governments, and governmental agencies such as the post office and N.A.S.A.

All of these organizations use management accounting extensively. Also, individuals use the economic concepts that form the foundation of management accounting in their personal lives, to assist in decisions large and small: home and automobile purchases, retirement planning, and splitting the cost of a vacation rental with friends.

Management Accounting and Financial Accounting Compared:

The field of accounting consists of three broad subfields: financial accounting, management accounting, and auditing. This classification is user-oriented. Financial accounting is concerned with communicating accounting information to external parties. Management accounting is concerned with generating accounting information for managers and other employees to assist them in performing their jobs. Auditing refers to examining the authenticity and usefulness of all types of accounting information. Other subfields of accounting include tax and accounting information systems.

Because many students taking management accounting have just completed a course in financial accounting, it is useful to examine the ways in which management accounting differs from financial accounting.

Financial Accounting	**Management Accounting**
Mandatory for most companies. Financial reporting is required by U.S. securities laws for public companies. Private companies with debt are often required by lenders to prepare audited financial statements in accordance with GAAP.	Mostly optional. However, it is inconceivable that a large company could operate without sophisticated management accounting systems. Also, legislation such as the Sarbanes-Oxley Act of 2002 sets minimum standards for public companies for their internal reporting systems.
Follows Generally Accepted Accounting Principles (GAAP) in the U.S., and other uniform standards in other countries.	No general principles. Companies often develop management accounting systems and measurement rules that are unique and company-specific.
Backward-looking: focuses mostly on reporting past performance.	Forward-looking: includes estimates and predictions of future events and transactions.
Emphasis on reliability of the information	Can include many subjective estimates.
Provides general purpose information. Investors, stock analysts, and regulators use the same information (one size fits all).	Provides many reports tailored to specific users.
Provides a high-level summary of the business	Can provide a great deal of detail.
Reports almost exclusively in dollar-denominated amounts. A recent exception is the increasing (but still infrequent) use of the Triple Bottom Line.	Communicates many nonfinancial measures of performance, particularly operational data such as units produced and sold by product type.

These differences are generalizations, and are not universally true. For example, GAAP allows some important choices, such as the FIFO or LIFO inventory flow assumption. Also, GAAP uses predictions of future events and transactions to value assets and liabilities under certain circumstances. Nevertheless, the differences between financial accounting and management accounting shown above reveal important attributes of financial accounting that are driven by the goal of providing reliable and understandable information to investors and regulators. These individuals are often far removed from the companies in which they are interested, so a regulatory and self-regulatory institutional structure exists to ensure the quality of the information provided to them.

For example, financial accounting uses historical information, not because investors are interested in the past, but rather because it is easier for accountants and auditors to agree on what happened in the past than to agree on management's predictions about the future.

The past can be "audited." Investors then use this information about the past to make their own predictions about the company's future.

As another example, financial accounting follows a set of rules (GAAP in the U.S.) that investors can study. Once investors obtain an understanding of GAAP, the fact that all U.S. companies comply with the same rules greatly facilitates investors' ability to follow multiple companies. Also, the fact that financial reporting is mandatory for all public companies ensures that the information will be available.

Management accounting, on the other hand, serves an entirely different audience, with different needs. Managers need detailed information about their part of the organization, so management accounting provides detailed information tailored for specific users. Also, managers must make decisions, sometimes on a daily basis, that affect the future of the business, and they need the best predictions of the future that are available as input in those decisions, no matter how subjective those estimates are.

Management Accounting Institutions:

The most important professional association of management accountants in the U.S. is the **Institute of Management Accountants** (**IMA**). There are similar organizations in other countries. Formerly the **National Association of Accountants**, the IMA has about 100,000 members. Its headquarters are in Montvale, NJ, outside of New York City, and there are local chapters throughout the country.

The IMA sponsors the Certified Management Accountant's certification program. Certification requires passing the CMA examination, and working for two years in a field related (at least loosely) to management accounting. The exam is similar to the CPA exam, although it is broader in scope and places less emphasis on financial reporting and auditing. Unlike the CPA certification, which is required by state laws of accountancy for practicing public accountants, the CMA certification is voluntary. Next to the CPA, the CMA and CIA (Certified Internal Auditor) are probably the most widely-recognized certifications of accountants in the U.S.

The IMA issues a Code of Professional Ethics for management accountants, which is mandatory for CMAs. The Code clearly indicates that management accountants have responsibilities to the public as well as to organizations for which they work. The Code provides explicit guidance on how management accountants should respond to questionable or clearly improper financial or regulatory reporting practices in their organizations, which is probably the most difficult ethical issue that every management accountant should be prepared to encounter. Anyone who becomes a management accountant (even if he or she does not become a CMA), and anyone who works with or supervises management accountants, should become familiar with the CMA's ethical standards.

The IMA supports research on management accounting, sponsors continuing education seminars, publishes materials on management accounting topics (some of which are available at no charge from the IMA website), and publishes a monthly magazine called

Strategic Finance (prior to March 1999, the magazine was called *Management Accounting*). *Strategic Finance* is probably the premier management accounting magazine for practitioners in the U.S.

A Note on Terminology:

Because management accounting developed over many decades in a decentralized fashion, within leading companies of the day and without the direction of a regulatory or self-regulatory rule-making body, terminology has evolved that is sometimes redundant and sometimes inconsistent. A single concept can go by multiple names, and the same term can refer to multiple concepts.

For example, full costing has two meanings, one of which is synonymous with absorption costing. Variable costing is synonymous with direct costing, and overhead is synonymous with indirect costs. However, direct costs, direct costing, and the direct method of cost allocation all refer to different concepts and techniques.

There is nothing “normal” about a normal costing system. A standard costing system is closely related to—but not quite synonymous with—the concept of a standard cost.

Management accounting and managerial accounting are synonymous. However, the relationship between these terms and cost accounting is ambiguous. Many accounting practitioners use these terms interchangeably. When cost accounting is distinguished from management accounting, cost accounting sometimes refers to accounting for inventory, and as such, the term applies primarily to manufacturing and merchandising firms. In this case, cost accounting would be a large subset of the management accounting system, because most but not quite all of the accounting activity inside manufacturing and merchandising companies relate to inventory. Alternatively, cost accounting is sometimes distinguished from management accounting in the following way: if the answer depends upon the accounting techniques employed, the question is a cost accounting question; if the answer is independent of the accounting techniques employed, the question is a management accounting question. For example, the valuation of ending inventory depends on whether the company uses the LIFO (last in, first out) or FIFO (first in, first out) inventory flow assumption. That is cost accounting. However, the determination of whether the company would be more profitable in the long-run by closing the factory and sourcing product from an independent supplier is independent of the inventory flow assumption or any other accounting choice. That is a management accounting problem.

Even recent advances in management accounting are sometimes associated with ambiguous or redundant terminology. For example, supervariable costing is synonymous with throughput costing.

Textbooks usually shelter students from this ambiguity in terminology, by defining terms carefully, avoiding redundancy, and maintaining consistency. However, the ambiguity exists out there in practice.

CHAPTER 2: Relevant Concepts from the Fields of Strategy and Operations Management, and a Brief History of Management Accounting

This chapter describes some concepts and characteristics from the fields of strategy and operations management that are relevant to the study of management accounting. Because management accounting is a management support function, management accountants need to be aware of emerging trends, issues and techniques in the field of management. Also, because many of the most challenging management accounting problems occur in the manufacturing sector of the economy, management accountants must have a solid understanding of the terminology and basic characteristics of common manufacturing processes. This chapter also provides a brief history of the development of management accounting.

Manufacturing Processes:

Manufacturing industries can be categorized according to the extent to which individual units of output are distinguishable from each other during and subsequent to the production process. We describe four points on a continuum.

Job order: In a job order process, each unit of output is unique. Examples include a custom home builder and a custom furniture-maker.

Batch process: In a batch process, identical (or very similar) units of output are produced in groups called batches, but the units in one batch can differ significantly from the units in another batch. The units within each batch usually remain within close physical proximity throughout the production process.

Apparel factories often use a batch process. For example, different styles of pants are produced in separate batches. Each batch might consist of 50 or several hundred pairs of pants. Within each batch, there might be minor differences, such as different waist and inseam sizes. At any one time, the factory might have work-in-process related to several different styles of pants, and numerous batches of work-in-process for each style.

Assembly line: In an assembly-line process, similar units are produced in sequence, usually in a highly-automated operation. The automobile industry is a good example. An automobile manufacturer makes only one model car on any one assembly line. The assembly line allows for some product differentiation. For example, cars produced on the assembly line can differ from each other with respect to such features as color and upholstery, and perhaps in more substantive ways such as the size of engine, and two-wheel versus all-wheel drive. However, to change an assembly line from one model to another usually requires significant expense and down-time.

Continuous process: In a continuous manufacturing environment, the manufacturing facility produces a continuous flow of product during the operating hours of the facility. A classic example of a continuous process is an oil drilling operation. The distinguishing feature of a continuous process is that any grouping of output into individual units is arbitrary. For example, oil can be divided into barrels or gallons or any other measure of liquid volume. In order to determine the cost of production in a continuous process, it is necessary to select a period of time, collect costs incurred during that period, determine the amount of output produced during that same period, and divide total costs by total output.

There is no presumption that a continuous manufacturing process is a one-product facility (drilling operations often extract both crude oil and natural gas), or that it runs 24 hours a day.

Overview of manufacturing processes: Distinguishing manufacturing processes along this continuum is helpful, because where a process falls on this continuum influences the types of management accounting issues that arise, and the design of the management accounting system. However, it is often difficult and seldom helpful to classify any particular manufacturing process precisely into one of the four points of the continuum described here. Also, any one company might operate over several points on this continuum.

Decentralization:

An important issue in the management of firms is the extent to which decision-making is centralized or decentralized. Many large companies operate in a highly decentralized fashion, and have numerous **responsibility centers** and responsibility-center managers with considerable autonomy. Important types of responsibility centers include the following:

Cost centers: Managers of cost centers are responsible for costs only. Most factories are cost centers.

Profit centers: Managers of profit centers are responsible for revenues and costs. The Jeans Division of Levi Strauss & Co. might be a profit center.

Investment centers: Managers of investment centers are responsible for revenues, expenses, and invested capital. The Canadian Division of Levi Strauss & Co. might be an investment center.

Following are important benefits of decentralization.

1. Decision-making is delegated to managers who are often in the best position to understand the local economy, consumer tastes, and labor market.

2. Autonomy is inherently rewarding. Job positions that are characterized by a high degree of responsibility and autonomy are likely to attract and retain more talented, experienced and capable managers than positions that provide managers minimal decision-making authority.

3. Companies that delegate responsibility deep within the organization create a training ground where managers gain experience and prepare themselves for higher-level positions.

4. Decentralization places fewer burdens on top management. Highly-centralized companies impose on top management the responsibility for numerous routine decisions.

Following are important costs and risks of decentralization.

1. The incentives of responsibility-center managers do not always align with the incentives of owners or top management. There is the obvious risk that managers might consume perquisites at the expense of corporate profits (e.g., expensive business lunches and office furniture). Also, there is evidence that managers will attempt to increase the size of the units for which they are responsible (called the manager's span of control), even if doing so does not increase the profitability of the company.

2. Economic theory suggests that managers prefer for the responsibility center under their control to accept less risk than owners would like. This theory builds on the observation that higher-risk projects generate higher returns, on average, reflecting the trade-off between risk and return, which constitutes a building block of finance theory. Shareholders prefer riskier projects than managers, because shareholders can diversify their portfolios by owning shares in numerous companies. However, the manager's career is closely connected with the performance of his or her responsibility center. Consequently, managers of responsibility centers of decentralized companies might reject risky projects that shareholders would favor.

Although there are both benefits and costs to decentralization, it would appear that by any objective measure, most large corporations operate in a highly-decentralized fashion. As a benchmark, one might wish to compare the extent of decentralization in modern corporations with the extent of decentralization in such entities as the military or the former Soviet economy.

The Origins of Management Accounting:

Management accounting first emerged as a significant activity during the early industrial revolution, in the leading industries and enterprises of the day. As such, management accounting arose after financial accounting, which can trace its origins to its stewardship role in European merchant trading ventures beginning in the Italian Renaissance, and to tax records that governments apparently have required for as long as governments have existed. Double-entry bookkeeping had been used for more than 300 years by the time management accounting first emerged as a recognizable field.

Two leading industries of the industrial revolution that played important roles in the early history of management accounting were textiles and railroads. Textile mills used raw materials and labor to make fabrics and associated products, and the mills developed methods to track the efficiency with which they used these inputs. Railroads required significant investments of capital over long periods of time for the construction of roadbed and track. Once operational, railroads handled large volumes of cash receipts from numerous customers, and developed both financial and operational measures of efficiency for moving passengers and freight.

By the end of the 19th century, new industries and types of businesses were becoming important to the economies of the United States, Great Britain, and other industrializing nations. These enterprises included steel producers, mass producers of consumer products such as foodstuffs and tobacco, and mass merchandisers such as Sears, Roebuck & Company. Leading companies in these industries developed accounting systems to meet their needs for operational control.

In the first two decades of the 20th century, the fields of industrial engineering and management accounting developed in tandem. During this period, industrial engineers developed methods to control production that included a “scientific” determination of standards for inputs of materials, labor and machine time, against which actual results could be compared. This development led directly to standard costing systems, which are still widely used by manufacturing companies. Management accounting concepts and techniques continued to evolve rapidly throughout the rest of the first half of the 20th century, and by 1950 most of the key elements of management accounting as practiced today were well established.

These developments occurred in a decentralized fashion, inside large companies that were using common sense and commonplace bookkeeping and analytical tools to meet their internal reporting requirements. Companies that business historians have identified as innovators in management accounting practice during this period include DuPont, General Motors and General Electric. However, an innovator is not necessarily a leader. There appears to have been relatively little communication among companies regarding the management accounting methods that were developed. Perhaps managers and accountants viewed these accounting systems and techniques as proprietary, a possible source of competitive advantage. Also, there was no institutional or regulatory impetus for sharing information. In the early 1900s, there was no association of management accountants to hold annual meetings in Chicago or Boston for continuing professional education and revelry. There was no government oversight of management accounting practice. With very few exceptions, management accounting itself was not required for regulatory purposes until the Foreign Corrupt Practices Act of 1977, which mandated that large companies maintain adequate systems of internal control. Even today, companies have a great deal of discretion in the design of management accounting systems, and management accounting looks very different from one company to another even within the same industry.

Key Developments in the Past 50 Years:

The economic, business and technological developments that have probably had the greatest impact on management accounting over the last 50 years are the following:

The information revolution: Those of us born in the second half of the 20th century have difficulty appreciating the enormous hurdle that the collection and processing of information once posed to management accounting systems, and the impact that the cost of information had on management in general. Today, information technology makes possible sophisticated database accounting systems that are both powerful and flexible in terms of the accounting information that they can collect, organize and report. Even today, however, the cost of designing, implementing, and running cost accounting systems is a substantial obstacle in many organizations; a fact probably underrepresented in business schools.

Proliferation of product lines: If a company makes only one product, many cost accounting issues are moot. When companies significantly expanded their product lines beginning in the 1950s, to gain market share and increase profits, the difficulty and importance of obtaining accurate cost information on individual products increased. It is generally agreed that in the 1970s and 1980s, some U.S. companies were allocating costs among products in a manner that led to poor production and marketing decisions. A management accounting tool called activity-based costing was developed to help correct this problem, by improving the accuracy with which costs are allocated among products.

Globalization of the economy: Globalization has several implications for management accounting. First, globalization has resulted in a more competitive environment, which encourages the implementation of accounting systems that provide the most accurate, relevant, and timely information possible. Second, the growth of multinational corporations has increased the importance of transfer pricing. A transfer price is the amount one division of a company charges another division for an intermediate product. Transfer pricing plays a role in taxation, international trade negotiations, and production and marketing decisions within decentralized firms. Finally, globalization has increased the pace of change within the management accounting profession. Many recent innovations in management accounting, as well as in the fields of strategy and operations management, originated in Japan. Direct competition between Japanese and U.S. companies has led many U.S. companies to adopt these Japanese management practices.

Increasing importance of the service sector: Prior to the 1970s, most innovations in management accounting techniques, and the most sophisticated management accounting systems, were found in manufacturing firms (although as discussed above, railroads played an important role in the early development of management accounting). As the service sector became a larger part of the overall economy, and as competitive pressures within service sector industries increased (in some cases brought about by deregulation), many service companies invested substantial resources in management accounting systems tailored to meet their needs. Service sector industries noted for significant developments in their management accounting systems include transportation, financial institutions, and health care. Customer costing (determining the cost of servicing an individual customer), and improving the timeliness of accounting information, are two issues of particular importance to many service sector companies.

Innovative Management Practices:

In addition to the four economic and technological trends described above, the following innovations in the fields of strategy and operations management have influenced management accounting systems and practices over the past several decades.

Total quality management (TQM): Quality programs go by several names, including TQM, zero defect programs, and six sigma programs. The focus on quality has had a significant impact on many organizations in all sectors of the economy, beginning with the automobile industry and some other industries in the manufacturing sector of the economy about forty years ago. Sophisticated quality programs are found today in many areas of government, education and other not-for-profit organizations as well as in for-profit businesses.

The impetus for TQM programs is the assessment that the cost of defects is greater than the cost of implementing the TQM program. Advocates of TQM claim that some costs of defects have been underestimated historically, particularly the loss of customer goodwill and future sales when a defective unit is sold. Some advocates of quality programs believe that the most cost-effective approach to quality is to eliminate all defects at the point at which they occur. If successful, these “zero defect” programs would not only result in higher levels of customer satisfaction, but would also eliminate costs associated with more conventional quality control procedures, such as inspection costs that occur at the end of the production line, the cost of reworking units identified as defective, and costs associated with processing customer returns. The focus is on preventive controls to prevent the defect from occurring in the first place, as opposed to detective controls to identify and correct the defect after it has occurred.

Just-in-time (JIT): During the last two decades of the 20th century, many companies implemented just-in-time programs designed to minimize the amount of inventory on hand. These companies identified significant benefits from reducing all types of inventories—raw materials, work-in-process, and finished goods—to the lowest possible levels. These benefits consist principally of reduced inventory holding costs (such as financing and warehousing costs), reduced losses due to inventory obsolescence, and more effective quality control.

The relationship between JIT and TQM is important. Many defects in raw materials or the production process can be ignored indefinitely if high-quality materials can be substituted for defective materials, and if additional first-quality units can be produced to replace defective units. In a non-JIT environment, defective materials and half-finished units might be set aside in a corner of the factory. However, under a JIT program, if raw materials received at the factory are defective, there might be no first-quality materials on hand to substitute for the defective materials. In extreme cases, the production line might be shut down until first-quality materials are received. Hence, a JIT program can focus attention on quality control in ways not generally possible in a non-JIT environment.

The challenge in a JIT environment is to avoid stock-outs. To meet this challenge, some companies have found ways to decrease production lead times. Shorter production schedules result in less work-in-process inventory, and also allows companies to maintain lower levels of finished goods inventory while still maintaining high levels of customer satisfaction.

Early in the 21st century, acts of terrorism (such as the destruction of the World Trade Center in New York City) and natural disasters (such as Hurricane Katrina) prompted some companies to rethink the practice of maintaining extremely low levels of inventories. These companies are concerned that future incidents could result in the disruption of inventory pipelines, particularly for imported materials. Consequently, the advantage of maintaining safety stocks of inventory is receiving renewed interest.

Theory of constraints: The theory of constraints is an operations management technique that decreases inventory levels and increase throughput in a manufacturing setting. Eliyahu Goldratt, a business consultant, is largely responsible for the development of the theory of constraints. Goldratt popularized his ideas in a business novel that he coauthored with Jeff Cox called *The Goal: A Process of Ongoing Improvement*. The basis of the theory is to identify bottlenecks in the production process, and to focus all efforts on increasing the capacity of the bottleneck operations. Typically, bottleneck operations are easy to identify, because large amounts of inventory back up at these operations waiting to be processed. The theory of constraints also advocates setting the speed of the entire production process at the speed of the bottleneck operation, because otherwise excess work-in-process will inevitably build up. This “pull” system should replace traditional “push” systems, where every operation processes inventory at its maximum capacity.

Like most new ideas, the theory of constraints has a basis in earlier techniques and ideas. As early as the 1970s or 1980s, engineers and production managers used a tool called critical path analysis to predict the time required to accomplish major new objectives, such as introducing a new product or bringing a new facility on line. Critical path analysis involved identifying the sequence in which various steps were required, and identifying at what point, and for how long, the entire project would depend on the completion of any particular step.

Lean production and the lean enterprise: In recent years, the term "lean" has been adopted by some organizations to describe the organization's comprehensive effort to apply state-of-the-art management practices to improve quality and customer satisfaction, reduce costs and production lead-times, and increase value-creation. "Lean" is an umbrella term that includes such techniques as JIT and TQM as component elements. Some accountants credit Toyota as the originator of lean production. The term "lean" was originally applied to manufacturing settings, such as in the phrases "lean production" or "lean manufacturing." But the term is now used more broadly, and sometimes describes lean initiatives in the distribution and support functions of a manufacturing company, lean initiatives in service-sector companies, and even initiatives in other types of organizations such as governmental entities. The term "**lean accounting**" has been coined to describe accounting systems that either support lean production, or that are, themselves, "lean."

PART 2

MICROECONOMIC FOUNDATIONS
OF
MANAGEMENT ACCOUNTING

> The beginning of wisdom in using accounting for decision-making is a clear understanding that the relevant costs and revenues are those which as between the alternatives being considered are expected to be different in the future. It has taken accountants a long time to grasp this essential point.
>
> - R. H. Parker (1969, 15)
> *Management Accounting: An Historical Perspective*

CHAPTER 3: Relevant Cost Analysis

Chapter Contents:

Overview:

Management accounting uses the following terms from economics:

Costs: Resources sacrificed to achieve a specific objective, such as manufacturing a particular product, or providing a client a particular service.

Sunk costs: These are costs that were incurred in the past. Sunk costs are irrelevant for decisions, because they cannot be changed.

Opportunity cost: The profit foregone by selecting one alternative over another. It is the net return that could be realized if a resource were put to its next best use. It is "what we give up" from "the road not taken."

Relevant costs: These are costs that are relevant with respect to a particular decision. A relevant cost for a particular decision is one that changes if an alternative course of action is taken. Relevant costs are also called **differential costs**.

The following discussion elaborates on these definitions:

Costs:

Costs are different from expenses. Costs are resources sacrificed to achieve an objective. **Expenses** are the costs charged against revenue in a particular accounting period. Hence, "cost" is an economic concept, while "expense" is a term that falls within the domain of accounting. Profit is calculated as revenues minus expenses, and hence, profit is generally a function of various accounting conventions and choices. Profits can be calculated for the organization as a whole, or for a part of the organization such as a division, product line, or individual product.

Costs can be classified along the following functional dimensions:

1. The **value chain**. The value chain is the chronological sequence of activities that adds value in a company. For example, for a manufacturing firm, the value chain might consist of research & development, design, manufacturing, marketing and distribution.

2. Division or business segment: e.g., Chevrolet, Oldsmobile, G.M.C.

3. Geographic location.

Classification of costs according to the value chain is particularly important for financial reporting purposes, because for external reporting, only manufacturing costs are included in the valuation of inventory on the balance sheet. Non-manufacturing costs are treated as period expenses. To some extent, traditional management accounting systems have been influenced by external reporting requirements, and consequently, costing systems usually reflect this distinction between manufacturing and non-manufacturing costs.

Sunk Costs:

Sunk costs are costs that were incurred in the past. **Committed costs** are costs that will occur in the future, but that cannot be changed. As a practical matter, sunk costs and committed costs are equivalent with respect to their decision-relevance; neither is relevant with respect to any decision, because neither can be changed. Sometimes, accountants use the term "sunk costs" to encompass committed costs as well.

Experiments have been conducted that identify situations in which individuals, including professional managers, incorporate sunk costs in their decisions. One common example from business is that a manager will often continue to support a project that the manager initiated, long after any objective examination of the project seems to indicate that the best course of action is to abandon it. A possible explanation for why managers exhibit this behavior is that there may be negative repercussions to poor decisions, and the manager might prefer to attempt to make the project *look* successful, than to admit to a mistake.

Some of us seem inclined to consider sunk costs in many personal situations, even though economic theory is clear that it is irrational to do so. For example, if you have purchased a nonrefundable ticket to a concert, and you are feeling ill, you might attend the concert anyway because you do not want the ticket to go to waste. However, the money spent to buy the ticket is sunk, and the cost of the ticket is entirely irrelevant, whether it cost $5 or $100. The only relevant consideration is whether you would derive more pleasure from attending the concert or staying home on the evening of the concert.

Here is another example. Consider a student who is between her junior and senior year in college, deciding whether to complete her degree. From a financial point of view (ignoring nonfinancial factors) her situation is as follows. She has paid for three years of tuition. She can pay for one more year of tuition and earn her degree, or she can drop out of school. If her market value is greater with the degree than without the degree, then her decision should depend on the cost of tuition for next year and the opportunity cost of lost earnings related to one more year of school, on the one hand; and the increased earnings throughout her career that are made possible by having a college degree, on the other hand. In making this comparison, the tuition paid for her first three years is a sunk cost, and it is entirely irrelevant to her decision. In fact, consider three individuals who all face this same decision, but one paid $24,000 for three years of in-state tuition, one paid

$48,000 for out-of-state tuition, and one paid nothing because she had a scholarship for three years. Now assume that the student who paid out-of-state tuition qualifies for in-state tuition for her last year, and the student who had the three-year scholarship now must pay in-state tuition for her last year. Although these three students have paid significantly different amounts for three years of college ($0, $24,000 and $48,000), all of those expenditures are sunk and irrelevant, and they all face exactly the same decision with respect to whether to attend one more year to complete their degrees. It would be wrong to reason that the student who paid $48,000 should be more likely to stay and finish, than the student who had the scholarship.

Opportunity Cost:

As noted above, opportunity cost is the profit foregone by selecting one alternative over another. Opportunity costs are relevant for many decisions, but are sometimes difficult to identify and quantify, and are seldom recorded in an organization's accounting system.

A common and very important type of opportunity cost that arises in all sectors of the economy is the opportunity cost associated with the limited capacity of an asset. The asset might be a tangible asset such as a machine or a factory, or it might be an intangible asset that may or may not be recorded in the accounting records, such as human capital. For example, in a given period of time such as a day or month, a machine can run only so many hours, a factory can produce only so many units, and an employee can work only so many hours. The appropriate way to analyze a decision of whether to accept a new client or sales order, or to produce a new type of product, depends fundamentally on whether the organization has the capacity to service the new client, fill the sales order, or make the new product, without displacing existing customers, orders or products. If the new client, sales order, or product can be accommodated without displacing existing clients, orders or products, the organization is described as having sufficient ***excess capacity***, whereas if the new client, sales order or product will displace existing clients, orders or products, the organization is described as having a ***capacity constraint***. If the organization has a capacity constraint, then the decision of whether to accept the new client or order, or produce the new product, should consider the opportunity cost of clients, orders or products that will be displaced. If the organization has excess capacity, the decision is typically simpler: there is no opportunity cost arising from a capacity constraint, so the appropriate decision depends only on the marginal costs and revenues from the new client, order or product.

The term opportunity cost is sometimes ambiguous in the following sense. Sometimes it is used to refer to the profit foregone from the next best alternative, and sometimes it is used to refer to the *difference* between the profit from the action taken and the profit foregone from the next best alternative.

Example: Tina has $5,000 to invest. She can invest the $5,000 in a certificate of deposit that earns 5% annually, for a first-year return of $250. Alternatively, she can pay off an auto loan on her car, which carries an interest rate of 7%. If she pays off the auto loan, she will save $350 (7% of $5,000) in interest expense. (In this context, a dollar saved is as good as a dollar earned.)

Question: What is Tina's opportunity cost from investing in the certificate of deposit?

Answer: The opportunity cost is the "profit foregone" from the best action not taken. The *payoff* from the action not taken is clear: it is the $350 in interest expense avoided by paying off the loan. However, there is some ambiguity as to whether the opportunity cost is this $350, or the *difference* between the $350, and the $250 that would be earned on the certificate of deposit, which is $100.

This ambiguity is only a question of semantics with respect to the definition of opportunity cost; it does not create any ambiguity with respect to the information provided by the concept of opportunity cost. Clearly, the opportunity cost of paying off the auto loan implies that Tina is better off paying off the loan than investing in the certificate of deposit.

When opportunity cost is defined in terms of the difference between the two profits (the $100 in the above example), then the opportunity cost can be either positive or negative, and a negative opportunity cost implies that the action taken is better than all alternatives.

Relevant Costs:

Relevant costs are costs that change with respect to a particular decision. Sunk costs are never relevant. Future costs may or may not be relevant. If the future costs are going to be incurred regardless of the decision that is made, those costs are not relevant. Committed costs are future costs that are not relevant. Even if the future costs are not committed, if we anticipate incurring those costs regardless of the decision that we make, those costs are not relevant. The only costs that are relevant are those that differ as between the alternatives being considered.

Including sunk costs in a decision can lead to a poor choice. However, including future irrelevant costs generally will not lead to a poor choice; it will only complicate the analysis. For example, if I am deciding whether to buy a Toyota Camry or a Subaru Legacy, and if my auto insurance will be the same no matter which car I buy, my consideration of insurance costs will not affect my decision, although it will add a few numbers to my analysis.

Microeconomic Analysis and the Matching Principle:

The matching principle (matching expenses with the associated revenues) provides useful information, if properly interpreted. However, there are ways in which the matching principle can obscure relevant costs. For example, to honor the matching principle, companies capitalize assets and depreciate them over their useful lives. In manufacturing companies, depreciation expense in any one year for assets used in production is allocated yet again, to individual products made during the period. The result is that the cost of each unit of product includes depreciation expense that represents the allocation of a cost that was probably incurred years ago. However, except for any tax implications that arise because depreciation expense reduces taxable income, depreciation expense should be ignored with respect to all decisions.

Exercises and Problems:

Discussion Question 3-1:
Part A: You are a big fan of rock musician David Bowie. (There's no accounting for taste.) You decide to spend $200 for you and your friend to go to an upcoming David Bowie concert, and you buy a pair of tickets. On your way to the concert, you realize that you have lost the tickets! At first, you panic. Then you realize that, most likely, your little sister put the tickets down the kitchen disposal the other day when she was mad at you. Anyhow, she put something down the disposal, and seemed to derive great satisfaction from it. You make a mental note to kidnap her beanie baby collection. In the meantime, at the box office, you learn that seats are still available, and you can buy new tickets that are comparable to the ones you lost, for $200. Evaluate the logic, in terms of the relevant cost concepts of incremental cost, sunk cost and/or opportunity cost, with respect to each of the following responses to the question of "What should you do?"

A. You should forego the concert, because although the concert was worth $200 to attend, it's not worth $400 to attend.

B. You should buy the tickets, even though you never would have spent $400 to attend, because at this point, the incremental cost is only $200.

C. You should buy the tickets, even though you never would have spent $400 to attend, because at this point, if you don't, your friend will be very disappointed in you.

Part B: You decide that it is not worth another $200 to attend the concert, and you and your friend decide to go bowling. On the way out of the lobby, a wealthy and happy-looking couple whom you have never seen before confront you, tell you they have decided to fly to Paris tonight, and ask if you want their tickets. You say "yes," of course, and "thank you." A bystander standing in line to buy tickets sees this happening, and offers to buy the tickets from you for $200. Evaluate the logic, in terms of relevant cost concepts, with respect to each of the following responses to the question of "What should you do now?"

A. You should attend the concert, since you are now in exactly the same situation you were in when you were driving to the concert and thought you had the original tickets.

B. You should sell the tickets for $200, since you had already decided, only a few minutes ago, that you didn't want to spend another $200 to buy the tickets.

3-2: Assume that last semester you bought a textbook new for $77. Today, the same book sells new for $100, and used copies in the bookstore now sell for $75. The bookstore offers to buy back your book for $45. You would like to sell your book, and a student who will be taking the course next semester wants to buy your book directly from you. At what range of prices should a sale take place between you and the other student?

3-3: Roulex has 500 watches that cost $15 each to manufacture. The watches are out of fashion and cannot be sold as is. They can be refitted at a cost of $4 per watch, and then sold for $18 each. Alternatively, the watches can be donated to charity for a net financial benefit (i.e., a reduction in the company's tax liability) of 20% of the original production cost.

A) Identify a sunk cost in the scenario described above.

B) What should the company do?

C) Quantify the opportunity cost associated with the course of action you recommended above.

3-4: The Uris Deli purchased a machine for $67,000. Current accumulated depreciation on the machine is $33,000. Management is thinking about buying a new machine at a cost of $85,000. The disposal of the old machine would cost $21,000. Which of the following choices most accurately describes which costs are sunk and which costs are relevant?

(A) Sunk costs consist of the $67,000 purchase price of the old machine, and the $33,000 accumulated depreciation on the old machine. Relevant costs consist of the $85,000 purchase price of the new machine, and the $21,000 disposal cost of the old machine.

(B) Sunk costs consist of the $67,000 purchase price of the old machine. Relevant costs consist of the $85,000 purchase price of the new machine.

(C) Sunk costs consist of the $67,000 purchase price of the old machine. Relevant costs consist of the $85,000 purchase price of the new machine, and the $21,000 disposal cost of the old machine.

(D) Sunk costs consist of the $67,000 purchase price of the old machine, and the $34,000 book value of the old machine. Relevant costs consist of the $85,000 purchase price of the new machine, and the $21,000 disposal cost of the old machine.

3-5: The year is 2001. Arthur Andersen has ordered some custom-made furniture from Lane Furniture Company. Lane recently completed manufacturing ten executive desks that had the Arthur Andersen logo carved into the front and sides of the desk. Lane's manufacturing costs were $2,000 per desk, which consist of $400 in materials, $600 in labor, and $1,000 of other manufacturing-related costs. Arthur Andersen had agreed to pay $3,000 per desk, but has now informed Lane that it can no longer honor the agreement. Lane's options are as follows. Lane can rework the desks, removing the Arthur Andersen logo at a labor cost of $750 per desk, and sell each desk for $1,500. Alternatively, Lane can sell each desk, as is, to collectors, for $800.

Should Lane (1) rework the desks and sell them; (2) sell them with the logo to collectors; or (3) not sell the desks at all?

3-6: Smith Company makes widgets. Newman Company has approached Smith with a proposal to sell the company one of the components used to make widgets at a price of $100,000 for 50,000 units. Smith is currently making these components in its own factory. The following costs are associated with this part of the process when 50,000 units are produced:

Materials used to make the widgets	$44,000
Labor incurred to make the widgets	20,000
Other manufacturing costs	60,000
Total	$124,000

The category "other manufacturing costs" includes $28,000 of costs that will be eliminated if the components are no longer produced by Smith. The remaining costs in this category will continue to be incurred, whether or not Smith makes the components.

Required: How much better off or worse off will Smith be, if Smith buys the components from Newman, versus continuing to make the components in-house? Should Smith make the components or buy them from Newman?

3-7: SunFun makes beach equipment, including frisbees. The cost to make each frisbee (assuming 100,000 are produced each year) is as follows: materials of $0.50 per unit; labor of $0.10 per unit, variable overhead (such as factory electricity) of $0.15 per unit, and allocated fixed overhead of $0.25 per unit (an allocation of costs such as factory rent and insurance). An Australian company approaches SunFun for a large order in February (typically a slow month) and offers to buy 10,000 frisbees for $0.90 each. Regular sales would not be affected and capacity is available to produce them. Total fixed costs will be unaffected. The normal selling price is $1.25 each. What will be the effect on profits from accepting the order?

3-8: The Jennie Mae Frog Farm incurs production costs of $2 each time a frog is produced. In addition, the farm spends a lump-sum $5,000 each month for expenditures such as insurance, property taxes, and equipment leases, regardless of how many frogs are produced. Times are good: Jennie Mae is operating at capacity, and she is producing and selling 1,000 frogs per month. Jennie Mae's usual sales price is $9 per frog. The U.S. Army has approached Jennie Mae and proposed a one-time purchase of 300 frogs.

A) What is the lowest price Jennie Mae should be willing to charge the Army per frog?

B) Disregard your answer to part (A) and assume the Army offers to pay $6 per frog. What is the opportunity cost associated with each frog sold to the Army at this price?

C) Now assume that times are not so good, and Jennie Mae has excess capacity to make 500 frogs. The Army offers to buy 300 frogs at $6 each. What is the opportunity cost associated with each frog sold to the Army at this price?

3-9: Refer to the previous question. Now assume that the market for frogs crashes, and Jennie Mae changes over to making platypuses. She has an aging inventory of frogs sufficient to meet market demand for ten months (300 frogs per month), but unfortunately, frogs only have a useful life of five months and her inventory becomes obsolete after that. What is the lowest price Jennie Mae should accept from the Army for a one-time-only purchase of 300 frogs?

3-10: Joe can stock his cooler with beer, soda or juice, and sell everything in it at the beach on a hot Saturday in June. The beer costs $1 per bottle, and he can sell beer for $2 per bottle. The soda costs $0.25 per can, and he can sell soda for $1.50 per can. The juice costs $1.25 per carton, and he can sell each carton for $1.75. The cooler has a capacity of 12 cubic feet. Each cubic foot can hold 16 juice cartons, six soda cans, or eight bottles of beer. What should Joe do in order to maximize his profits?

3-11: Refer to the previous question. Now assume that Joe has to pay for parking and for a vendor's license. How will these lump-sum costs, which do not depend on how Joe stocks his cooler, affect your answer to the previous question?

CHAPTER 4: Cost Behavior

Chapter Contents:

- Introduction
- Variable costs
- Fixed costs
- Relevant range
- Mixed costs
- Cost behavior assumptions in management accounting versus microeconomics
- Exercises and problems

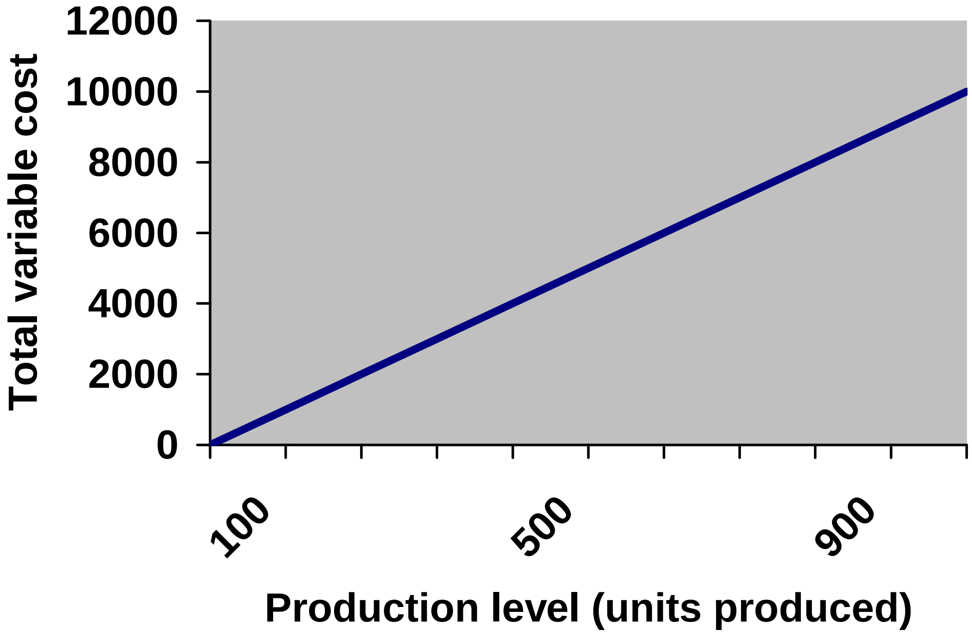
Introduction:

The most important building block of both microeconomic analysis and cost accounting is the characterization of how costs change as output volume changes. Output volume can refer to production, sales, or any other principle activity that is appropriate for the organization under consideration (e.g.: for a school, number of students enrolled; for a health clinic, number of patient visits; for an airline, number of passenger miles). The following discussion examines the volume of production in a factory, but the same principles apply regardless of the type of organization and the appropriate measure of activity.

Costs can be variable, fixed, or mixed.

Variable Costs:

Variable costs vary in a linear fashion with the production level. However, when stated on a per unit basis, variable costs remain constant across all production levels within the **relevant range**. The following two charts depict this relationship between variable costs and output volume.



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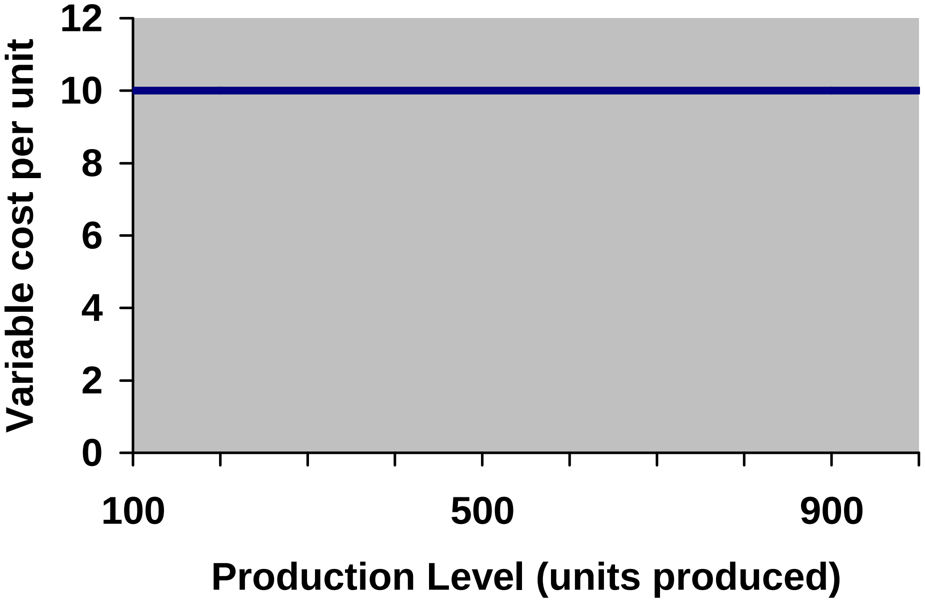
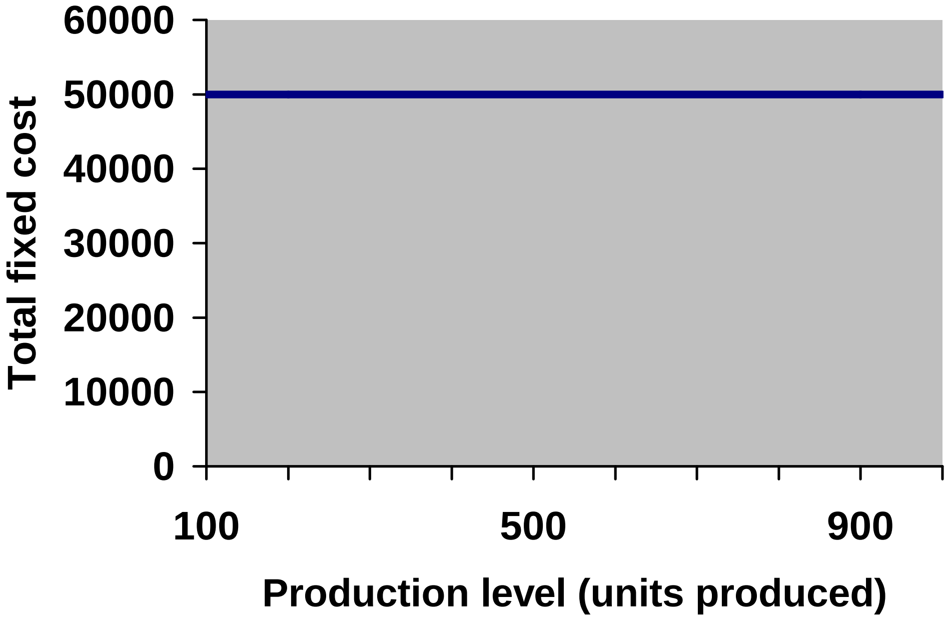
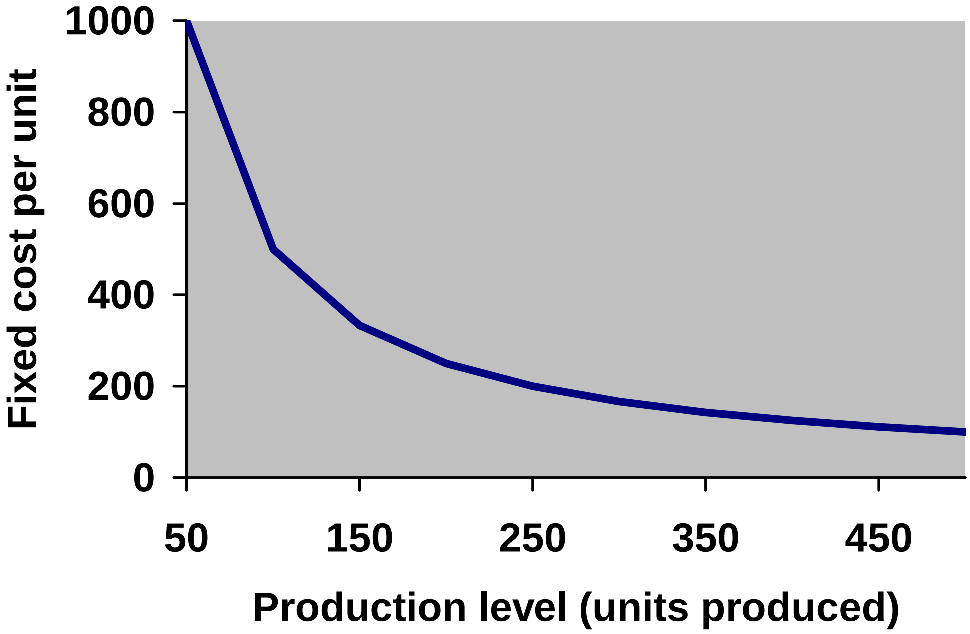


A good example of a variable cost is materials. If one pair of pants requires $10 of fabric, then every pair of pants requires $10 of fabric, no matter how many pairs are made. The fabric cost is $10 ***per unit*** at every level of production. If one pair is made, the total fabric cost is $10; if two pairs are made, the total fabric cost is $20; and if 1,000 pairs are made, the total fabric cost is $10,000. Hence, the ***total cost*** is increasing and linear in the production level.

Fixed Costs:

Fixed costs do not vary with the production level. Total fixed costs remain the same, within the **relevant range**. However, the fixed cost per unit decreases as production increases, because the same fixed costs are spread over more units. The following two charts depict this relationship between fixed costs and output volume.





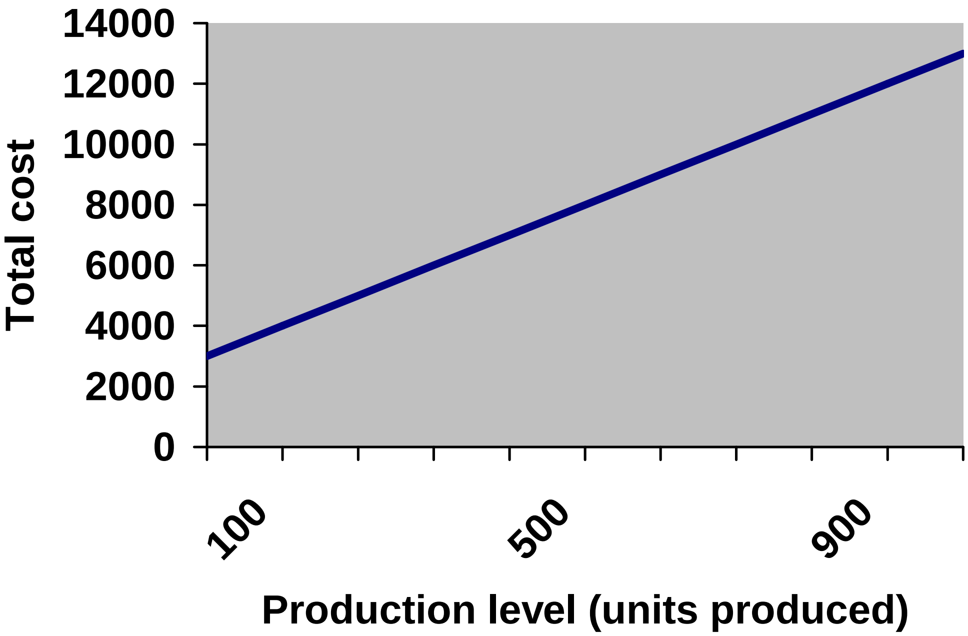
In this example, fixed costs are $50,000. The first chart shows that fixed costs remain $50,000 at all production levels from 100 units to 1,000 units. The second chart shows that the fixed cost per unit decreases as production increases. Hence, when 100 units are manufactured, the fixed cost per unit is $500 ($50,000 ÷ 100). When 500 units are manufactured, the fixed cost per unit is $100 ($50,000 ÷ 500).

Relevant Range:

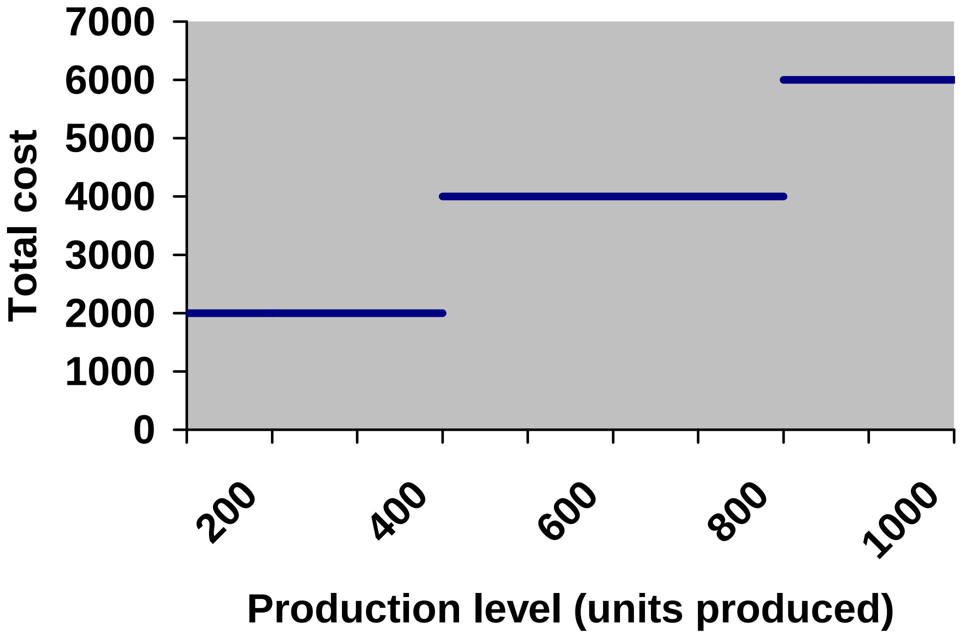
The **relevant range** is the range of activity (e.g., production or sales) over which these relationships are valid. For example, if the factory is operating at capacity, increasing production requires additional investment in fixed costs to expand the facility or to lease or build another factory. Alternatively, production might be reduced below a threshold at which point one of the company's factories is no longer needed, and the fixed costs associated with that factory can be avoided. With respect to variable costs, the company might qualify for a volume discount on fabric purchases above some production level. The relevant range for characterizing fabric as a variable cost ends at that production level, because the fabric cost per unit of output is different when the factory produces above that threshold than when the factory produces below that threshold.

Mixed Costs:

If, within a relevant range, a cost is neither fixed nor variable, it is called **semi-variable** or **mixed**. Following are two common examples of mixed costs.



In this example, although the total cost line increases in production, it does not pass through the origin because there is a fixed cost component. An example of a cost that fits this description is electricity. A fixed amount of electricity is required to run the factory air conditioning, computers and lights. There is also a variable cost component related to running the machines on the factory floor. The fixed component in this example is $3,000 per month. The variable cost component is $10 per unit of output. Hence, at a production level of 500 units, the total electric cost is $8,000 [$3,000 + ($10 x 500)].



The mixed cost illustrated in the above chart is called a step function. An example of such cost behavior would be the total salary expense for shift supervisors. If the factory runs one shift, only one shift supervisor is required. In order for the factory to produce above the maximum capacity of a single shift, the factory must add a second shift and hire a second shift supervisor, so that total shift supervisor salary expense doubles. If the factory runs three shifts, three shift supervisors are required.

Cost Behavior Assumptions in Management Accounting Versus Microeconomics: Microeconomic analysis usually assumes decreasing marginal costs of production, sometimes followed by increasing marginal costs of production beyond a certain production level. Hence, economists' graphs of the total cost of production and the average per-unit cost of production show smooth, curved functions. Management accountants usually assume the linear relationships depicted in the previous graphs. Linearity is a more accurate description of many situations encountered by management accountants than the economists' curves, and even when linearity constitutes a simplifying assumption it is almost always sufficiently descriptive for the task at hand.

Exercises and Problems

Discussion Question 4-1: A leading management accounting textbook (*Cost Accounting: A Managerial Emphasis*, by Horngren, Datar and Foster, 12th edition) provides the following table (Exhibit 2-5 in that textbook) providing examples of cost classifications:

	Direct Costs	**Indirect Costs**
Variable Costs:	Cost object: BMW X5s produced Example: Tires used in assembly of automobile	Cost object: BMW X5's produced Example: Power costs at Spartanburg plant. Power usage is metered only to the plant, where multiple products are assembled.
Fixed Costs:	Cost object: BMW X5s produced Example: Salary of supervisor on BMW X5 assembly line	Cost object: BMW X5s produced Example: Annual lease costs at Spartanburg plant. Lease is for whole plant, where multiple products are produced.

Required: Evaluate whether the cost object is identical in each of the four boxes.

4-2:

A) If a company makes 100 units of product, the allocated fixed cost per unit is $5 and the variable cost per unit is $6. What will be the per-unit total cost (fixed plus variable cost) if the company makes 200 units?

B) At a production and sales level of 1,000 units, the company's costs are as follows:

Variable manufacturing costs per unit	$20
Allocated fixed manufacturing cost per unit	$10
Variable selling costs per unit	$ 5
Allocated fixed selling costs per unit	$ 3

How much would the company have to spend in total (total cash outlay for both fixed and variable costs), if it makes 1,200 units and sells 200 units (so that 1,000 units are in ending inventory at the end of the period)?

4-3: Describe each of the following costs as either fixed, variable, or semi-variable (i.e., mixed)

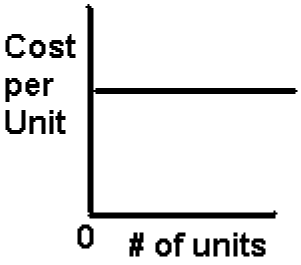
A) The cost is $500 per unit at a production level of 50 units, and $500 per unit at a production level of 100 units.

B) The cost is $500 in total at a production level of 50 units, and $1,000 in total at a production level of 100 units.

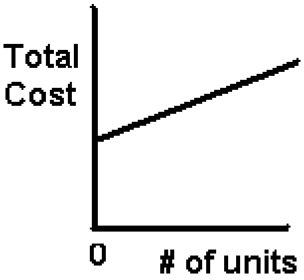
C) The cost is $500 in total at a production level of 5 units, and $100 per unit at a production level of 10 units.

4-4: If a company makes 100 units of product, the fixed cost per unit is $5 and the variable cost per unit is $6. How much will the company have to spend in total to make 200 units?

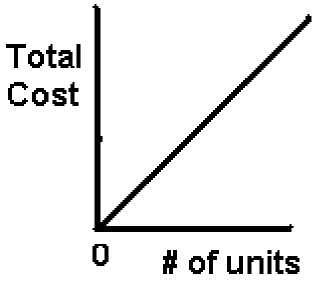
4-5: Identify the following cost as either fixed, variable or mixed (semi-variable). The horizontal axis refers to the number of units produced. The vertical axis refers to the cost per unit at that level of production.



4-6: Identify the following cost as either fixed, variable or mixed (semi-variable). The horizontal axis refers to the number of units produced. The vertical axis refers to the total cost incurred for all of the units produced.



4-7: Identify the following cost as either fixed, variable or mixed (semi-variable). The horizontal axis refers to the number of units produced. The vertical axis refers to the total cost incurred for all of the units produced.



4-8: Turquoise Company manufactures widgets and other good stuff. When 12,000 widgets are produced, the total cost per widget is $40, calculated as follows:

Materials (a variable cost)	$10
Labor (another variable cost)	15
Variable overhead (yet another variable cost)	10
Fixed overhead (not a variable cost)	5

The company is considering buying its widgets, instead of making them (hence, the company would become a widget ***wholesaler***, but will still manufacture other good stuff). The company can buy widgets from another company for $42 per widget. If the company stops making widgets, total fixed costs will not change, although some of the facilities currently being used to make widgets can be rented out, resulting in $50,000 in rental income to the Turquoise Company. What would be the incremental cost or benefit to the Turquoise Company from becoming a widget wholesaler instead of a widget manufacturer?

4-9: A particular cost is $10,000 in total when 50 units are made.

A) Complete the following table, indicating what the cost would be if production is increased to 200 units:

	Cost per Unit	Cost in total
If this cost is a variable cost		
If this cost is a fixed cost		

B) Complete the following table, indicating what the cost would be if production is reduced to 20 units:

	Cost per Unit	Cost in total
If this cost is a variable cost		
If this cost is a fixed cost		

4-10: Describe in two or three (no more than four) complete, well-written sentences the difference between fixed costs and variable costs.

4-11: In general, and within the relevant range, as production increases:

(A) Per unit fixed costs and per unit variable costs both stay the same.

(B) Per unit variable costs go down, and per unit fixed costs stay the same.

(C) Per unit fixed costs go down, and per unit variable costs stay the same.

(D) Per unit fixed costs and total variable costs both stay the same.

4-12: A particular cost is a semi-variable (or mixed) cost, within a relevant range of 100 to 200 units of production. This cost is $1,000 in total when 100 units are manufactured (i.e., $10 per unit, when 100 units are manufactured). If production is doubled to 200 units, which of the following is the most likely amount incurred for this particular cost?

(A) $ 990

(B) $1,000

(C) $1,100

(D) $2,000

4-13: If production doubles, what will happen to variable costs?

(A) Total variable costs and the variable cost per unit will both double.

(B) Total variable costs will stay the same, and the variable cost per unit will decrease

(C) Total variable costs will stay the same, and the variable cost per unit will double.

(D) Total variable costs will double, and the variable cost per unit will stay the same.

4-14: At a production level of 200 units, total costs for the factory are $9,000, consisting of $8,000 in variable costs and $1,000 in fixed costs. Calculate total factory costs if production increases 25%.

4-15 (The Matching Principle and cost behavior): Assume that the Little Rock Company calculates income in the following manner: All manufacturing costs (variable and fixed) are treated as a cost of inventory, and the "matching principle" is honored for these costs, such that the cost to make inventory appears on the Income Statement as Cost of Goods Sold when the inventory is sold. All non-manufacturing costs are expensed (appear on the Income Statement) when incurred (i.e., the matching principle is not honored for these costs).

In 2003, the Little Rock Company incurred fixed manufacturing costs of $500,000 and fixed non-manufacturing costs of $300,000. The Company made 10,000 units and sold 5,000. Variable manufacturing cost was $150 per unit. Variable non-manufacturing cost was $30 for every unit sold (this was a sales commission). Revenue was $3,000,000.

Required: Calculate income for 2003.

CHAPTER 5: Cost-Volume-Profit

Chapter Contents:

The Basic Profit Equation:

Cost-Volume-Profit analysis (CVP) relates the firm's cost structure to sales volume and profitability. A formula that facilitates CVP analysis can be easily derived as follows:

Profit = Sales – Expenses

Profit = Sales – (Variable Costs + Fixed Costs)

Profit + Fixed Costs = Sales – Variable Costs

Profit + Fixed Costs = Units Sold x (Unit Sales Price – Unit Variable Cost)

This formula is henceforth called the **Basic Profit Equation** and is abbreviated:

P + FC = Q x (SP – VC)

Contribution margin is defined as

Sales – Variable Costs

The **unit contribution margin** is defined as

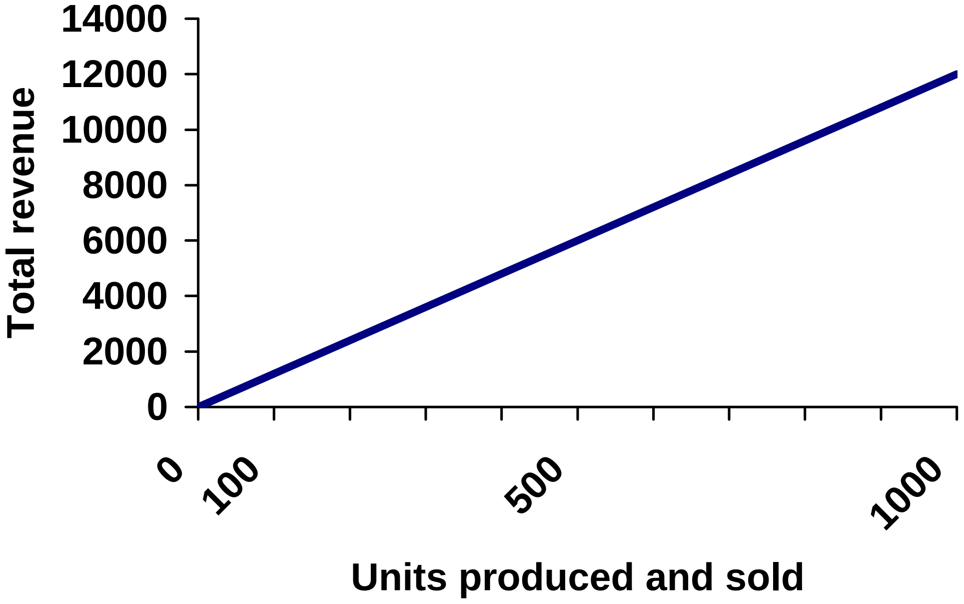
Unit Sales Price – Unit Variable Cost

Typically, the Basic Profit Equation is used to solve one equation in one unknown, where the unknown can be any of the elements of the equation. For example, given an understanding of the firm's cost structure and an estimate of sales volume for the coming period, the equation predicts profits for the period. As another example, given the firm's cost structure, the equation indicates the required sales volume **Q** to achieve a targeted level of profits **P**. If targeted profits are zero, the equation simplifies to

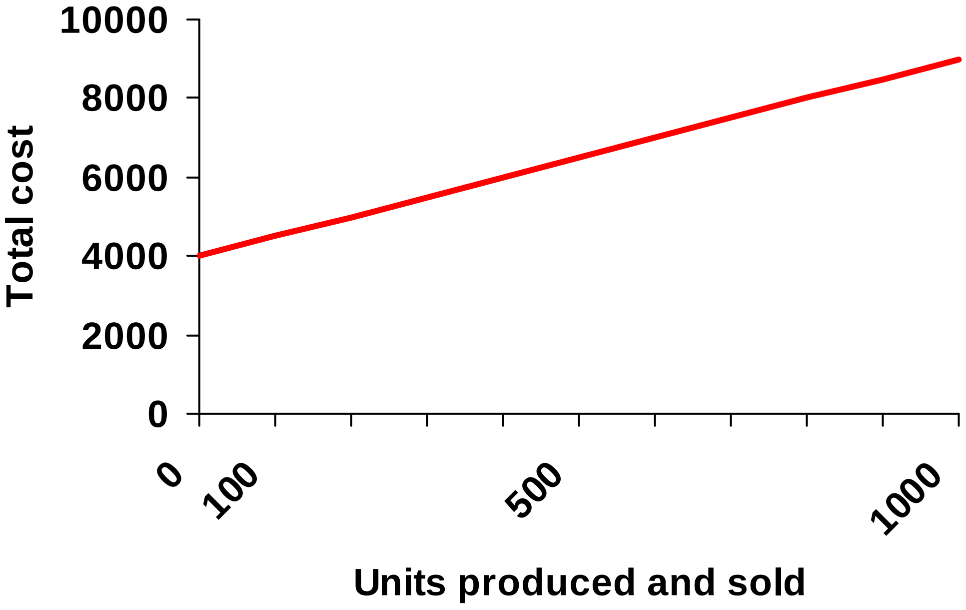
Q = FC ÷ Unit Contribution Margin

In this case, **Q** indicates the required sales volume to break even, and the exercise is called **breakeven analysis**.

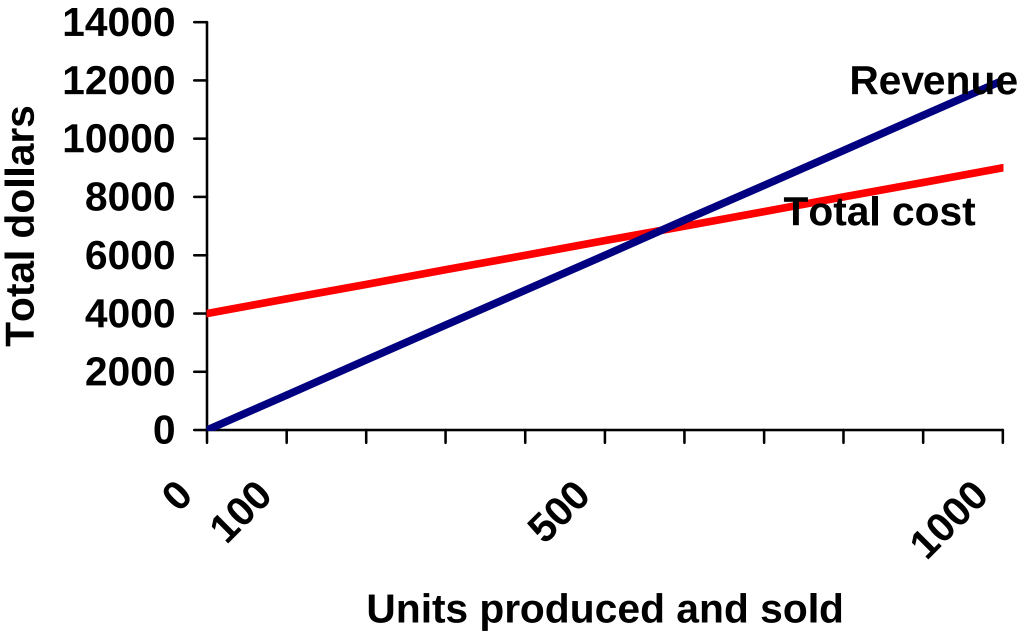
CPV analysis can be depicted graphically. The graph below shows total revenue (SP x Q) as a function of sales volume (Q), when the unit sales price (SP) is $12.



The following graph shows the total cost function when fixed costs (FC) are $4,000 and the variable cost per unit (VC) is $5.



The following graph combines the revenue and cost functions depicted in the previous two graphs into a single graph.



The intersection of the revenue line and the total cost line indicates the breakeven volume, which in this example, occurs between 571 and 572 units. To the left of this point, the company incurs a loss. To the right of this point, the company generates profits. The amount of profit or loss can be measured as the vertical distance between the revenue line and the total cost line.

Assumptions in CVP Analysis:

The Basic Profit Equation relies on a number of simplifying assumptions.

1. Only one product is sold. However, multiple products can be accommodated by using an average sales mix and restating **Q**, **SP** and **VC** in terms of a representative bundle of products. For example, a hot dog vendor might calculate that the "average" customer buys two hot dogs, one bag of chips, and two-thirds of a beverage. **Q** is the number of customers, and **SP** and **VC** refer to the sales price and variable cost for this "average" customer order.

2. If the equation is applied to a manufacturer, beginning inventory is assumed equal to zero, and production is assumed equal to sales. Relaxing these assumptions requires additional structure on the equation, including specifying an inventory flow assumption (e.g., FIFO or LIFO) and the extent to which the matching principle is honored for manufacturing costs.

3. The analysis is confined to the **relevant range**. In other words, fixed costs remain unchanged in total, and variable costs remain unchanged per unit, over the range of **Q** under consideration.

Target Costing:

A relatively recent innovation in product planning and design is called **target costing**. In the context of the Basic Profit Equation, target costing sets a goal for profits, and solves for the unit variable cost required to achieve those profits. The design and manufacturing engineers are then assigned the task of building the product for a unit cost not to exceed the target. This approach differs from a more traditional product design approach, in which design engineers (possibly with input from merchandisers) design innovative products, manufacturing engineers then determine how to make the products, cost accountants then determine the manufacturing costs, and finally, merchandisers and sales personnel set sales prices. Hence, setting the sales price comes last in the traditional approach, but it comes first in target costing.

Target costing is appropriate when **SP** and **Q** are predictable, but are not choice variables, such as might occur in well-established competitive markets. In such a setting, merchandisers might know the price that they want to charge for the product, and can probably estimate the sales volume that will be achieved at that price. Target costing has been used successfully by a number of companies including Toyota, which redesigned the Camry around the turn of the century as part of a target costing strategy.

Constrained Resources:

Contribution margin analysis plays an important role when a multi-product organization has a binding resource constraint. The resource constraint can take many forms, such as production throughput on a critical machine, freezer space, or skilled labor hours in a particular function. In the presence of a resource constraint, the optimal production decision is to maximize the contribution margin per unit of the constraint.

For example, assume that a company makes small widgets and large widgets. Small widgets incur $5 in variable manufacturing and non-manufacturing costs, and sell for $10. Large widgets incur $11 in variable manufacturing and non-manufacturing costs, and sell for $15. If production throughput is constrained by the capacity of a particular machine, and both small and large widgets require one hour of processing time on that machine, then the company should make only small widgets, because small widgets provide a contribution margin of $5 per unit, whereas large widgets provide a contribution margin of $4 per unit. On the other hand, if each small widget requires two hours of processing time on the machine, and large widgets require only one hour, then the company should make only large widgets, calculated as follows:

Small widgets: contribution margin per machine hour = ($10 – $5) ÷ 2 = $2.50 per hour

Large widgets: contribution margin per machine hour = ($15 – $11) ÷ 1 = $4.00 per hour

The company maximizes profits by making large widgets, even though large widgets have a lower contribution margin per unit than small widgets, because large widgets require less machine time and hence, are more efficient with respect to the limited resource. In other words, the large widgets generate a higher contribution margin per hour on the machine that constitutes the capacity constraint of the factory.

Leverage:

There is often a trade-off between fixed cost inputs and variable cost inputs. For example, in the manufacturing sector, a company can build its own factory (thereby operating with relatively high fixed costs but relatively low variable costs) or outsource production (operating with relatively low fixed costs but relatively high variable costs). A merchandising company can pay its sales force a flat salary (relatively higher fixed costs) or rely to some extent on sales commissions (relatively higher variable costs). A restaurant can purchase the equipment to launder table cloths and towels, or it can hire a laundry service.

A company that has relatively high fixed costs is more highly leveraged than a company with relatively high variable costs. Higher fixed costs result in greater downside risk: as **Q** falls below the breakeven point, the company loses money more quickly than a company with less leverage. On the other hand, the company's lower variable costs result in a higher unit contribution margin, which means that as **Q** rises above the breakeven point, the more highly-leveraged company is more profitable.

There is an ongoing trend for companies to outsource support functions and other "non-core" activities to third party suppliers and providers. Usually, outsourcing reduces the leverage of the company by eliminating the fixed costs associated with conducting those activities inside the firm. When the activities are outsourced, the contractual payments to the outsource providers usually contain a large variable cost component and a relatively small or no fixed cost component.

Examples:

Breakeven: Steve Poplack owns a service station in Walnut Creek. Steve is considering leasing a machine that will allow him to offer customers the mandatory California emissions test. Every car in the state must be tested every two years. The machine costs $6,000 per month to lease. The variable cost per test (i.e., per car inspected) is $10. The amount that Steve can charge each customer is set by state law, and is currently $40.

How many inspections would Steve have to perform monthly to break even from this part of his business?

Q = FC ÷ Unit Contribution Margin
Q = $6,000 ÷ ($40 – $10) = 200 inspections

Targeted profits, solving for volume: Refer to the information in the previous question. How many inspections would Steve have to perform monthly to generate a profit of $3,000 from this part of his business?

P + FC = Q x (SP – VC)
$3,000 + $6,000 = Q x ($40 – $10)
Q = 300 inspections

Targeted profits, solving for sales price: Alice Waters (age 9) runs a lemonade stand in the summer in Palo Alto, California. Her daily fixed costs are $20. Her variable costs are $2 per glass of ice-cold, refreshing, lemonade. Alice sells an average of 100 glasses per day. What price would Alice have to charge per glass, in order to generate profits of $200 per day?

P + FC = Q x (SP – VC)
$200 + $20 = 100 x (SP – $2)
SP = $4.20 per glass

Contribution margin: Refer to the previous question. What price would Alice have to charge per glass, in order to generate a total contribution margin of $200 per day?

Total CM = Q x (SP – VC)
$200 = 100 x (SP – $2.00)
SP = $4.00 per glass

Target costing: Refer to the information about Alice, but now assume that Alice wants to charge $3 per glass of lemonade, and at this price, Alice can sell 110 glasses of lemonade daily. Applying target costing, what would the variable cost per glass have to be, in order to generate profits of $200 per day?

P + FC = Q x (SP – VC)
$200 + $20 = 110 x ($3 – VC)
VC = $1

Exercises and Problems:

5-1: Sara, Sarah, Shara and Associates want to earn a total contribution margin of $10,000 on sales of 1,000 units. Their sales price is $15 per unit, and their fixed costs are $5,000. What variable cost per unit is necessary to achieve their goal?

5-2: George and Gracie both make the same product, and sell it for the same sales price. Gracie has a higher variable cost per unit than George. George has higher fixed costs than Gracie. Who has the higher breakeven point, in terms of number of units sold?

(A) Gracie has a higher breakeven point than George.

(B) George has a higher breakeven point than Gracie.

(C) Gracie and George have the same breakeven point.

(D) Impossible to ascertain, from the information given.

5-3: The Virginia Company has fixed costs of $100,000 per month, and variable costs of $30 per unit of output. The sales price is $50 per unit of output. How many units would the company have to sell per month, to generate profits of $30,000 per month?

5-4: The Charleston Company has fixed costs of $20,000 per month, and variable costs of $15 per unit of output. The company would like to earn profits of $4,000 per month. At a sales volume of 12,000 units per month, what sales price per unit would the company have to charge in order to achieve its targeted monthly profit?

5-5: The Delaware Company has fixed costs of $100,000 per year and variable costs of $10 per unit of output. The Pennsylvania Company has fixed costs of $120,000 per year and variable costs of $9 per unit of output. The sales price per unit is the same for both companies. Identify a sales price at which both companies will have the same break-even point in terms of number of units sold.

5-6: The Biloxi Company has the following cost structure: fixed costs of $70,000 per month and variable costs of $50 per unit. The Birmingham Company has the following cost structure: fixed costs of $60,000 per month and variable costs of $60 per unit. Both companies make the same product, which sells for $100 per unit. There is a sales level at which these two companies earn the same profits. What is that sales level? Which company is more profitable as sales volume exceeds this sales level?

5-7: Company X and Company Y sell the same product for the same price. Company X has fixed costs of $100 and variable costs of $10 per unit. Company Y has fixed costs of $200 and variable costs of $8. What is the unit sales price at which these companies will have the same break-even point in terms of unit sales?

5-8: Eliza sells flowers in Covent Garden. Her fixed costs are $50 per day. Her average sales price is $4 per flower. She is currently selling 400 flowers per day. Her current variable cost is $3 per flower. Eliza anticipates that her daily sales will increase to 500 flowers per day. How much could her variable cost per flower *increase* for her to still earn the same daily profits as before?

5-9: The following information is available for the publisher of "Frank the Cow Dog" Children's Books:

Variable cost:	$10.00 per book
Sales price:	$15.00 per book
Fixed costs:	$35,000 per year

These costs apply over a relevant range of the production of one book to the production of 40,000 books.

Required:

A) What is the contribution margin per unit?

B) What would operating income be at a sales level of 15,000 books?

C) What is the breakeven point in units?

D) Ignore the sales price of $15 per book. What would the sales price have to be for the publisher to earn operating income of $165,000 on sales of 25,000 books?

5-10: The Emerald Street Ice Cream Shop sells ice cream cones. The store's cost structure is as follows: fixed costs per month are $2,000. Variable costs are $1.50 for a single scoop cone and $1.75 for a double scoop cone.

Required:

A) If Emerald Street only sells double scoop cones, and sells them for $4.25 per cone, what is the break-even point in units?

B) If Emerald Street only sells single scoop cones, and charges $3.50 per cone, how many ice cream cones would Emerald Street have to sell to make a profit of $3,000 per month?

C) Assume that Emerald Street wants to sell only double scoop cones, and believes it can sell 8,000 cones per month at $4.25 per cone. What would the variable cost per cone have to be for Emerald Street to make a profit of $8,000 per month?

D) Ignore Part (C) and refer to the original information. If Emerald Street only sells single scoop cones, and sells 5,000 cones per month for $3.60 per cone, what is the contribution margin per unit?

5-11: Teddy Bear Fudge Company makes two types of fudge: plain fudge and fudge with nuts. Following is information about the company's cost structure when 1,000 pounds of fudge are produced. There is no direct labor.

	Overhead	**Plain Fudge**	**Fudge with Nuts**
Per unit information:			
Sales price per pound		$8.00	$8.00
Direct materials per pound		$2.00	$2.25
Sales commission per pound		$0.50	$0.50
Variable overhead	$500		
Fixed costs:			
Fixed manufacturing overhead	$2,000		
Fixed non-manufacturing overhead	$300		

Required: Assuming that variable overhead costs are linear in the quantity of production (i.e., pounds of fudge), and assuming that 50% of sales are plain fudge, and 50% of sales are fudge with nuts, calculate the breakeven point in pounds of fudge.

CHAPTER 6: Flexible Budgeting

Chapter Contents:

Introduction:

A budget is a plan for the future. Hence, budgets are planning tools, and they are usually prepared prior to the start of the period being budgeted. However, the comparison of the budget to actual results provides valuable information about performance. Therefore, budgets are both planning tools and performance evaluation tools.

Usually, the single most important input in the budget is some measure of anticipated output. For a factory, this measure of output is the number of units of each product produced. For a retailer, it might be the number of units of each product sold. For a hospital, it is the number of patient days (the number of patient admissions multiplied by the average length of stay).

The **static budget** is the budget that is based on this projected level of output, prior to the start of the period. In other words, the static budget is the "original" budget. The **static budget variance** is the difference between any line-item in this original budget and the corresponding line-item from the statement of actual results. Often, the line-item of most interest is the "bottom line": total cost of production for the factory and other cost centers; income for profit centers.

The **flexible budget** is a performance evaluation tool. It cannot be prepared before the end of the period. A flexible budget adjusts the static budget for the actual level of output. The flexible budget asks the question: *"If I had known at the beginning of the period what my output volume (units produced or units sold) would be, what would my budget have looked like?*" The motivation for the flexible budget is to compare apples to apples. If the factory actually produced 10,000 units, then management should compare actual factory costs for 10,000 units to what the factory should have spent to make 10,000 units, not to what the factory should have spent to make 9,000 units or 11,000 units or any other production level.

The **flexible budget variance** is the difference between any line-item in the flexible budget and the corresponding line-item from the statement of actual results.

The following steps are used to prepare a flexible budget:

1. Determine the budgeted variable cost per unit of output. Also determine the budgeted sales price per unit of output, if the entity to which the budget applies generates revenue (e.g., the retailer or the hospital).

2. Determine the budgeted level of fixed costs.

3. Determine the actual volume of output achieved (e.g., units produced for a factory, units sold for a retailer, patient days for a hospital).

4. Build the flexible budget based on the budgeted cost information from steps 1 and 2, and the actual volume of output from step 3.

Flexible budgets are prepared at the end of the period, when actual output is known. However, the same steps described above for creating the flexible budget can be used prior to the start of the period to anticipate costs and revenues for any projected level of output, where the projected level of output is incorporated at step 3. If these steps are applied to various anticipated levels of output, the analysis is called **pro forma** analysis. Pro forma analysis is useful for planning purposes. For example, if next year's sales are double this year's sales, what will be the company's cash, materials, and labor requirements in order to meet production needs?

Pro Forma Analysis at Guess Who Jeans:

Following are pro forma monthly income statements for Guess Who Jeans, a small, start-up fashion jeans manufacturer. The pro forma analysis was prepared at the beginning of the month and considered three alternative sales levels. The company has no variable marketing costs.

GUESS WHO JEANS
PRO FORMA ANALYSIS
FOR THE UPCOMING MONTH

Income Statement line-item	**Budgeted amount per unit**	**Pro Forma Analysis for Alternative Output Levels**		
		10,000 units	**20,000 units**	**30,000 units**
Revenue	$40	$400,000	$800,000	$1,200,000
Variable costs:				
Materials	15	150,000	300,000	450,000
Labor	10	100,000	200,000	300,000
Overhead	5	50,000	100,000	150,000
Total	30	300,000	600,000	900,000
Contribution margin	$10	100,000	200,000	300,000
Fixed costs:				
Manufacturing Overhead		100,000	100,000	100,000
Marketing costs		50,000	50,000	50,000
Total fixed costs		150,000	150,000	150,000
Operating income		($50,000)	$50,000	$150,000

Since by definition, fixed costs are not expected to change as volume of output changes within the relevant range, fixed costs remain the same at all three projected levels of output. Revenue and variable costs vary with output in a linear fashion. Hence, when output increases 100% from 10,000 units to 20,000 units, revenue, each line-item for variable costs, and contribution margin all increase 100%.

Static Budget Variance at Guess Who Jeans:

Guess Who management decides that 10,000 units is the most likely output volume, and sets the static budget based on this sales and production level. After the end of the month, company personnel prepare the following table, showing the static budget, actual results, and the static budget variance.

GUESS WHO JEANS
STATIC BUDGET VARIANCE
FOR THE MONTH JUST ENDED

Income Statement line-item	Budgeted amount per unit	Static Budget (A) 10,000 units	Actual Results (B) 16,000 units	Static Budget Variance (A) – (B)
Revenue	$40	$400,000	$670,000	$270,000
Variable costs:				
Materials	15	150,000	230,000	(80,000)
Labor	10	100,000	167,000	(67,000)
Overhead	5	50,000	84,000	(34,000)
Total	30	300,000	481,000	(181,000)
Contribution margin	$10	100,000	189,000	89,000
Fixed costs:				
Manufacturing Overhead		100,000	105,000	(5,000)
Marketing costs		50,000	49,000	1,000
Total fixed costs		150,000	154,000	(4,000)
Operating income		($50,000)	$35,000	$85,000

In the variance column, positive numbers are favorable variances (good news), and negative numbers are unfavorable (bad news).

The static budget variance shows a large favorable variance for revenue, and large unfavorable variances for variable costs. These large variances are due primarily to the fact that the static budget was built on an output level of 10,000 units, while the company actually made and sold 16,000 units. The revenue variance might also be due to an average unit sales price that differed from budget. The variable cost variances might also be due to input prices that differed from budget (e.g., the price of fabric), or input quantities that differed from the per-unit budgeted amounts (e.g., yards of fabric per pair of pants).

There are also small variances for fixed costs. These costs should not vary with the level of output (at least within the relevant range). However, many factors can cause actual fixed costs to differ from budgeted fixed costs that are unrelated to output volume. For example, property tax rates and the fixed salaries of front office personnel can change, and depreciation expense can change if unexpected capital acquisitions or dispositions occur.

The Flexible Budget Variance at Guess Who Jeans:

In order to better understand the causes of the large revenue and variable cost variances in the static budget variance column, Guess Who personnel prepare the following flexible budget.

GUESS WHO JEANS
FLEXIBLE BUDGET VARIANCE
FOR THE MONTH JUST ENDED

Income Statement line-item	Budgeted amount per unit	Flexible Budget (A) 16,000 units	Actual Results (B) 16,000 units	Flexible Budget Variance (A) – (B)
Revenue	$40	$640,000	$670,000	$30,000
Variable costs:				
Materials	15	240,000	230,000	10,000
Labor	10	160,000	167,000	(7,000)
Overhead	5	80,000	84,000	(4,000)
Total	30	480,000	481,000	(1,000)
Contribution margin	$10	160,000	189,000	29,000
Fixed costs:				
Manufacturing Overhead		100,000	105,000	(5,000)
Marketing costs		50,000	49,000	1,000
Total fixed costs		150,000	154,000	(4,000)
Operating income		$10,000	$35,000	$25,000

Once again, positive variances are favorable (good news), and negative variances are unfavorable (bad news).

From this table, Guess Who management sees that even after adjusting for sales volume, revenue was higher than would have been expected. The favorable $30,000 variance must be due entirely to an average sales price that was higher than planned (almost $42 per pair compared to the original budget of $40 per pair).

Materials costs were lower than would have been expected for a sales volume of 16,000 units. This favorable variance could be due to lower fabric prices, or to more efficient utilization of fabric (less waste than expected), or a combination of these two factors. Labor and overhead were higher than expected, even after adjusting for the sales volume of 16,000 units. This unfavorable flexible budget variance implies that either wage rates were higher than planned, or labor was not as efficient as planned, or both. Similarly, the components of variable overhead were either more expensive than budgeted, or were used more intensively than budgeted. For example, electric rates might have been higher than planned, or more electricity was used than planned per unit of output.

The fixed cost variances are identical in this table to the previous table. In other words, the flexible budget and flexible budget variance provide no additional information about fixed costs beyond what can be learned from the static budget variance.

Exercises and Problems:

6-1: The Silver Company planned to make 10,000 units of product in July. Budgeted costs were $110,000 in variable costs and $220,000 in fixed costs. The company actually made 11,000 units. Actual costs incurred were $110,000 in variable costs and $210,000 in fixed costs. Calculate the flexible budget variance for July. Is it favorable or unfavorable?

6-2: The Davenport 4-H Club plans to spend $5,000 to send 20 of its members to the State Fair in Des Moines. $2,000 of the $5,000 are fixed costs. Twenty-five members actually attend the fair, at a cost of $6,000. Calculate the flexible budget variance. Is it favorable or unfavorable?

6-3: A piano teacher has budgeted fixed costs of $1,250 per month, and budgeted variable costs of $1,200 per month, where variable costs are a linear function of the number of one-hour piano lessons. The piano teacher expected to give 120 one-hour piano lessons in April, but actually gave 150 one-hour piano lessons in April. Actual fixed costs were $1,000 and actual variable costs were $1,500. What is the flexible budget variance for April? Is it favorable or unfavorable?

6-4: The Amber Company planned to make 1,000 units of product in June. The static budget showed a per-unit cost of $10, which consisted of $3 for variable costs and $7 for allocated fixed overhead. The company actually made 1,100 units. The actual per-unit cost was $10, which consisted of $3 for variable costs and $7 for allocated fixed overhead. Calculate the total flexible budget variance for June. Is it favorable or unfavorable?

6-5: The static budget (i.e., the original budget) of the Tam-Taha Corporation showed a production cost of $10 per unit at a production level of 100 units. This $10 included $2 of fixed costs. Actual production was 200 units, and actual costs were $9 per unit, which included $1 of fixed costs. Calculate the flexible budget variance. Is it favorable or unfavorable?

6-6: MDC company plans to make 7,000 units, and at this level of production, the cost per unit would be $50. This $50 consists of $30 in variable costs and $20 in allocated fixed overhead. What would the flexible budget show for total costs, if the company makes 6,000 units?

6-7: Kinney-Borst anticipates production and sales of 100 units, total variable costs of $6,000, and total fixed costs of $3,000. Actual production and sales were 200 units. Calculate a flexible budget.

6-8: At the beginning of the year, a company budgets variable costs of $2,000 and fixed costs of $1,500 at a production level of 100 units. The company actually produces 110 units, and incurs variable costs of $2,000 and fixed costs of $1,800. What is the flexible budget variance? Is it favorable or unfavorable?

6-9: CWC company planned to make 2,100 units in 2005, and budgeted $900,000 in fixed costs and $130 per unit for variable costs. CWC actually made 2,000 units in 2005, and incurred total costs of $1,200,000. What is the flexible budget variance for 2005? Is it favorable or unfavorable?

6-10: Iron Butterfly, Inc., manufactures a single model of a deluxe portable camping stove. Information for August production is as follows:

	Budgeted	Actual
Variable Costs, per unit	$50	$52
Fixed Costs for August	$2,500,000	$2,150,000
Production for August	40,000 units	38,000 units

Required: What is the flexible budget variance for August?

6-11: The Pretenders, Inc., produces exercise equipment for dogs. The following information pertains to variable manufacturing overhead, which is allocated using machine hours.

	Budget	**Actual**
Units produced	15,000	22,000
Machine hours	5,000	7,500
Variable manufacturing overhead	$161,250	$242,000

Required: Calculate the flexible budget variance.

6-12: The Bee Gees cultivate and sell honey. They provide you the following data with respect to the upcoming year.

Budgeted variable costs (per jar):

Cost of the jar & label	$1.50
Labor	2.40
First aid supplies	.25

Budgeted fixed costs:

Salaries:	$50,000
Lease expense:	10,000
Other fixed costs	15,000

Relevant range over which these cost relationships are expected to hold: zero to 50,000 jars. Average sales price per jar is $7.00.

Required: Prepare three flexible budgets, showing operating income, for the following levels of sales (assume sales equals production):

A) 20,000 jars

B) 40,000 jars

C) 50,000 jars

6-13: The Vanilla Fudge Company runs a chain of ice cream stands in the Pacific Northwest. Following is data for location #37 for June. This location sells only one product: a large size double-scoop ice cream cone, in one flavor: vanilla fudge.

Cost per gallon of premium ice cream	$5.00
Scoops per gallon	20
Cost for the waffle cone	.25
Paper products (a variable cost)	$500 for the month
Fixed costs for the month (salaries, rent, insurance, etc.)	$1.00 per cone
Cones sold in June:	5,000
Sales price per cone:	$2.35

The company expects the same cost relationships to hold for July.

Required: Prepare two pro forma budgets for July, deriving projected operating income; one based on sales of 7,500 cones, and one based on sales of 10,000 cones.

6-14: Assume the following information for the Chestnut Ridge Dog Kennel for 2004:

	Budget	**Actual**
Number of dogs cared for	50	60
Fixed Costs	$40,000	$45,000
Variable Costs:		
Food	$20,000	$21,000
Supplies	$10,000	$13,200
Total Costs	$70,000	$79,200

Variable costs are linear in the number of dogs cared for.

Required:

A) Calculate a flexible budget for 2004.

B) Calculate the flexible budget variance for each of the three expense line-items for 2004, and indicate whether the variance is favorable or unfavorable.

C) Assume that the actual results for 2004 are used as the basis for building the 2005 static budget, except that the kennel believes it will care for 50 dogs in 2005. Develop a static budget for 2005.

6-15: The Convent at New Skeet runs an orphanage. Sister Sarah manages the orphanage and Sister Rachel is responsible for the accounting records. Sister Rachel prepared the following summary of costs for 2001, including a column showing the original budget for 2001.

The New Skeet Orphanage - Cost Analysis	2001 Budget	2001 Actual
Number of children (all ages)	80	72
Fixed costs:		
Utilities	$ 25,000	$ 27,250
Janitorial Services	14,000	15,500
Repairs and Maintenance	17,500	14,300
Salaries for non-Convent employees	85,000	92,000
Total fixed costs	141,500	149,050
Variable costs:		
Food	438,000	409,968
Clothing	40,000	39,600
Laundry & Linen Service	14,000	13,040
Educational Costs	26,000	25,480
Allowances	20,000	25,000
Total variable costs	538,000	513,088
Total costs	$679,500	$662,138

Sister Sarah is very concerned that the orphanage uses its funds efficiently. She is pleased that total costs were below budget for the year, but she wonders if this is partly due to the fact that the orphanage housed fewer children than expected for the year.

Required:

A) Prepare a flexible budget for 2001, based (i.e., "flexed") on the number of children actually housed in 2001.

B) Should Sister Sarah be satisfied with the orphanage's cost management in 2001? Briefly explain.

CHAPTER 7: Cost Variances for Direct Materials and Labor

Chapter Contents:

Introduction:

In the previous chapter, we saw that the ***static budget variance*** measures the difference between budgeted costs and actual costs (or budgeted revenues and actual revenues). We also saw that when the actual volume of output (sales or production) differs from the budgeted volume of output, this difference contributes to the static budget variance. We saw that a ***flexible budget*** adjusts the static budget to reflect what the budget would have looked like, if the actual output volume could have been known in advance. The ***flexible budget variance*** measures the difference between the flexible budget and actual results.

As stated in the previous chapter, there can be only two explanations for the flexible budget variance for variable costs. First, there can be a difference between budgeted input prices and actual input prices: the company paid more per yard of fabric, or less per pound of steel, than planned. Second, there can be an efficiency piece: the company used more fabric per pair of pants, or fewer pounds of steel per widget, than planned. In this chapter, we separate the flexible budget variance for direct materials into these two pieces: the "price" piece, and the "efficiency" piece. At the end of the chapter, we extend the discussion to other variable costs: direct labor and variable overhead.

Notation:

The following concepts and abbreviations are used:

Inputs are the materials used in the production process (fabric or steel).
Outputs are the units of finished product (pairs of pants, or widgets).

Abbreviation	Definition	Explanation
Q	Quantity	The ***total*** quantity of ***inputs*** used in production (the inputs for all output units, not the inputs for one unit of output)
P	Price	The price per unit of input
AP	Actual Price	The actual price paid per unit of input
SP	Standard Price	The budgeted price paid per unit of input
AQ	Actual Quantity	The actual quantity of inputs used in production
SQ	Standard Quantity	The quantity of inputs that "should have been used" for the actual output produced

Sometimes Q refers to the total quantity of inputs ***purchased***, not used in production. We will return to this possibility later in this chapter, but for now, Q refers to the quantity used in production.

The most important concept identified above is the **Standard Quantity (SQ)**. SQ is a ***flexible budget*** concept: it is the quantity of inputs that would have been budgeted had the budget correctly anticipated the actual volume of output.

Derivation of the Direct Materials Variances:

Given these definitions, the flexible budget can be expressed as

$$SQ \times SP;$$

and the flexible budget variance can be expressed as

$$(AQ \times AP) - (SQ \times SP) \qquad (1)$$

We introduce the following expression:

$$(AQ \times SP)$$

This expression measures what the company "should have spent" for the actual quantity of inputs used. We can insert this expression into Equation (1) in order to separate the flexible budget variance into two pieces:

$$(AQ \text{ x } AP) - (AQ \text{ x } SP) - (SQ \text{ x } SP) \qquad (2)$$

The first term minus the second term in Equation (2) can be rewritten as follows:

$$(AQ \text{ x } AP) - (AQ \text{ x } SP) = AQ \text{ x } (AP - SP)$$

This expression is the **price variance**. It is the actual inputs used in production (AQ) multiplied by the difference between the budgeted price (SP) and the actual price (AP) paid per unit of input. The price variance is abbreviated PV. Hence:

$$PV = AQ \text{ x } (AP - SP)$$

If the term in parenthesis is positive, the factory paid more per unit of input than budgeted, and the price variance is unfavorable. If the term in parenthesis is negative, the factory paid less per unit of input than budgeted, and the price variance is favorable. In either case, the price variance can be interpreted as answering the following question: *What was the total impact on the cost of production caused by the fact that the actual price per unit of input differed from the budgeted price.*

The second term minus the third term in Equation (2) can be rewritten as follows:

$$(AQ \text{ x } SP) - (SQ \text{ x } SP) = SP \text{ x } (AQ - SQ)$$

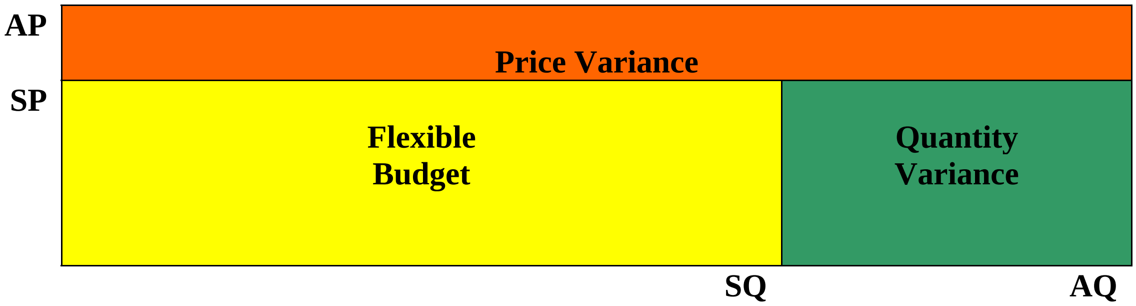
This expression is the **quantity variance** (also called the **usage variance**). It is the budgeted price per unit of input (SP) multiplied by the difference between the quantity of inputs that should have been used for the output units produced (SQ) and the quantity of inputs actually used (AQ). The quantity variance is abbreviated QV. Hence:

$$QV = SP \text{ x } (AQ - SQ)$$

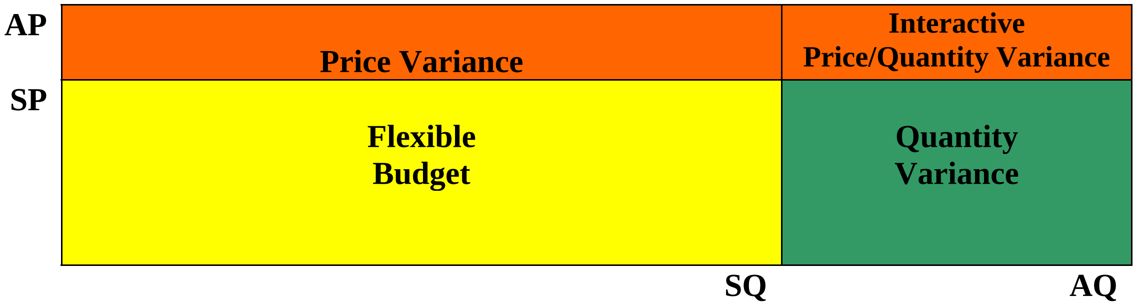
If the term in parenthesis is positive, the factory used more inputs than it should have used for the amount of output units produced, and the quantity variance is unfavorable. If the term in parenthesis is negative, the factory used fewer inputs than it should have used for the amount of output units produced, and the quantity variance is favorable. In either case, the quantity variance can be interpreted as answering the following question: *What was the total impact on the cost of production caused by the fact that the quantity of inputs used to make each unit of output differed from budget.*

Geometric Representation of the Direct Materials Variances:

The following table shows the price and quantity variances graphically, when both variances are negative. The area of the yellow box represents the flexible budget. The area of the "outer" box (the union of the three colored boxes) represents the actual amount incurred for direct materials. The price variance is the area of the orange box, and the quantity variance is the area of the green box. It is easy to see from this geometric representation that the difference between the flexible budget and actual costs consists of two variances: the price variance and the quantity variance.



The following table is identical to the one shown above except for the upper right-hand corner. This table shows that the formula for the price variance includes an "interactive" variance that only exists when ***both*** AP ≠ SP ***and*** AQ ≠ SQ. If AQ = SQ, this interactive variance box collapses from the right. If AP = SP, this box collapses from the top.



There is no theoretical justification for treating this interactive variance as part of the price variance instead of part of the quantity variance, but it is customarily assigned to the price variance or else reported separately.

Timing of Recognition of the Price Variance:

Some firms recognize the price variance for direct materials when the raw materials are purchased, rather than waiting until the raw materials are put into production. In this case, the AQ in the price variance will generally differ from the AQ in the quantity variance, which is denoted in the following expressions for these variances:

$$PV = AQ_{\text{Purchased}} \text{ x } (AP - SP)$$

$$QV = SP \text{ x } (AQ_{\text{Used}} - SQ)$$

$$\text{Where usually, } AQ_{\text{Purchased}} \neq AQ_{\text{Used}}$$

Recognizing the price variance when raw materials are purchased provides more timely information to management about the cost of direct materials and the performance of the purchasing department. Hence, this method for calculating the price variance has much to commend it. However, in this situation, the sum of the price variance and quantity variance will not equal the flexible budget variance, except by coincidence or when beginning and ending quantities of raw materials are zero.

Cost Variances and External Reporting:

Cost variances are not reported separately in the external financial statements of a firm, but are implicitly incorporated in one or more line-items on the balance sheet and income statement, such as Cost of Goods Sold and ending Finished Goods Inventory. However, for internal reporting, cost variances are frequently reported as separate line-items on divisional income statements and product-specific profit statements.

Cost Variances for Direct Labor:

The formulas for splitting the flexible budget variance into a "price" variance and "quantity" variance are the same for direct labor as direct materials. However, the terminology differs slightly. What is called the price variance for direct materials is called the **rate variance** or **wage rate variance** for direct labor. However, we retain the same abbreviations:

$$PV = AQ \times (AP - SP)$$

where AQ is the actual labor hours used in production, AP is the actual wage rate, and SP is the budgeted wage rate.

What is called the quantity or usage variance for direct materials is called the **efficiency variance** for direct labor. We abbreviate this variance as EV:

$$EV = SP \times (AQ - SQ)$$

where SP and AQ are the same as above, and SQ is the flexible budget quantity of labor hours (the labor hours the factory should have used for the volume of output units produced).

The issue discussed earlier in this chapter regarding the timing of the recognition of the price variance for direct materials does not arise for direct labor. Consequently, for direct labor, the sum of the wage rate variance and efficiency variance always equals the flexible budget variance.

The Blue Moose Restaurant:

The Blue Moose Restaurant makes and sells sandwiches. The Restaurant makes and sells a lot of sandwiches. Following is the restaurant's budget for making a peanut butter and jelly sandwich:

Direct Materials

Bread
  Quantity: 2 slices of bread (you probably knew this)
  Price: $0.10 per slice of bread

Peanut butter
  Quantity: 3 tablespoons
  Price: $0.05 per tablespoon

Jelly
  Quantity: 4 tablespoons
  Price: $0.03 per tablespoon

Direct labor
  Quantity: two minutes of labor
  Wage rate: $12 per hour ($0.20 per minute)

The static budget for May indicated a production and sales level of 1,100 peanut butter and jelly sandwiches. In fact, the restaurant made and sold 1,000 peanut butter and jelly sandwiches. The total cost in direct materials and labor to make these 1,000 sandwiches was $520 for ingredients and $450 for labor.

Required:

1. What is the budgeted cost per unit for making a peanut butter and jelly sandwich?

2. What would the static budget show, in total, for the cost of production for all peanut butter and jelly sandwiches?

3. What would the flexible budget show, in total, for the cost of production for all peanut butter and jelly sandwiches? Show materials separately from labor.

4. What is the flexible budget variance? Show this variance separately for materials and labor. Is the flexible budget variance favorable or unfavorable?

5. Each loaf of bread contains 20 slices of bread. 105 loafs of bread were used to make all of the peanut butter and jelly sandwiches. The actual price paid per loaf was $2.20. Calculate the quantity (usage) variance for bread. Provide a possible explanation for this variance.

6. What is the price variance for bread? Is it favorable or unfavorable?

7. 30 labor hours were spent making peanut butter and jelly sandwiches, at an average wage rate of $15 per hour. What is the efficiency variance for labor?

8. What is the wage rate variance?

Solutions:

1. What is the budgeted cost per unit for making a peanut butter and jelly sandwich?

Bread	$0.20
Peanut butter	$0.15
Jelly	$0.12
Labor	$0.40
Total budgeted cost per unit	$0.87

2. What would the static budget show, in total, for the cost of production for all peanut butter and jelly sandwiches?

$0.87 per sandwich x 1,100 sandwiches = $957.

3. What would the flexible budget show, in total, for the cost of production for all peanut butter and jelly sandwiches? Show materials separately from labor.

Ingredients	$0.47 x 1,000 =	$470
Labor	$0.40 x 1,000 =	$400
Total		$870

4. What is the flexible budget variance? Show this variance separately for materials and labor. Is the flexible budget variance favorable or unfavorable?

Ingredients	$520 actual – $470 budgeted =	$ 50 unfavorable
Labor	$450 actual – $400 budgeted =	$ 50 unfavorable
Total		$100 unfavorable

5. Each loaf of bread contains 20 slices of bread. 105 loafs of bread were used to make all of the peanut butter and jelly sandwiches. The actual price paid per loaf was $2.20. Calculate the quantity (usage) variance for bread. Provide a possible explanation for this variance.

SP x (AQ – SQ)
= $0.10 per slice x (2,100 actual slices – 2,000 flexible budget slices)
= $10 unfavorable

Possible reasons for the unfavorable usage variance for bread include the following:

1. Some of the bread was stale.

2. Some bread was dropped on the floor and not used
3. The 20 slices per loaf includes the heels, which are not used.

6. What is the price variance for bread? Is it favorable or unfavorable?

AQ x (AP – SP)
= 2,100 slices of bread x ($0.11 per slice – $0.10 per slice)
= $21 unfavorable

7. 30 labor hours were spent making peanut butter and jelly sandwiches, at an average wage rate of $15 per hour. What is the efficiency variance for labor?

SP x (AQ – SQ)
= $12 per hour x (30.00 actual hours – 33.33 flexible budget hours)
= $40 favorable

8. What is the wage rate variance?

AQ x (AP – SP)
= 30 actual hours x ($15 actual wage rate – $12 budgeted wage rate)
= $90 unfavorable

Exercises and Problems:

7-1: Following is selected information about the Hopi Popcorn company. All information represents total amounts, not per unit amounts.

	Static Budget	**Actual Results**
Units made and sold	100	50
Direct materials costs	$5,000	$2,700
Direct materials used in production	1,000 pounds	450 pounds

Hopi had no beginning or ending inventory of either finished product or raw materials.

Required:

A) Calculate the direct materials price variance. Indicate whether it is favorable or unfavorable.

B) Calculate the direct materials usage (quantity) variance. Indicate whether it is favorable or unfavorable.

7-2: Assume the following information for the year:

	Budget	Actual
Wage rate	$10	$12
Direct labor hours per unit	5	7
Units produced	100	110

Required:

A) Calculate the direct labor wage rate variance (i.e., the price variance). Is it favorable or unfavorable?

B) Calculate the direct labor efficiency variance. Is it favorable or unfavorable?

C) Calculate the flexible budget variance for direct labor. Is it favorable or unfavorable?

7-3: The Plutonium Fruitcake Company's production level (units of output) and direct materials prices (cost per pound) in 1957 were exactly as planned in the static budget for that year, but the company used more pounds of direct materials per unit of output than planned.

Given this set of circumstances, which of the following two statements can be made with certainty?

(I) There was an unfavorable flexible budget variance for direct materials.

(II) There was an unfavorable static budget variance for direct materials.

(A) both (I) and (II)

(B) (I) only

(C) (II) only

(D) neither (I) nor (II)

7-4: A company that manufactures a single product has a favorable flexible budget variance for direct materials, an unfavorable quantity variance for direct materials, and an unfavorable price variance for direct materials. Which of the following statements is most likely true?

(A) The company recognizes the price variance for direct materials at the time the materials are purchased, not at the time the materials are put into product.

(B) The company used less direct materials per output unit than planned.

(C) The company made fewer units than planned.

(D) The company made more units than planned.

7-5: Following are data for the Van Ness shirt factory in San Angelo, Texas, for the month of March.

	Budget	**Actual**
Units Manufactured	500,000	400,000
Fabric:		
price per yard	$2.50	$2.60
total yards used	1,000,000	800,000
Direct Labor:		
wage rate per hour	$10.00	$12.00
total hours used	250,000	220,000

Required: Compute the price and quantity (usage) variances for fabric, and the wage rate and efficiency variances for labor.

7-6: Following is information for May for the operations of Pink, Inc., which makes reproductions of famous paintings in various shades and hues of pink, mostly for the motel industry.

	Budget	**Actual**
Production in units:	1,000	1,100
Raw materials:	3 pounds per unit at $24 per pound	4 pounds per unit at $18 per pound
Direct labor:	20 minutes per unit at $17 per hour	15 minutes per unit at $17 per hour

Required:

A) Calculate the flexible budget variance for raw materials.

B) Calculate the direct labor wage rate variance.

C) How much of the total flexible budget variance for materials and labor is due to the fact that the company produced more units than planned?

7-7: Li, Lee and Levy Industries makes widgets in its factory located in the Marina Shores district of Seattle. Following is budgeted and actual information for the month.

	Static Budget Information	**Actual Results**
Widgets produced	1,000	900
Direct materials: copper fibers	15,000 pounds for a total cost of $31,500	12,600 pounds for a total cost of $25,200
Direct labor	1,000 hours for a total cost of $9,000	950 hours for a total cost of $8,075
Variable overhead (allocated based on machine hours)	$18,000	$14,553
Fixed costs	$56,000	$57,000

Required:

A) Compute the flexible budget variance for the month. Show separate line-items for direct materials, direct labor, variable overhead and fixed overhead.

B) Calculate the direct materials price variance. Is it favorable or unfavorable?

C) Calculate the direct materials quantity variance. Is it favorable or unfavorable?

D) Calculate the direct labor wage rate variance. Is it favorable or unfavorable?

E) Calculate the direct labor efficiency variance. Is it favorable or unfavorable?

7-8: Silverstream Company makes travel trailers. The following information pertains to the company's Ohio Division, which manufactures and markets only one model of trailer: the 32-foot Ambassador trailer. Following is budgeted and actual information for the Ohio Division for 2004:

	Budgeted		**Actual**
	Per Unit	Total	
Trailers manufactured in 2004		1,000	800
Trailers sold in 2004		1,000	600
Sales price per trailer		$45,000	$45,000
Direct materials costs (all variable costs):			
Aluminum	$4,000	$4,000,000	$3,400,000
Steel	$2,000	$2,000,000	$1,600,000
Other	$4,000	$4,000,000	$3,800,000
Total materials costs	$10,000	$10,000,000	$8,800,000
Direct labor costs (all variable costs)	$5,000	$5,000,000	$3,800,000
Variable overhead manufacturing costs	$8,000	$8,000,000	$6,400,000
Fixed overhead costs:			
Manufacturing fixed overhead		$10,000,000	$11,000,000
Non-manufacturing fixed overhead		$2,000,000	$2,100,000

Additional information:
The company started the year with no inventory of finished trailers or direct materials.

Direct labor standard:	250 hours per trailer
Actual direct labor hours incurred:	195,000 hours
The budgeted quantity of aluminum:	100 lbs. per trailer
The budgeted cost of aluminum:	$40 per lb.
The actual quantity of aluminum purchased	84,000 lbs.
The actual quantity of aluminum used	82,927 lbs.

Calculate the following:

A) The aluminum usage variance.

B) The aluminum price variance, if the price variance is calculated at the time the aluminum is purchased.

C) The aluminum price variance, if the price variance is calculated at the time the aluminum is put into production.

D) The flexible budget variance for aluminum.

E) The flexible budget variance for steel.

F) The direct labor wage rate variance.

G) The direct labor efficiency variance.

H) The flexible budget variance for direct labor.

7-9: The Durango Clothing Company reports the following costs for one of its products.

The Plaid Frock	**Static Budget**	**Actual Results**
Units produced	5,600	6,500
Materials:		
Yards of fabric per unit	2.2	2.0
Cost per yard	$5.10	$5.00
Labor:		
Hours per unit	4.5	5.0
Wage rate per hour	$15	$14
Fixed costs	$125,000	$152,000

Actual quantity of fabric purchased was 15,000 yards.

Required:
A) Complete the flexible budget in the table below for production costs:

	Flexible Budget
Units produced	6,500 units
Materials cost	
Labor cost	
Fixed costs	
Total costs	

B) Calculate the flexible budget variance for direct labor.

C) Calculate the quantity (usage) variance for direct materials.

D) What is the direct labor efficiency variance?

E) What is the direct labor wage rate variance?

F) Calculate the price variance for direct materials, assuming the company recognizes the price variance at the time the materials are put into production.

7-10: Arden Brothers reports the following cost information for one of its products.

Product Model XJ-12	**Static Budget**	**Actual Results**
Units produced	900	850
Materials:		
Pounds of materials per unit	3	4
Cost per pound of materials	$7.00	$6.50
Labor:		
Hours per unit	1.0	1.2
Wage rate per hour	$13	$10
Fixed costs	$45,000	$39,000

Actual quantity of materials purchased was 4,000 pounds.

Required:

A) Calculate the flexible budget variance for direct labor.

B) Calculate the price variance for direct materials, assuming the company recognizes the price variance at the time the materials are purchased.

C) Calculate the quantity (usage) variance for direct materials.

D) What is the direct labor wage rate variance?

E) What is the direct labor efficiency variance?

7-11: The Oswald Company makes four products in its factory in Jefferson City. Following is production and cost information for April:

	Steppers	**Runners**	**Walkers**	**Gliders**
Actual Results				
Units produced	80	70	60	50
Machine hours per unit	7	7	6	5
Budget				
Units produced	100	70	50	50
Machine hours per unit	8	8	7	5

Oswald allocates variable overhead using machine hours. Actual variable overhead was $456,789. Budgeted variable overhead was $654,321.

Required: Calculate the variable overhead spending and efficiency variances for steppers. Be sure to indicate if these variances are favorable or unfavorable.

7-12: Preparation of a box of Chex Party Mix is budgeted to require 1.0 pound of Wheat Chex, 1.5 pounds of Rice Chex, and 0.8 pounds of Corn Chex. On Tuesday, the manager's five-year-old son sat at the control panel of the highly-automated factory and made 50 boxes of Party Mix. The following information pertains to material variances for that day's production, analyzed by ingredient:

	Wheat Chex	Rice Chex	Corn Chex
Price variance	$16 Unfavorable	$12 Favorable	$19 Unfavorable
Usage variance	$20 Unfavorable	$25 Favorable	$10 Favorable

The actual prices were $0.30 more per pound of Wheat Chex, $0.20 less per pound of Rice Chex, and $0.50 more per pound of Corn Chex, than their standard prices.

Required:

A) Determine the standard price per pound of each ingredient.

B) Determine the number of pounds used of each ingredient.

7-13: Billy Bones, your long-time business partner in the rum-making business, dies unexpectedly from natural causes. (It's unexpected because nobody expected Billy to live long enough to die from natural causes.) You now discover that he was not always so honest in his business dealings, and the company's silent partners are becoming not-so-silent about the return on their investment. The silent partners demand to know the company's revenue for the year just ended.

You know that the financial statements that Billy prepared before his death were a hoax. But you also know that the company's rum recipe calls for one barrel of molasses to produce 20 pints of rum, and that the company had no beginning or ending inventory of either molasses or rum. Also, you find among Billy's private papers the following information, which you believe is reliable. The company's fixed costs are $2,530 per year. The company budgeted $2 per barrel of molasses, but paid $0.10 more per barrel of molasses than budgeted, resulting in an unfavorable price variance for molasses of $115 for the year. Also, the company had an unfavorable quantity variance for molasses of $74 for the year. (Somehow, under Billy's supervision, all variances were always negative.) Also, a few days before he died, Billy scribbled a note to himself that at the sales price that the company has had in place for over two years now, and at the current variable cost per pint of $0.30 (which includes molasses and all other variable costs), the company's breakeven volume was 11,500 pints of rum.

Required:

A) How many pints of rum were produced and sold during the year?

B) Calculate the company's revenue for the year.

PART 3

PRODUCT COSTING
AND
COST ALLOCATIONS

“Are all your family wizards?” asked Harry, who found Ron just as interesting as Ron found him.

“Er—Yes, I think so,” said Ron. “I think Mom’s got a second cousin who’s an accountant, but we never talk about him.”

- J.K. Rowling (1997)
Harry Potter and the Sorcerer’s Stone

CHAPTER 8: Product Costing

Chapter Contents:

Some Useful Definitions:

Cost object: A cost object is anything that we want to know the cost of. We might want to know the cost of making one unit of product, or a batch of product, or all of Tuesday's production, in which case the cost objects are one unit of product, a batch of product, or Tuesday's production, respectively. We might want to know the cost of operating a department or a factory, in which case the cost object is the department or factory. In a service sector company, we might want to know the cost of treating a patient in a hospital, or the cost of conducting an audit, in which case the cost object is the patient or the audit client. In a government setting, a cost object might be a program such as "Meals on Wheels."

Product costs: A product cost is any cost that is associated with units of product for a particular purpose. Hence, the identification of product costs depends on the purpose for which it is done. For example, the factory manager is interested in manufacturing costs, whereas the merchandising manager might be interested in both manufacturing and nonmanufacturing costs, including research and development, marketing, and advertising costs.

Inventoriable costs: These are costs that are debited to inventory for either external or internal reporting purposes. For manufacturing firms, all inventoriable costs are manufacturing costs, but the reverse is not necessarily true. In other words, inventoriable costs are either the complete set or a subset of manufacturing costs, and non-manufacturing costs are never included as inventoriable costs. For merchandising firms, inventoriable cost is usually the purchase price of inventory.

Period costs: These are costs that are expensed when incurred, usually because they are not associated with the manufacture of products. Examples include advertising costs and research and development costs. Period costs are distinguished from inventoriable costs.

Direct costs and **overhead costs**: In relation to a given cost object, all costs are either direct costs or overhead costs. Direct costs can be traced to the cost object in an economically feasible way. Overhead costs (also called **indirect costs**) are associated with the cost object, but cannot be traced to the cost object in an economically feasible way. These terms apply to companies in all sectors of the economy and to all types of organizations.

Cost driver: A cost driver is any factor that affects costs. A change in the cost driver will cause a change in the total cost of a related cost object. Any one cost object almost always has numerous cost drivers. This term applies to companies in all sectors of the economy and to all types of organizations.

Cost allocation: The assignment of overhead costs to the cost object. This term applies to companies in all sectors of the economy and to all types of organizations.

Cost allocation base: A quantitative characteristic shared by multiple cost objects that is used to allocate overhead costs among the cost objects. A cost allocation base can be a financial measure (such as the raw material cost of each unit of product) or a nonfinancial measure (such as direct labor hours incurred in the manufacture of each unit of product). The simplest cost allocation base is simply the number of cost objects (e.g., the number of units produced by the factory during a period of time).

The distinction between a cost driver and a cost allocation base can be summarized as follows. A cost driver is an economic concept; it relates to the economic reality of the business. A cost allocation base is an accounting choice that is made by accountants and managers. Usually, the best choice for a cost allocation base is a cost driver.

Conversion costs: All manufacturing costs other than direct materials.

Overview of Product Costing:

Product costing follows these steps:

1. Identify the **cost object**;
2. Identify the **direct costs** associated with the cost object;
3. Identify the **overhead costs**;
4. Select the **cost allocation base** to use in assigning overhead costs to the cost object;
5. Develop the **overhead rate** for allocating overhead to the cost object.

The cost accounting system "builds up" the cost of product (or other cost object) by recording to a job cost sheet, a work-in-process account, or some other appropriate ledger, the direct costs that can be ***traced*** to the product, and a share of the overhead costs, which are ***allocated*** to the product by multiplying the overhead rate by the amount of the allocation base identified with the cost object.

Cost Objects:

Recall that a cost object is anything that we want to know the cost of, such as a product or service.

There is a common convention that can be confusing. We often talk about the cost object (the thing we want to know the cost of) as one unit of product, because factory managers and product managers speak in terms of unit costs. These managers want to know the unit cost for product pricing, product sourcing, and performance evaluation purposes. They do not want to talk about the cost of making 620 units, even if that is the batch size. However, in most batch processes, there would be very little benefit and enormous additional expense in determining the cost of each unit of product individually. Rather, the accounting system treats the batch as the cost object, and to derive a unit cost, we divide the cost of the batch by the number of units in the batch. Hence, loosely speaking, we talk as if a unit of product is the cost object, but more precisely, it is the batch (or the production run in an assembly-line process, or perhaps one day's production in a continuous manufacturing process) that constitutes the cost object.

Direct Costs:

Management accounting classifies product costs as either direct costs or overhead costs (indirect costs). This distinction is important because costing systems handle these two types of costs very differently. The distinction is sometimes subtle, because whether a cost is direct or overhead is a function of the cost object, and also partly a matter of choice on the part of managers and accountants.

Following are three definitions of direct costs from different accounting textbooks:

> Direct costs of a cost object are costs that are related to the cost object and can be traced to it in an economically feasible way.
>
> Direct costs are costs that can be directly attached to the unit under consideration.
>
> Direct costs are costs that can be traced easily to specific products.

Direct costs are also called **prime costs**. For manufacturing companies, direct costs usually can be categorized as either materials or labor.

Direct materials: materials that become part of the finished product and that can be conveniently and economically traced to specific units (or batches) or product.

An example of direct materials for an apparel manufacturer is fabric. All other materials, such as thread and zippers, are probably indirect.

Direct labor: costs for labor that can be conveniently and economically traced to a unit (or batch) of product. The following examples show how the determination of whether a cost is direct or overhead depends on the identification of the cost object:

Examples of direct labor for an apparel manufacturer:

1) If the cost object is a single pair of pants, in a batch of several dozen pairs:

   Most likely no labor is direct.

2) If the cost object is a batch of several dozen pairs of pants:

   Most likely sewing operators' wages are direct.

3) If the cost object is a production line in the factory:

   Add the line manager's salary, and possibly wages incurred in the cutting room (where rolls of fabric are cut into panels and pieces that are then sewn together).

4) If the cost object is the entire factory:

   Add the factory manager's salary, wages of maintenance and janitorial workers, and salaries of front office personnel.

Even though it is likely that no labor is direct with respect to a single pair of pants, if labor is direct with respect to a batch of 50 or 100 units, cost accountants would usually (and loosely) call labor a direct cost with respect to units of product, and divide the direct labor cost for the batch by the number of units per batch to derive the direct labor cost per unit.

Overhead Costs:

Overhead costs are costs that are related to the cost object, but cannot be traced to the cost object in an economically feasible way. Overhead costs are not directly traceable to specific units of production. Examples of overhead costs incurred at an apparel manufacturer, when the cost object is a batch of product, would usually include the following:

- Electricity
- Factory office salaries
- Building and machine maintenance
- Factory depreciation

The distinction between direct costs and overhead costs relate, in some measure, to the way the accounting system treats the cost. For example, one apparel manufacturer might track thread using the same methods that are used to track fabric, thus treating thread as a direct material. Another apparel manufacturer might decide that the cost of thread is immaterial, and does not warrant the cost and effort to track it as a direct cost. For this company, thread is an overhead cost. Therefore, whether some costs are direct or overhead depend on a choice made by the manager and the cost accountant.

There are three ways overhead costs can be treated in any decision-making context: (1) they can be ignored, (2) they can be treated as a lump-sum, or (3) they can be allocated to the products and services (i.e., to the cost objects) to which they relate. Each of these three alternatives is appropriate, depending on the circumstances and the purpose for which the accounting is done. However, in this chapter and throughout much of this book, we are concerned with the third alternative: how to allocate overhead costs to products and services.

Cost Allocation Bases

The allocation base is the "link" that is used to attach overhead costs to the cost object. In a manufacturing setting, the simplest allocation base is the number of units produced. For example, if the factory makes 15,000 units, the accounting system can simply "spread" the overhead costs evenly over all 15,000 units. The problem with using units as an allocation base, however, is that if the factory makes a range of different products, those products might differ significantly in their resource utilization. A deluxe widget might require twice as much labor and 20% more materials than a standard widget, and one might infer that the deluxe widget also requires more resources that are represented by overhead costs.

Whatever cost allocation base is chosen, it must be a "common denominator" across all cost objects. For example, a furniture factory could allocate overhead costs across all products using direct labor hours, because direct labor is incurred by all products made at the factory. However, it would not seem appropriate to allocate factory overhead based on the quantity of wood used in each unit, if the factory makes both wood furniture and a line of plastic-molded, because no overhead would be allocated to the plastic chairs.

Overhead Rates:

The overhead rate is the ratio of cost pool overhead dollars in the numerator, and the total quantity of the allocation base in the denominator:

$$\text{Overhead rate} = \frac{\text{Overhead costs in the cost pool}}{\text{Total quantity of the allocation base}}$$

The result represents dollars of overhead per unit of the allocation base. For example, if an apparel factory allocates overhead based on direct labor hours, the overhead rate represents dollars of overhead per direct labor hour. Assume the overhead rate is $20 per direct labor hour. Then for every hour that a sewing operator spends working on product, $20 will be allocated to the products that the sewing operator assembles during that hour.

ZFN Apparel Company, Example of Actual Costing:

The ZFN apparel company in Albuquerque, New Mexico makes jeans and premium chinos. Each product line has its own assembly line on the factory floor. Overhead costs for the factory for 2005 were $3,300,000. 500,000 jeans and 400,000 chinos were produced during the year. 500,000 direct labor hours were used: 200,000 for jeans, and 300,000 for chinos. The average direct labor wage rate was the same on both assembly lines, and was $14 per hour. Denim fabric is used to make jeans, and chinos are made from a cotton twill fabric. Overhead is allocated using direct labor hours.

The following journal entries and T-accounts illustrate how the accounting system records the manufacturing activities of the factory in order to derive product cost information for jeans and chinos. Journal entry (6) to debit overhead to work-in-process is based on an overhead rate calculated as follows.

$3,300,000 ÷ 500,000 direct labor hours = $6.60 per direct labor hour.

In practice, the factory would track costs by batch, or perhaps weekly, but to simplify our example, we record only one journal entry for each type of transaction. We also make the unrealistic assumption that there is no work-in-process at the end of the period. To focus the presentation on inventory-related accounts, T-accounts for some non-inventory accounts, and the entry to debit accounts receivable and credit revenue, are omitted.

(1)	Raw Materials: denim fabric	$3,000,000	
	Raw Materials: cotton twill	2,250,000	
	Accounts Payable		$5,250,000

(To record the purchase of 600,000 yards of denim fabric at $5.00 per yard, and 500,000 yards of cotton twill fabric at $4.50 per yard.)

(2)	Work-in-process: Jeans	$2,500,000	
	Raw Materials: denim fabric		$2,500,000

(To record materials requisitions for 500,000 yards, for the movement of denim from the receiving department to the cutting room.)

(3)	Work-in-process: Chinos	$2,160,000	
	Raw Materials: cotton twill		$2,160,000

(To record materials requisitions for 480,000 yards, for the movement of cotton twill from the receiving department to the cutting room.)

(4)	Work-in-process: Jeans	$2,800,000	
	Work-in-process: Chinos	4,200,000	
	Accrued Sewing Operator Wages		$7,000,000

(To record sewing operator wages for the year: 200,000 hours for jeans, and 300,000 hours for chinos, at $14 per hour.)

(5)	Factory Overhead	$3,300,000	
	Accounts Payable		$1,800,000
	Accrued Wages for Indirect Labor		900,000
	Accumulated Depreciation		600,000

(To record overhead costs incurred during the year, including utilities, depreciation, repairs and maintenance, and indirect wages and salaries.)

(6)	Work-in-process: Jeans	$1,320,000	
	Work-in-process: Chinos	1,980,000	
	Factory Overhead		$3,300,000

(To allocate factory overhead to production, using an overhead rate of $6.60 per direct labor hour.)

(7)	Finished Goods: Jeans	$6,620,000	
	Work-in-process: Jeans		$6,620,000

(To record the completion of all 500,000 jeans, at $13.24 per pair.)

(8)	Finished Goods: Chinos	$8,340,000	
	Work-in-process: Chinos		$8,340,000

(To record the completion of all 400,000 chinos, at $20.85 per pair.)

(9)	Cost of Goods Sold: Jeans	$5,296,000	
	Cost of Goods Sold: Chinos	7,297,500	
	Finished Goods: Jeans		$5,296,000
	Finished Goods: Chinos		7,297,500

(To record the sale of 400,000 jeans and 350,000 chinos.)

Raw Materials:
Denim Fabric

(1)	$3,000,000	$2,500,000	(2)
	$ 500,000		

Raw Materials:
Cotton Twill

(1)	$2,250,000	$2,160,000	(3)
	$ 90,000		

Accrued Sewing
Operator Wages

		$7,000,000	(4)

Factory Overhead

(5)	$3,300,000	$3,300,000	(6)
	$0		

Work-in-Process: Jeans

(2)	$2,500,000	$6,620,000	(7)
(4)	2,800,000		
(6)	1,320,000		
	$0		

Work-in-Process: Chinos

(3)	$2,160,000	$8,340,000	(8)
(4)	4,200,000		
(6)	1,980,000		
	$0		

Finished Goods: Jeans

(7)	$6,620,000	$5,296,000	(9)
	$1,324,000		

Finished Goods: Chinos

(8)	$8,340,000	$7,297,500	(9)
	$1,042,500		

Cost of Goods Sold: Jeans

(9)	$5,296,000		

Cost of Goods Sold: Chinos

(9)	$7,297,500		

Accounts Payable

		$5,250,000	(1)
		1,800,000	(5)

The per-unit inventory cost is calculated as follows:

Jeans:	$6,620,000 ÷	500,000 pairs	= $13.24 per pair
Chinos:	$8,340,000 ÷	400,000 pairs	= $20.85 per pair

These amounts, which are used in journal entry (9), can be detailed as follows:

Input	**Jeans**	**Chinos**
Fabric	1 yard/jean x $5/yard = $5.00	1.2 yards/chino x $4.50/yard = $5.40
Direct labor	0.4 hrs/jean x $14/hr = $5.60	0.75 hrs/chino x $14/hr = $10.50
Overhead	0.4 hrs/jean x $6.60/hr = $2.64	0.75 hrs/chino x $6.60/hr = $4.95
Total	$13.24	$20.85

In the above table, the direct labor hours per jean and per chino appear in the lines for both the per-unit direct labor cost and the per-unit overhead cost, because overhead is allocated based on direct labor hours. If the allocation base had been something else, such as machine hours, the hours per unit would only appear in the calculation of the direct labor cost.

More overhead is allocated to each pair of chinos than to each pair of pants ($4.95 versus $2.64) because direct labor hours has been chosen as the allocation base, and each chino requires more direct labor time than each pair of jeans (0.75 hours versus 0.40 hours). Changing the allocation base cannot change the total amount of overhead incurred, but it will usually shift costs from some products to others. For example, if the allocation base were units of production instead of direct labor hours, the overhead rate would be:

$3,300,000 ÷ 900,000 units = $3.67 per unit.

In this case, the total cost per pair of jeans would increase from $13.24 to $14.27, and the total cost per pair of chinos would decrease from $20.85 to $19.57.

Because the choice of allocation base determines how overhead is allocated across products, product managers usually have preferences over this choice (because a lower reported product cost results in higher reported product profitability). However, the company's choice of allocation base should be guided, if possible, by the cause-and-effect relationship between activity on the factory floor and the incurrence of overhead resources. For example, direct labor hours is a sensible allocation base if the significant components of overhead increase as direct labor hours increase. More direct labor implies more indirect labor by human resources and accounting personnel, janitorial staff and other support staff. Also, more direct labor implies more machine time, which implies more electricity usage, and more repairs and maintenance expense. For these reasons, direct labor hours is probably a better choice of allocation base than units of product.

Exercises and Problems:

8-1: A company allocates overhead based on direct labor cost (dollars). The rate is 160% of the direct labor cost. A job has direct materials cost of $12,000 and direct labor cost of $14,000 (700 labor hours). What is the total cost of the job?

(A) $26,000

(B) $34,400

(C) $48,400

(D) $27,120

8-2: A multi-product manufacturing company uses many different machines and employs a labor force with widely-varying skill levels and pay rates. Generally, the higher paid and more skilled employees operate the more complex and expensive machinery. If all overhead is going to be applied using a single overhead rate, based on the information provided, which allocation base would work best in this environment?

(A) Machine hours

(B) Direct labor hours

(C) Direct labor dollars

(D) Direct material dollars

8-3: The Quad City Candy Company uses a budgeted overhead rate, and allocates variable overhead based on direct material costs (i.e., direct materials dollars). The company only allocates variable overhead; the company does not allocate fixed overhead. Following is information for the year 2005:

	Budget	**Actual**
Boxes of candy (this is output)	10,000	11,000
Variable overhead	$20,000	$22,000
Fixed overhead	$10,000	$13,200
Direct labor:		
Hours per box	0.5	0.4
Hourly wage rate	$10	$12
Direct materials:		
Pounds per box	2	2
Cost per pound	$5	$4

Required: Calculate the overhead rate for applying overhead:

8-4: The Santa Fe Candy Company expects to incur overhead of $60,000. Also, the company expects to incur 300 direct labor hours (which is paid an average of $20 per hour) and 200 machine hours, in order to produce 30,000 pounds of candy. Using the information provided, calculate four different overhead rates using four different allocation bases. In each case, be sure to identify the allocation base.

8-5: The Bernalillo factory of Winrock and Associates makes two models of a portable pneumatic compressor: Model #A567 and Model #B234. Information about the year 1967 follows:

	Model #A567	**Model #B234**
Units produced	500	500
Direct materials costs	$40,000	$60,000
Direct labor hours	5,000	5,000

Factory overhead for the year was $180,000. The average wage rate for workers on the Model #A567 production line is $10 per hour. The average wage rate for workers on the Model #B234 production line is $20 per hour.

Required:

A) Assume the company allocates overhead based on direct labor hours. What is the overhead rate?

B) What is the total cost per unit for the Model #B234?

C) Assume the company changes the allocation base from direct labor hours to direct labor costs (i.e., direct labor dollars). What is the new overhead rate?

D) Using this new overhead rate, what is the new cost per unit for the Model #B234?

8-6: Following is information about Aztech Industries, which makes three types of portable heaters:

	Model A	**Model B**	**Model C**	**Total**
Units produced	300	500	200	1,000
Direct materials (per unit)	$50	$75	$100	
Direct labor (per unit)	$20	$50	$40	
Cost driver information:				
# of parts (per unit)	20	42	30	
direct labor hours (per unit)	3	4.60	4	
square feet (in total)	400	600	1,000	
Overhead cost pools:				
Labor Support				$22,000
Materials Support				$33,000
Facility Cost				$90,000
Total overhead				$145,000

Required:

A) Allocating Facility Cost using square feet as the allocation base, how much Facility Cost overhead would be allocated to each Model A heater?

B) If Labor Support is allocated using direct labor hours as the allocation base, what is the overhead rate for allocating Labor Support?

C) If all overhead is allocated using direct materials dollars as the allocation base, what is the total cost of manufacturing each Model C heater?

8-7: The Lobaton Cookie Company makes three types of cookies: sugar cookies, oatmeal cookies, and chocolate chip cookies. Following is information for December:

	Sugar Cookies	**Oatmeal Cookies**	**Chocolate Chip Cookies**
Pounds of cookies produced	700 pounds	300 pounds	400 pounds
Machine hours	20 hours	10 hours	10 hours
Direct labor hours	7 hours	6 hours	8 hours
Average wage per hour	$10 per hour	$12 per hour	$9 per hour

Total overhead incurred in December was $8,400.

Required:

A) Calculate the overhead applied per pound of Oatmeal Cookies, when all overhead is applied using machine hours as the allocation base.

B) Now assume that $4,000 of the overhead is fixed, and the remainder is variable. Calculate the overhead applied per pound of Sugar Cookies, using machine hours to allocate fixed overhead and direct labor dollars to allocate variable overhead.

8-8: The Svendsgaard Organic Cereal Company makes 20 brands of cereal, including wheat squares, corn squares, and rice squares. Following is information for December:

	Wheat Squares	**Corn Squares**	**Rice Squares**
Pounds of cereal produced	800 pounds	600 pounds	500 pounds
Machine hours	40 hours	30 hours	30 hours
Direct labor hours	45 hours	60 hours	40 hours

Total overhead incurred in December was $10,000. Total machine hours incurred were 500.

Required:

A) Calculate the overhead rate using machine hours as the allocation base.

B) Calculate the overhead applied per pound of corn squares using machine hours as the allocation base.

8-9: Teddy Bear Fudge Company makes two types of fudge: plain fudge and fudge with nuts. Following is information for operations in the month of February. All quantities are expressed in pounds. There is no direct labor.

	Total	**Plain Fudge**	**Fudge with Nuts**
Beginning inventory	0	0	0
Production	1,000	600	400
Sales	850	500	350
Per unit information:			
Sales price per pound		$8.00	$8.00
Direct materials		$2.00	$2.25
Sales commission		$0.50	$0.50
Variable manufacturing overhead	$500		
Fixed costs:			
Fixed manufacturing overhead	$2,000		
Fixed non-manufacturing overhead	$300		

Required: What is the manufacturing cost for each type of fudge, assuming the company allocates overhead based on direct materials dollars?

CHAPTER 9: Normal Costing

Chapter Contents:

Introduction:

Recall the discussion from the previous chapter on overhead rates. The overhead rate is the ratio of cost pool overhead dollars in the numerator, and the total quantity of the allocation base in the denominator:

$$\text{Overhead rate} \quad = \quad \frac{\text{Overhead costs in the cost pool}}{\text{Total quantity of the allocation base}}$$

The result represents dollars of overhead per unit of the allocation base. For example, if an apparel factory allocates overhead based on direct labor hours, the overhead rate represents dollars of overhead per direct labor hour.

Normal costing:

Many companies calculate and apply this overhead rate using, not actual overhead costs and the actual quantity of the allocation base, but rather budgeted overhead costs and the budgeted quantity of the allocation base. When a company uses budgeted overhead rates in its costing system, but all other information in the costing system is based on actual costs, the company is using what is called a **normal costing system**.

It is important to remember that although there are no rules in management accounting, companies always, as a matter of practice, use either budgeted numbers in *both the numerator and the denominator* of the overhead rate, or actual numbers in *both the numerator and the denominator* of the overhead rate. Companies never use budgeted overhead divided by the actual quantity of the allocation base, or actual overhead divided by the budgeted quantity of the allocation base.

It is also important to remember that in a normal costing system, the budgeted overhead rate is multiplied by the ***actual*** quantity of the allocation base incurred. In Chapter 10, we will discuss another type of accounting system, called a **standard costing system**, that multiplies the budgeted overhead rate by a flexible budget quantity for the allocation base: the amount of the allocation base that should have been used for the amount of output achieved. However, in a normal costing system, the only budgeted number is the overhead rate; direct costs are recorded at their actual cost, and the overhead rate is multiplied by the actual quantity of the allocation base used during the period.

Advantages of Using Budgeted Overhead Rates:

There are three principal reasons that many companies in all sectors of the economy use budgeted overhead rates, either as part of a normal costing system or as part of a standard costing system.

Actual overhead rates are not known in a timely manner: Factory managers often use production cost information in their monitoring of the manufacturing process. Control of manufacturing activities is a daily or weekly process, not a monthly or quarterly process. The challenge of collecting and reporting actual direct costs—the cost of materials and labor used in production—within one or two days of actual production is difficult, but increasingly possible. For example, all materials used in production have already been purchased, and the cost of those materials can be ascertained. Also, sophisticated data collection systems, often called real-time systems, can track the movement of inventory, and track labor resources incurred at various work stations, as production occurs. Even the quantity of the overhead cost allocation base used in production can probably be ascertained, because the allocation base is usually a measure of a direct input. However, many of the components that make up overhead are not paid daily or even weekly. Utilities and property taxes are often paid monthly or quarterly. The factory manager who wants to know the cost of production on January 3 for the purpose of controlling operations on the factory floor will not want to wait until the books are closed on January 31 for that information. Usually, budgeted overhead rates are sufficiently close to actual overhead rates so that normal costing systems provide reasonably accurate cost information for management control purposes, and normal costing can provide this information in a timely manner.

Overhead rates are subject to short-run fluctuations: For an apparel factory in El Paso, electric costs are significantly higher in July than in January due to the cost of air conditioning. Should overhead rates be calculated and applied separately for each month, or should overhead rates be averaged over the entire year? The answer to this question is not clear, because it depends on the types of decisions for which management will use factory cost information as an input. For example, if the factory has excess capacity and management is considering suspending factory operations for two weeks, monthly cost data will assist in scheduling the down-time to maximize cost savings (i.e., close the factory for two weeks in July, not January). On the other hand, if several product managers are scheduling production for the coming year, it would seem counterproductive to provide these managers incentives to compete with each other for January factory time, for the sake of obtaining the lower per-unit production cost, if some of them will have to schedule production in July in any case. Using an overhead rate that averages over the entire year might be more reasonable for production costing purposes like this one. In fact, many companies prefer to average overhead rates over a quarter or an entire year, and these companies usually prefer using budgeted overhead rates instead of waiting until actual overhead is known at the end of the period.

When actual overhead rates are used, production volume of each product affects the reported costs of all other products: This issue arises because the production volume of each product affects the total quantity of the allocation base in the denominator of the overhead rate, whereas an important component of the numerator—fixed overhead—is invariant to changes in production volume. Hence, as production volume of one product decreases below budget, the overhead rate (which is common across all products) increases, and when that overhead rate is applied to other products, those products absorb more overhead (and so have higher reported costs) than was budgeted. The important point here is that the direct costs and production activity related to those other products could be exactly as planned, but the reported costs of those products will be higher than planned, due entirely to the production activities of another product. In a factory that makes jeans and chinos, one might imagine the reaction of the jeans product manager when a decline in chinos production increases the reported cost of each pair of jeans.

Misapplied Overhead:

When budgeted overhead rates are used, it is very likely that the amount of overhead applied to production (the debits to work-in-process) will differ from the actual overhead incurred (credits to cash, accounts payable, and various other accounts) during the period. This difference, which will occur whenever the budgeted overhead rate differs from the actual overhead rate, is called misapplied overhead. If less overhead is applied to inventory than is actually incurred, then the difference is called underapplied overhead (it is also called underallocated overhead or underabsorbed overhead). If more overhead is applied to inventory than is actually incurred, then the difference is called overapplied overhead (it is also called overallocated overhead or overabsorbed overhead).

Mechanically, misapplied overhead is accumulated in one or more temporary accounts that are closed out at the end of the period (month, quarter or year). These accounts collect the misapplied overhead because when overhead is debited to inventory, the corresponding credits are posted to these temporary accounts, and when overhead is paid (or accrued), the corresponding debits are also posted to these temporary accounts. The net difference between these debits and credits represents misapplied overhead. If two temporary accounts are used, they are called something like “overhead applied” and “overhead incurred.”

The nature of the closing entry to zero-out these accounts depends on the materiality of the misapplied overhead. If the amount is small, management might take the expedient approach of closing out all misapplied overhead to a line-item on the income statement for the period. The misapplied overhead might be posted to cost-of-goods-sold, or might be treated as a period expense, but in either case, the effect is to increase or decrease income by the total amount of misapplied overhead.

If the amount of misapplied overhead is material, management should consider whether the entry to close out misapplied overhead should be made in such a way as to approximate the balances in the balance sheet and income statement inventory accounts that would have occurred had an actual costing system been used. If so, then the entry to close out misapplied overhead should include the inventory balance sheet accounts of work-in-process and finished goods inventory, as well as cost-of-goods-sold on the income statement. One technique that approximates this objective is to pro-rate misapplied overhead based on the ending balances in work-in-process, finished goods inventory, and cost-of-goods-sold. A more accurate technique is to pro-rate misapplied overhead based on the amount of overhead in each of these three accounts.

If overhead is underapplied, some managers close out the entire amount to the income statement (thereby decreasing income) even if the amount is material. Conservatism is often the justification for this approach.

ZFN Apparel Company, Normal Costing Example:

The ZFN apparel company in Albuquerque, New Mexico makes jeans and premium chinos. Each product line has its own assembly line on the factory floor. Overhead costs for the factory for 2005 were budgeted for $3,600,000, but came in below budget at $3,300,000. Budgeted production for the year was 500,000 jeans and 500,000 chinos. Actual production was 500,000 jeans and 400,000 chinos. The reduction in chinos output relative to plan was due to unexpected slack in the demand for casual slacks. The budgeted direct labor hours per jean is 0.5, and per chino is 0.7. In fact, 500,000 direct labor hours were used: 200,000 for jeans, and 300,000 for chinos. The average direct labor wage rate was the same on both assembly lines, and was $14 per hour. Denim fabric is used to make jeans, and chinos are made from a cotton twill fabric. Overhead is allocated using direct labor hours.

The following journal entries and T-accounts illustrate how a normal costing system records the manufacturing activities of the factory in order to derive product cost information for jeans and chinos.

The first five entries are identical to the ZFN example in the previous chapter. The first entry that differs as the result of using normal costing instead of actual costing is (6). This entry to debit overhead to work-in-process is based on an overhead rate calculated as:

	Budgeted Production	Budgeted hours per unit	Budgeted labor hours
Jeans	500,000 units x	0.5 hours per unit =	250,000
Chinos	500,000 units x	0.7 hours per unit =	350,000
Total			600,000

The budgeted overhead rate =

$3,600,000 ÷ 600,000 direct labor hours = $6.00 per direct labor hour.

In practice, the factory would track costs by batch, or perhaps weekly, but to simplify our example, we record only one journal entry for each type of transaction. We also make the unrealistic assumption that there is no work-in-process at the end of the period. To focus the presentation on inventory-related accounts, T-accounts for some non-inventory accounts are omitted. Many companies would use two separate accounts instead of one account to track factory overhead; one account for factory overhead incurred, and the other account for factory overhead allocated.

(1)	Raw Materials: denim fabric	$3,000,000	
	Raw Materials: cotton twill	2,250,000	
	Accounts Payable		$5,250,000

(To record the purchase of 600,000 yards of denim fabric at $5.00 per yard, and 500,000 yards of cotton twill fabric at $4.50 per yard.)

(2)	Work-in-process: Jeans	$2,500,000	
	Raw Materials: denim fabric		$2,500,000

(To record materials requisitions for 500,000 yards, for the movement of denim from the receiving department to the cutting room.)

(3)	Work-in-process: Chinos	$2,160,000	
	Raw Materials: cotton twill		$2,160,000

(To record materials requisitions for 480,000 yards, for the movement of cotton twill from the receiving department to the cutting room.)

(4)	Work-in-process: Jeans	$2,800,000	
	Work-in-process: Chinos	4,200,000	
	Accrued Sewing Operator Wages		$7,000,000

(To record sewing operator wages for the year: 200,000 hours for jeans, and 300,000 hours for chinos, at $14 per hour.)

(5)	Factory Overhead	$3,300,000	
	Accounts Payable		$1,800,000
	Accrued Wages for Indirect Labor		900,000
	Accumulated Depreciation		600,000

(To record overhead costs incurred during the year.)

(6)	Work-in-process: Jeans	$1,200,000	
	Work-in-process: Chinos	1,800,000	
	Factory Overhead		$3,000,000

(To allocate overhead to production, using a budgeted overhead rate of $6 per direct labor hour, multiplied by actual hours used in production.)

(7)	Finished Goods: Jeans	$6,500,000	
	Work-in-process: Jeans		$6,500,000

(To record the completion of all 500,000 jeans, at $13.00 per pair.)

(8)	Finished Goods: Chinos	$8,160,000	
	Work-in-process: Chinos		$8,160,000

(To record the completion of all 400,000 chinos, at $20.40 per pair.)

(9)	Cost of Goods Sold: Jeans	$5,200,000	
	Cost of Goods Sold: Chinos	$7,140,000	
	Finished Goods: Jeans		$5,200,000
	Finished Goods: Chinos		$7,140,000

(To record the sale of 400,000 jeans and 350,000 chinos.)

(10)	Cost of Goods Sold: misapplied overhead	$300,000	
	Factory Overhead		$300,000

(To close out underapplied overhead to COGS. The total amount is taken to COGS because the result is not materially different from allocating misapplied overhead to COGS and finished goods inventory)

Raw Materials:
Denim Fabric

(1)	$3,000,000	$2,500,000	(2)
	$ 500,000		

Raw Materials:
Cotton Twill

(1)	$2,250,000	$2,160,000	(3)
	$ 90,000		

Accrued Sewing
Operator Wages

		$7,000,000	(4)

Factory Overhead

(5)	$3,300,000	$3,000,000	(6)
		300,000	(10)
	$0		

Work-in-Process: Jeans

(2)	$2,500,000	$6,500,000	(7)
(4)	2,800,000		
(6)	1,200,000		
	$0		

Work-in-Process: Chinos

(3)	$2,160,000	$8,160,000	(8)
(4)	4,200,000		
(6)	1,800,000		
	$0		

Finished Goods: Jeans

(7)	$6,500,000	$5,200,000	(9)
	$1,300,000		

Finished Goods: Chinos

(8)	$8,160,000	$7,140,000	(9)
	$1,020,500		

Cost of Goods Sold: Jeans

(9)	$5,200,000		

Cost of Goods Sold: Chinos

(9)	$7,140,000		

Accounts Payable

		$5,250,000	(1)
		1,800,000	(5)

COGS: misapplied overhead

(10)	$300,000		

The per-unit cost of finished goods inventory is calculated as follows:

Jeans:	$6,500,000 ÷	500,000 pairs	= $13.00 per pair
Chinos:	$8,160,000 ÷	400,000 pairs	= $20.40 per pair

These amounts can be detailed as follows:

Input	**Jeans**	**Chinos**
Fabric	1 yard/jean x $5/yard = $5.00	1.2 yards/chino x $4.50/yard = $5.40
Direct labor	0.4 hrs/jean x $14/hr = $5.60	0.75 hrs/chino x $14/hr = $10.50
Overhead	0.4 hrs/jean x $6.00/hr = $2.40	0.75 hrs/chino x $6.00/hr = $4.50
Total	$13.00	$20.40

Overhead is applied using the budgeted overhead rate of $6.00 per hour. However, this budgeted overhead rate is multiplied by the ***actual*** direct labor hours used by each product. Therefore, the only reason that more overhead or less overhead is allocated to each unit of product than budgeted is because each product used more of the allocation base or less of the allocation base (in this case, direct labor hours) than planned. Jeans used less overhead per unit than planned (0.4 versus 0.5), so less overhead is allocated to each pair of jeans than planned. Chinos used more overhead than planned (0.75 versus 0.7), so more overhead is allocated to each pair of chinos than planned.

The total misapplied overhead is a function of two factors: (1) the numerator in the budgeted overhead rate differing from actual overhead incurred; and (2), the denominator in the budgeted overhead rate differing from the actual quantity of the allocation base incurred. In the next two paragraphs, we consider each of these two factors.

Less overhead was incurred than planned: $3,300,000 versus $3,600,000. It is probable that one reason actual overhead incurred was less than budgeted is that fewer units were produced than planned. Unless all overhead is fixed, a reduction in output should decrease the total overhead incurred.

The denominator in the budgeted overhead rate can differ from the actual quantity of the allocation base incurred for two reasons. First, the amount of the allocation base used per unit of product (in this case, direct labor hours per unit) can differ from plan. Jeans used less direct labor hours per unit than planned, but chinos used more direct labor hours than plan. Second, the level of production can differ from plan (either total production or product mix). Because fewer units were made than planned (900,000 units versus 1,000,000 units), less overhead was allocated than otherwise would have been the case.

Exercises and Problems:

9-1: A company uses a Normal Costing System, and allocated overhead using direct labor hours. At the beginning of the year, the company estimated that there would be $960,000 in overhead and 40,000 direct labor hours worked. At the end of the year, the company had worked 39,000 hours and incurred $949,000 in overhead. What is the underapplied or overapplied overhead for the year?

(A) There is not enough information to determine this.

(B) $13,000 underapplied

(C) $11,000 overapplied

(D) $11,000 underapplied

9-2: DRG Company makes three products: cypress, silius, and sibelius. DRG expects to incur $900,000 in overhead, and expects to use 300 machine hours to make 500 units of cypress, 200 machine hours to make 100 units of silius, and 100 machine hours to make 50 units of sibelius. DRG uses a Normal Costing System, and uses machines hours as the allocation base.

Required:

A) If DRG uses 50 machine hours to make 20 units of sibelius, and actually incurs overhead of $1,111,000, how much overhead will be allocated to each unit of sibelius?

B) If DRG uses 200 machine hours to make 400 units of cypress, 400 machine hours to make 150 units of silius, and 50 machine hours to make 20 units of sibelius, what is the amount of overapplied or underapplied overhead?

9-3: The not-for-profit health clinic Shots-Я-Us provides various types of vaccinations and other shots, especially flu shots, to the public for free or for a nominal fee. The clinic is funded by several local governmental agencies as well as by a number of charitable organizations. Since different donors wish to fund different types of shots, the clinic determines the full cost of each type of shot, by adding overhead to the direct costs, and then provides this information to current and prospective donors.

Following are actual and budgeted costs for Shots-Я-Us for 2003:

	Actual	**Budgeted**
Number of patient visits Number of shots administered	5,000 6,000	4,000 4,500
Fixed overhead: salaries, rent for the facility, insurance, depreciation.	$94,000	$110,000
Variable overhead: nursing staff hoursly wages, utilities, disposable supplies.	$66,000	$40,500
Cost of hypodermics (a direct cost)	$1,000	$750
Cost of medications (a direct cost)	$30,000	$20,000

Required:

A) Under normal costing, the variable cost per shot is

(A) $9 per shot

(B) $13.61 per shot

(C) $14.17 per shot

(D) $38.06 per shot

B) Which of the following might help explain the increase in total variable overhead, from budget to actual?

(I) The increase in the number of shots given, from budget to actual.

(II) A misclassification of some fixed costs as variable (i.e., the costs are actually fixed, but are included under variable overhead, in both the budget and the actual columns).

(III) An increase in the average hourly wages for the nursing staff, from budget to actual.

(A) (I) only

(B) (III) only

(C) (I) and (III), but not (II)

(D) (I), (II) and (III)

9-4: The Santa Cruz Candy Company expects to incur overhead of $24,000. Also, the company expects to incur 300 direct labor hours (which is paid an average of $10 per hour) and 200 machine hours, in order to produce 2,000 pounds of candy. Using the information provided, calculate three different overhead rates using three different allocation bases. In each case, be sure to identify the allocation base.

9-5: The Santa Cruz Machine Shop allocates overhead based on machine hours, using a budgeted overhead rate. The budgeted overhead rate is calculated using an estimate of 6,000 machine hours in the denominator, and $60,000 in the numerator. Actual overhead was $500 less than budgeted. Actual machine hours were 1,500 more than budgeted. Calculate the misapplied overhead. Be sure to indicate whether this misapplied overhead is underapplied or overapplied.

9-6: Following is information for Penquo, Inc., which makes crayons in its Billings, MT factory:

	Budget	**Actual**
Production (# of boxes of crayons)	1,000	800
Total Direct Costs (materials & labor)	$ 2,000	$ 2,400
Total Machine Hours	140	100
Overhead (fixed and variable)	$2,800	$3,000

Penquo allocates overhead using a budgeted overhead rate, using machine hours as the allocation base. The overhead rate is then applied to product based on actual machine hours incurred. In other words, the company uses a Normal Costing system.

Required:

A) What is the overhead rate?

B) How much overhead would be applied to ***each*** box of crayons?

C) What is the actual ***direct*** cost of each box of crayons?

9-7: The Rio Grande Tile Company uses a budgeted overhead rate, and direct labor costs (i.e., direct labor dollars) as the allocation base. Overhead is applied using actual labor costs incurred. Following is information for January 2005. The labor wage rate was budgeted at $6 per hour, but was actually $8 per hour. Overhead was budgeted at $42,000, but was actually $49,000.

	Ceramic Tiles	Slate Tiles	Total
Production:			
Budgeted	4,000	2,000	6,000
Actual	3,000	4,000	7,000
Total Direct labor hours:			
Budgeted	500	200	700
Actual	400	300	700

Required:

A) Calculate the overhead rate. How much overhead would be allocated to all 4,000 slate tiles?

B) Now assume the company uses a budgeted overhead rate, direct labor hours as the allocation base, and applies overhead based on actual direct labor hours incurred. How much overhead would be applied to each ceramic tile?

C) Now assume the company allocates overhead using direct labor hours as in part B. What is the misapplied overhead? Is overhead overapplied or underapplied?

9-8: The Svendsgaard Organic Cereal Company makes cereal. Following is information for November:

	Actual Information	Budgeted Information
Pounds of cereal produced	800 pounds	800 pounds
Total direct materials	$3,200	$2,600
Total direct labor	$800	$800
Total machine hours	60 hours	50 hours
Total direct labor hours	45 hours	40 hours
Total overhead	$30,000	$30,000

Required:

A) Calculate the overhead rate using Normal Costing and machine hours as the allocation base.

B) Using Normal Costing, how much overhead will be applied to each pound of cereal?

C) Compute the amount of misapplied overhead.

9-9: Following is information for the James Woods Company, and one of the products made by the company. The factory has the capacity to produce 1.5 million square feet of wood product.

	Budget for the Company	**Actual for the Company**	**Budget for Mahogany Laminate**	**Actual for mahogany Laminate**
Production (in square feet)	1,000,000	1,200,000	50,000	40,000
Direct Product Costs	$2,500,000	$2,880,000	$150,000	$128,000
Variable Overhead	$2,000,000	$2,400,000		
Fixed Overhead	$1,500,000	$1,200,000		

Required:

A) Calculate the amount of overhead allocated to all of the mahogany laminate if the company uses a budgeted overhead rate, square feet of product as the allocation base, and applies the overhead rate based on actual square feet produced.

B) Calculate the amount of overhead allocated to all of the mahogany laminate if the company uses a budgeted overhead rate, direct product cost as the allocation base, and applies the overhead rate based on actual direct product costs incurred.

C) Calculate the amount of overhead allocated to all of the mahogany laminate if the company uses a budgeted overhead rate, square feet of product as the allocation base, and applies the overhead rate based on actual square feet produced. However, the company allocates variable overhead and fixed overhead separately. The denominator for the overhead rate for variable overhead is budgeted square feet, and the denominator for the overhead rate for fixed overhead is factory capacity (in terms of square feet).

9-10: A factory makes jeans and chinos. Overhead was budgeted at $150,000, but was actually $132,000. Budgeted production was 10,000 jeans and 5,000 chinos. Actual production was 10,000 jeans and 2,000 chinos. Overhead is applied using a budgeted overhead rate, and the allocation base is units of output.

Required:

A) Calculate the overhead rate.

B) How much overhead would be applied to the chinos production line?

C) What is the misapplied overhead? Is it underapplied or overapplied?

CHAPTER 10: Standard Costing

Chapter Contents:

Introduction:

If you were to design a cost accounting system with no accounting education other than financial accounting courses, you would probably design an accounting system that collects, summarizes, and reports actual costs. This approach would be consistent with the implicit assumption throughout every financial accounting course that when financial statements report historical cost data, such as would normally be the case for cost-of-goods-sold and ending inventory, that the information reported represents actual costs. Therefore, it comes as a surprise to most students that the initial journal entries to record the production and movement of inventory in the costing systems of most manufacturing firms are not based on actual costs at all, but rather are based on budgeted per-unit costs.

In most manufacturing firms, the initial journal entries to debit work-in-process, finished goods and cost-of-goods-sold are based on the actual quantity of output produced, multiplied by budgeted data about the inputs necessary to produce those outputs, and the budgeted costs of those inputs. Then, at the end of the month (or possibly quarterly), an “adjusting” or “closing” entry is made to record in the inventory accounts the difference between actual costs incurred, and the budgeted information that has formed the basis for the journal entries during the month. The nature of this adjusting entry depends on the materiality of the amounts involved. If the differences between actual costs and budgeted costs are small, this adjusting entry might be made in an expedient manner, involving only cost-of-goods-sold, but if the differences are large, the adjusting entry might also involve work-in-process and finished goods inventory accounts.

The accounting system described above is called a **standard costing system**, and it is widely-used by companies in the manufacturing sector of the economy. This chapter describes standard costing systems, and explains why companies use them. But first we discuss a related concept, **standard costs**, which constitutes an important component of standard costing systems.

Standard Costs:

A **standard**, as the term is usually used in management accounting, is a budgeted amount for a single unit of output. A **standard cost** for one unit of output is the budgeted production cost for that unit. Standard costs are calculated using engineering estimates of standard quantities of inputs, and budgeted prices of those inputs. For example, for an apparel manufacturer, standard quantities of inputs are required yards of fabric per jean and required hours of sewing operator labor per jean. Budgeted prices for those inputs are the budgeted cost per yard of fabric and the budgeted labor wage rate.

Standard quantities of inputs can be established based on ideal performance, or on expected performance, but are usually based on ***efficient and attainable*** performance. Research in psychology has determined that most people will exert the greatest effort when goals are somewhat difficult to attain, but not extremely difficult. If goals are easily attained, managers and employees might not work as hard as they would if goals are challenging. But also, if goals appear out of reach, managers and employees might resign themselves to falling short of the goal, and might not work as hard as they otherwise would. For this reason, standards are often established based on ***efficient and attainable*** performance.

Hence, a standard is a type of budgeted number; one characterized by a certain amount of rigor in its determination, and by its ability to motivate managers and employees to work towards the company's objectives for production efficiency and cost control.

There is an important distinction between standard costs and a standard costing system. Standard costs are a component in a standard costing system. However, even companies that do not use standard costing systems can utilize standards for budgeting, planning, and variance analysis.

Example of a Standard Cost Sheet:

The following example shows a standard cost sheet for a deluxe widget. It is a fictional example, yet provides a realistic picture of the level of detail involved in setting standard costs. Many manufacturing companies would have a standard cost sheet for each product, and would revise these cost sheets periodically, perhaps annually or once every three to five years, to incorporate changes in prices of inputs and manufacturing processes.

Inter-Office Memorandum
WIDGETS UNLIMITED, LTD.

To: Max David **Date:** July 8
From Iris Brenner
Project: Deluxe Widget

Attached is a sample of a cost model I did for the Deluxe Widget. As discussed at the last meeting, we probably want to use a model such as this to keep track of our standard costs as they change over time. We may want to have separate models for the motor and the housing. Please review the model and let me know of any changes that you feel would be helpful.

Distribution:
Hayden Dubinski
Louis DuPuis
Claire Brown
Thea Kimber
Allison Kirstukas
Zoe Pritchard

Deluxe Widget Standard Cost Sheet

Segments:	As Cast					
		100 pieces	5.00 ea			
		500 pieces	4.00 ea.		4.00	
		1000 pieces	3.00 ea			
		material overhead @	22%		0.88	
	Machining		0.1 hrs @	92.40	9.24	
	Coating	material overhead @	10%		1.00	
					0.10	
	Total for 6 segments					91.32
	(based on qty of 500)					
Lining:	Materials:			25.00		
		Resin		1.00		
		Adhesive		0.75		
		Prepreg		2.00		
		material overhead @	22%	6.33		
				35.08		
	Molding:					
		Winding	0.20 hrs @	85.00	17.00	
		Tool Assembly	0.15 hrs @	85.00	12.75	
		Injection	0.10 hrs @	85.00	8.50	
		Decouple	0.01 hrs @	85.00	0.85	
		Demold	0.25 hrs @	85.00	21.25	
			0.71 hrs		60.35	
	Total for 6 Linings					572.55
Sleeve:	Material (tubing)				5.00	
		material overhead @	22%		1.10	
	Machining		0.25 hrs @	92.40	23.10	
	Coating				2.00	
		material overhead @	10%		0.20	
	Total for 6 Sleeves					188.40
	For 6 Linings & Sleeves					760.95
Closure:	Material				9.00	
		material overhead @	22%		1.98	
	Machining		0.16 hrs @	92.40	14.48	
	Total: 6 Closures					152.76

Ring:	Material:	Carbon			100.00	
		Resin			4.00	
		Prepreg			9.00	
		material overhead @	22%		24.86	
					137.86	
	Molding:	Winding	0.30 hrs @	85.00	25.50	
		Tool Assembly	0.20 hrs @	85.00	17.00	
		Resin Transfer	0.10 hrs @	85.00	8.50	
		Demolding	0.10 hrs @	85.00	8.50	
			0.70 hrs @		59.50	
	Total for Ring					197.36
Core:	Material				0.00	
		material overhead @	22%		0.00	
	Machining		0.0 hrs @	92.40	0.00	
	Total for Core (Engineering Estimate)					200.00
Top:	Top from Vendor				15.00	
		material overhead @	22%		3.30	
	Anodize				5.00	
		material overhead @	10%		0.50	
	Total for Top					23.80
Window:	Window from Vendor				80.00	
		material overhead @	22%		17.60	
	Anodize				8.00	
		material overhead @	10%		0.80	
	Total for Window					106.40
Misc. labor:	Assembly and Balancing		0.75 hrs @	92.40	69.30	
	Spin		0.50 hrs @	92.40	46.20	
	Total for Misc. Labor					115.50
Total Deluxe Widget Standard Cost (based on quantity of 500)						$1,648.08
Total Deluxe Widget Standard Cost w/o Sleeves and Closures						$1,306.93

Standard Costing Systems:

A standard costing system initially records the cost of production at standard. Units of inventory flow through the inventory accounts (from work-in-process to finished goods to cost of goods sold) at their per-unit standard cost. When actual costs become known, adjusting entries are made that restate each account balance from standard to actual (or to approximate such a restatement). The components of this adjusting entry provide information about the company's performance for the period, particularly with regard to production efficiency and cost control.

Standard Costing Systems and Flexible Budgeting:

There is an important connection between flexible budgeting, which was discussed in Chapter 6, and standard costing. In fact, a standard costing system tracks inventory during the period at the flexible budget amount. Recall that the flexible budget is the budgeted per-unit cost multiplied by the actual number of units. Hence, a standard costing system answers the question: what would the income statement and balance sheet look like, if costs and per-unit input requirements were exactly as planned, given the actual output achieved (units made and units sold).

Given the point made in the previous paragraph, it follows that the adjustment made at period-end to restate the inventory accounts for the difference between the standard cost account balance and the actual cost account balance constitutes the difference between the flexible budget amount and actual costs. For direct costs, such as materials and labor, this adjusting entry represents the sum of the price (or labor wage rate) variance and the efficiency (or quantity) variance. For overhead costs, this adjusting entry represents misapplied overhead. For variable overhead, misapplied overhead consists of the sum of the spending variance and the efficiency variance. For fixed overhead, misapplied overhead consists of the sum of the spending variance and the volume variance. These overhead variances are discussed in Chapter 17.

Hence, standard costing systems track inventory at flexible budget amounts during the period, and post adjusting entries at the end of the period that provide variance information that managers use for performance evaluation and control.

ZFN Apparel Company, Standard Costing Example:

We continue with the ZFN example from the previous two chapters. The ZFN apparel company in Albuquerque, New Mexico makes jeans and premium chinos. Each product line has its own assembly line on the factory floor. The following table shows actual and budgeted information for the year. There was no beginning or ending work-in-process.

	Budgeted Information	**Actual Results**
Units produced		
Jeans	500,000	500,000
Chinos	500,000	400,000
Total	1,000,000	900,000
Direct Costs:		
Jeans:		
Materials (denim)		
Price per yard	$ 4.80	$ 5.00
Yards per jean	x 1.10	x 1.00
Material cost per jean	$ 5.28	$ 5.00
Direct labor		
Wage rate	$15.00	$14.00
Hours per jean	x 0.50	x 0.40
Labor cost per jean	$ 7.50	$ 5.60
Chinos:		
Materials (cotton twill)		
Price per yard	$ 4.40	$ 4.50
Yards per chino	x 1.10	x 1.20
Material cost per chino	$ 4.84	$ 5.40
Direct labor		
Wage rate	$15.00	$14.00
Hours per chino	x 0.70	x 0.75
Labor cost per chino	$10.50	$10.50
Factory Overhead	$3,600,000	$3,300,000

Most of this information is available from the previous chapter. Also, the ZFN example in the previous chapter derived the budgeted overhead rate of $6.00 per direct labor hour, and that same overhead rate is used by the standard costing system. Based on this information, the standard costing system would debit the finished goods inventory account as follows:

	Jeans	**Chinos**
Standard cost per unit:		
Materials	$5.28	$4.84
Labor	$7.50	$10.50
Overhead	$6.00 x 0.50 = $3.00	$6.00 x 0.70 = $4.20
Total standard cost per unit	$15.78	$19.54
Actual units produced	x 500,000	x 400,000
Total	$7,890,000	$7,816,000

Recall from the previous chapter that 400,000 jeans and 350,000 chinos were sold. The entries to record the movement of inventory from the finished goods inventory account into the cost-of-goods-sold account would multiply these sales volumes by $15.78 per jean and $19.54 per chino.

Reasons for using a Standard Costing System:

There are several reasons for using a standard costing system:

Cost Control: The most frequent reason cited by companies for using standard costing systems is cost control. One might initially think that standard costing provides less information than actual costing, because a standard costing system tracks inventory using budgeted amounts that were known before the first day of the period, and fails to incorporate valuable information about how actual costs have differed from budget during the period. However, this reasoning is not correct, because actual costs *are* tracked by the accounting system in journal entries to accrue liabilities for the purchase of materials and the payment of labor, entries to record accumulated depreciation, and entries to record other costs related to production. Hence, a standard costing system records *both* budgeted amounts (via debits to work-in-process, finished goods, and cost-of-goods-sold) *and* actual costs incurred. The difference between these budgeted amounts and actual amounts provides important information about cost control. This information could be available to a company that uses an actual costing system or a normal costing system, but the analysis would not be an integral part of the general ledger system. Rather, it might be done, for example, on a spreadsheet program on a personal computer. The advantage of a standard costing system is that the general ledger system itself tracks the information necessary to provide detailed performance reports showing cost variances.

Smooth out short-term fluctuations in direct costs: Similar to the reasons given in the previous chapter for using normal costing to average the overhead rate over time, there are reasons to average direct costs. For example, if an apparel manufacturer purchases denim fabric from different textile mills at slightly different prices, should these differences be tracked through finished goods inventory and into cost-of-goods-sold? In other words, should the accounting system track the fact that jeans production on Tuesday cost a few cents more per unit than production on Wednesday, because the fabric used on Tuesday came from a different mill, and the negotiated fabric price with that mill was slightly higher? Many companies prefer to average out these small differences in direct costs.

When actual overhead rates are used, production volume of each product affects the reported costs of all other products: This reason, which was discussed in the previous chapter on normal costing, represents an advantage of standard costing over actual costing, but does not represent an advantage of standard costing over normal costing.

Costing systems that use budgeted data are economical: Accounting systems should satisfy a cost-benefit test: more sophisticated accounting systems are more costly to design, implement and operate. If the alternative to a standard costing system is an actual costing system that tracks actual costs in a more timely (and more expensive) manner, then management should assess whether the improvement in the quality of the decisions that will be made using that information is worth the additional cost. In many cases, standard costing systems provide highly reliable information, and the additional cost of operating an actual costing system is not warranted.

Summary of Actual Costing, Normal Costing and Standard Costing:

The following table summarizes and compares three commonly-used costing systems.

	Actual Costing System	**Normal Costing System**	**Standard Costing System**
Direct Costs:	(**Actual** prices or rates x **actual** quantity of inputs per output) x **actual** outputs	(**Actual** prices or rates x **actual** quantity of inputs per output) x **actual** outputs	(**Budgeted** prices or rates x **standard inputs allowed** for each output) x **actual** outputs
Overhead Costs:	**Actual** overhead rates x **actual** quantity of the allocation base incurred.	**Budgeted** overhead rates x **actual** quantity of the allocation base incurred.	**Budgeted** overhead rates x (**standard inputs allowed** for actual outputs achieved)

The following points are worth noting:

1. All three costing systems record the cost of inventory based on actual output units produced. The static budget level of production does not appear anywhere in this table.

2. Actual costing and normal costing are identical with respect to how direct costs are treated.

3. With respect to overhead costs, actual costing and normal costing use different overhead rates, but both costing systems multiply the overhead rate by the same amount: the actual quantity of the allocation base incurred.

4. Normal costing and standard costing use the same overhead rate.

5. Standard costing records the cost of inventory using a flexible budget concept: the inputs "that should have been used" for the output achieved.

There are costing systems other than these three. For example, some service sector companies apply direct costs using budgeted prices multiplied by actual quantities of inputs. For example, many accounting firms track professional labor costs using budgeted professional staff hourly rates multiplied by actual staff time incurred on each job.

Exercises and Problems:

Discussion Question 10-1:
Refer to the standard cost sheet for the Deluxe Widget in the first part of this chapter.

A) Where does this cost information come from?

B) What components of the widget are outsourced?

C) What is going on with the costing of the "core"?

D) How is manufacturing overhead applied? What are the allocation bases?

10-2: A factory makes only one product. Which of the following circumstances ensures that the amount of variable overhead recorded as part of the cost of inventory is the same under Normal Costing as under Standard Costing, when direct labor dollars is used as the allocation base, and the factory makes exactly the number of units as were budgeted.

(I) The actual overhead rate is the same as the budgeted overhead rate.

(II) The actual direct labor dollars is the same as the budgeted direct labor dollars.

(A) (I) is sufficient.

(B) (II) is sufficient.

(C) (I) and (II) are sufficient together, although neither is sufficient by itself.

(D) The amount recorded for variable overhead is always the same under Normal Costing as under Standard Costing. The only difference between these two costing systems pertains to direct costs.

10-3: The Jaramillo Tortilla Factory manufactures two products: corn tortillas, and flour tortillas. Both types of tortillas are made in the same factory, but on different machinery, and each type of tortilla has its own production line. Overhead includes variable and fixed costs, and is allocated based on machine hours. Which of the following costing methods is likely to result in underapplied overhead, if the demand and production of corn tortillas drops relative to plan (i.e., relative to the static budget)?

(I) The use of an Actual Costing System.

(II) The use of a Normal Costing System.

(III) The use of a Standard Costing System.

(A) (I) only

(B) (III) only

(C) (II) and (III), but not (I)

(D) Neither (I), (II) nor (III)

10-4: A company uses a Standard Costing System, and allocated overhead using direct labor hours. At the beginning of the year, the company estimated that there would be \$960,000 in overhead and 40,000 direct labor hours worked. At the end of the year, the company had worked 39,000 hours and incurred \$949,000 in overhead. What is the underapplied or overapplied overhead for the year?

(A) There is not enough information to determine this.

(B) \$13,000 underapplied

(C) \$11,000 overapplied

(D) \$11,000 underapplied

10-5: The Resistol Company manufactures hats. The company uses a Standard Costing System. Production of one hat is budgeted at \$10 of direct materials, and 2 hours of direct labor at \$20 per hour. Overhead is budgeted at \$500,000, and is allocated based on direct labor hours. The static budget calls for production of 10,000 hats in 2005. Actual costs per hat in 2005 were \$12 of direct materials, and 2.2 hours of direct labor at \$19 per hour. Actual overhead was \$400,000. Actual production was 10,500 hats. Calculate the cost of goods manufactured at standard.

10-6: The following information applies to the manufacture of horseshoes by the town blacksmith:

	Budget	**Actual**
Direct Materials:		
Cost per pound	$5.00	$5.13
Pounds per unit	3	2.78
Direct Labor:		
Wage rate per hour	$20.00	$19.36
Hours per unit	0.5	0.526
Manufacturing Overhead:		
Rate per labor hour	$5.00	$5.14

The blacksmith uses a standard costing system. On January 1st she has no inventory. She manufactures 120 horseshoes during January, and sells 100 during the month. Variances are written off to Cost of Goods Sold. What is the cost of ending inventory, rounded to the nearest dollar?

(A) $543

(B) $550

(C) $539

(D) $541

10-7: Lincoln Trains manufactures model railroad equipment. The company uses a standard costing system. The following information pertains to the Lincoln Steam Engine Division for 2004.

Budgeted output units	14,000 engines
Budgeted fixed manufacturing overhead	$11,200
Budgeted variable manufacturing overhead	$1.50 per direct labor hour
Budgeted direct manufacturing labor hours	0.2 hours per engine
Fixed manufacturing costs incurred	$12,000
Direct manufacturing labor hours used	4,000 hours
Variable manufacturing costs incurred	$5,500
Actual units manufactured	15,000 engines

Required: Calculate the flexible budget variance for variable overhead.

10-8: The Hopi Popcorn Factory makes and sells two kinds of popcorn: plain, and cheese-flavored. The only direct materials used for the plain popcorn is corn. The company allocates all overhead (fixed and variable) based on pounds of direct materials (i.e., pounds of popcorn).

	Budget	**Actual**
boxes of plain popcorn	1,000	1,200
boxes of cheese-flavored	500	500
capacity of the facility (boxes)	2,000	2,000
Direct materials (corn):		
for plain popcorn:		
cost per pound	$0.25 per pound	$0.30 per pound
pounds per box	1.00 pound	1.10 pounds
for cheese-flavored popcorn:		
cost per pound	$0.25 per pound	$0.30 per pound
pounds per box	1.00 pound	0.90 pounds
Direct labor:		
(for plain popcorn only)		
wage rate	$10 per hour	$12 per hour
hours per box	0.10 hours	0.11 hours
Total variable overhead	$15,000	$18,000
Total fixed overhead	$10,000	$12,500

Required:

A) Calculate the cost of producing one box of plain popcorn, and also all of the plain popcorn, assuming the company uses an Actual Costing System.

B) Calculate the cost of producing one box of plain popcorn, and also all of the plain popcorn, assuming the company uses a Normal Costing System.

C) Calculate the cost of producing one box of plain popcorn, and also all of the plain popcorn, assuming the company uses a Standard Costing System. Do not consider any adjusting entries at the end of the period.

10-9: The Baked Apple is a bakery specializing in pies. The Bakery uses a Standard Costing System. Following are the standards for the direct costs for making an apple pie:

Direct Materials
Flour
  Quantity: 2 cups
  Price: $0.40 per cup

Shortening
  Quantity: 2/3rds cup
  Price: $0.60 per cup

Apples
  Quantity: 7 apples
  Price: $0.30 per apple

Direct labor
  Quantity: 20 minutes of labor
  Wage rate: $12 per hour

The company does not apply overhead to its products. The static budget for May indicated a production and sales level of 150 apple pies. In fact, the restaurant made and sold 160 apple pies.

Required:

A) What is the standard cost per unit for making an apple pie?

B) What would the static budget show for the cost of production for all apple pies?

C) The actual cost in direct materials and labor to make all 160 pies was $960. What is the flexible budget variance for apple pies?

D) 330 cups of flour were used to make all of the apple pies. The actual price paid per cup of flour was $0.35. Calculate the quantity and price variances for flour. Provide a possible explanation for the quantity variance.

E) 50 labor hours were spent making apple pies, at an average wage rate of $11 per hour. Calculate the efficiency and wage rate variances for labor. Also calculate the flexible budget variance for labor.

10-10: Silverstream Company makes travel trailers. The following information pertains to the company's Ohio Division, which manufactures and markets only one model of trailer: the 32-foot Ambassador trailer. Following is budgeted and actual information for the Ohio Division for 2004:

	Budgeted		**Actual**
	Per Unit	Total	
Trailers manufactured in 2004		1,000	800
Trailers sold in 2004		1,000	600
Sales price per trailer		$45,000	$45,000
Direct materials costs (all variable costs):			
Aluminum	$4,000	$4,000,000	$3,400,000
Steel	$2,000	$2,000,000	$1,600,000
Other	$4,000	$4,000,000	$3,800,000
Total materials costs	$10,000	$10,000,000	$8,800,000
Direct labor costs (all variable costs)	$5,000	$5,000,000	$3,800,000
Variable overhead manufacturing costs	$8,000	$8,000,000	$6,400,000
Fixed overhead costs:			
Manufacturing fixed overhead		$10,000,000	$11,000,000
Non-manufacturing fixed overhead		$2,000,000	$2,100,000

Additional information:
The company started the year with no inventory of finished trailers or direct materials.

Direct labor standard:	250 hours per trailer
Actual direct labor hours incurred:	195,000 hours
The budgeted quantity of aluminum:	100 lbs. per trailer
The budgeted cost of aluminum:	$40 per lb.
The actual quantity of aluminum purchased	84,000 lbs.
The actual quantity of aluminum used	82,927 lbs.

The division allocates overhead based on direct labor hours. The only non-manufacturing costs are certain fixed overhead costs, as shown above.

Calculate the following:

A) The overhead rate to use for all manufacturing costs under Standard Costing.

B) The overhead rate to use for all manufacturing costs under Normal Costing.

C) The total manufacturing cost per trailer under Standard Costing.

D) The total manufacturing cost per trailer under Actual Costing.

E) The total manufacturing cost per trailer under Normal Costing.

CHAPTER 11: Activity-Based Costing

Chapter Contents:

Background:

Activity-based costing (**ABC**) is a better, more accurate way of allocating overhead.

Recall the steps to product costing:

1. Identify the **cost object**;
2. Identify the **direct costs** associated with the cost object;
3. Identify **overhead costs**;
4. Select the **cost allocation base** for assigning overhead costs to the cost object;
5. Develop the **overhead rate** per unit for allocating overhead to the cost object.

Activity-based costing refines steps #3 and #4 by dividing large heterogeneous cost pools into multiple smaller, homogeneous cost pools. ABC then attempts to select, as the cost allocation base for each overhead cost pool, a cost driver that best captures the ***cause and effect relationship*** between the cost object and the incurrence of overhead costs. Often, the best cost driver is a nonfinancial variable.

ABC can become quite elaborate. For example, it is often beneficial to employ a two-stage allocation process whereby overhead costs are allocated to intermediate cost pools in the first stage, and then allocated from these intermediate cost pools to products in the second stage. Why is this intermediate step useful? Because it allows the introduction of ***multiple cost drivers*** for a single overhead cost item. This two-stage allocation process is illustrated in the example of the apparel factory below.

ABC focuses on activities. A key assumption in activity-based costing is that overhead costs are caused by a variety of activities, and that different products utilize these activities in a non-homogeneous fashion. Usually, costing the activity is an intermediate step in the allocation of overhead costs to products, in order to obtain more accurate product cost information. Sometimes, however, the activity itself is the cost object of interest. For example, managers at Levi Strauss & Co. might want to know how much the company spends to acquire denim fabric, as input in a sourcing decision. The “activity” of acquiring fabric incurs costs associated with negotiating prices with suppliers, issuing purchase orders, receiving fabric, inspecting fabric, and processing payments and returns.

Apparel Factory Example of Two-Stage ABC Allocations:

Assume that an apparel factory uses forklifts in only two departments:

> The first department is Receiving, where large rolls of fabric are unloaded from semi-trailers and moved into storage, and later moved from storage to the cutting room.
>
> The second department is Shipping, where cartons of finished pants are staged and then loaded onto semi-trailers for shipment to the warehouse.

Costs associated with operating these forklifts consist of the following:

Forklift costs:	
Operator salaries	$ 80,000
Maintenance	8,000
Depreciation expense	7,500
Other	2,500
Total forklift costs	$ 98,000
All other overhead	1,400,000
Total overhead for the factory	$1,498,000

The factory operates two production lines. One line is for jeans, which are made from denim fabric. The other production line is for casual slacks, which are made from a cotton-twill fabric. Operational data for the month is as follows:

	Jeans	Casual Slacks	Total
Units produced	420,000	200,000	620,000
Direct labor hours	70,000	40,000	110,000
Rolls of fabric	1,750	640	2,390
Cartons shipped	52,500	20,000	72,500

The factory ships product to the company's warehouse, not directly to customers. Hence, to facilitate stocking at the warehouse, each carton is packed with jeans or casual slacks, but not both. An examination of the information in the above table reveals that a carton holds more slacks than jeans, and that fewer pants are cut from a roll of denim fabric than from a roll of cotton-twill. These operational statistics are driven by the fact that denim is a heavier-weight fabric than cotton-twill, and hence, it is bulkier. The data also indicate that more direct labor minutes are required for a pair of slacks than for a pair of jeans, which reflects greater automation on the jeans production line.

Traditional costing

Under a traditional costing system, forklift costs are pooled with all other overhead costs for the factory (electricity, property taxes, front office salaries, etc.), and then allocated to product based on direct labor hours (sewing operator time) for each product.

Overhead rate under traditional costing:

Total overhead costs	$ 1,498,000
Quantity of allocation base (direct labor hours)	÷ 110,000
Overhead rate per direct labor hour	$ 13.62

of which the following is due to forklift costs:

Forklift overhead	$ 98,000
Quantity of allocation base (direct labor hours)	÷ 110,000
Overhead rate for forklift costs per direct labor hour	$ 0.8909

Forklift overhead applied to product using traditional costing:

	Jeans	**Slacks**
Overhead rate	$ 0.8909	$ 0.8909
Quantity of allocation base (direct labor hours)	x 70,000	x 40,000
Forklift costs allocated	$ 62,363	$ 35,636
Units produced	420,000	200,000
Approximate cost per unit	$0.15	$0.18

Note that all forklift overhead is allocated: $62,363 + $35,636 = $97,999 (the difference due to rounding of the overhead rate).

If the casual slacks product manager asks why her product incurs more forklift costs on a per-unit basis than jeans, even though casual slacks use a lighter-weight fabric, the answer is that her product uses more direct labor per unit, which perhaps is not a very satisfying explanation from her perspective.

Activity-based costing

An ABC system might first allocate forklift costs into two cost pools: one for the Receiving Department and one for the Shipping Department. Then costs from each of these two departments would be allocated to the two product lines.

ABC first-stage allocation

The first-stage allocation might use an estimate of the amount of time the forklifts spend in each department. A one-time study indicates that forklifts spend approximately 70% of their time in the Shipping Department and 30% of their time in the Receiving Department. An additional benefit of ABC is that if this information were collected periodically, the managers of these two departments might be more willing to share the forklifts with each other, since the reported costs of each department would then depend on the time the forklifts spend in that department. In any case, the 70/30 allocation results in the following first-stage allocation:

30% of $98,000 = $29,400 is allocated to the Receiving Department
70% of $98,000 = $68,600 is allocated to the Shipping Department

ABC second-stage allocation

	Receiving	**Shipping**
Total costs	$29,400	$68,600
Quantity of allocation base	÷ 2,390 rolls	÷ 72,500 cartons
Overhead rate	$12.30 per roll	$0.946 per carton
Allocation to Jeans		
Overhead rate	$12.30 per roll	$0.946 per carton
Quantity of allocation base	x 1,750 rolls	x 52,500 cartons
	$21,525	$49,665
Allocation to Slacks		
Overhead rate	$12.30 per roll	$0.946 per carton
Quantity of allocation base	x 640 rolls	x 20,000 cartons
	$7,872	$18,920

Total forklift costs allocated to each product:

	Jeans	**Slacks**	**Total**
From Receiving	$21,525	$ 7,872	$29,397
From Shipping	49,665	18,920	68,585
Total	$71,190	$26,792	$97,982
Units Produced	420,000	200,000	
Approximate Cost per unit	$0.17	$0.13	

The $18 difference between total costs allocated of $97,982 and the original costs of $98,000 is due to rounding.

The first-stage allocation allows the second-stage to allocate forklift costs to product using rolls of fabric as the allocation base in Receiving, and cartons of pants as the allocation base in Shipping. Since there are no rolls of fabric in the shipping department, and no cartons in the Receiving Department, without the first stage allocation, there would be no obvious choice of an allocation base that would capture the cause-and-effect relationship between the costs of operating the forklifts, and the utilization of forklift resources by each product in the two departments.

Conclusion

The traditional costing method allocates more forklift costs to slacks than to jeans on a per-unit basis because casual slacks require more sewing effort. ABC allocates more forklift costs to jeans than to casual slacks, on a per-unit basis, which is intuitive because denim is a heavier-weight fabric than cotton twill.

Cost Hierarchy:

In ABC, cost pools are often established for each level in a hierarchy of costs. For manufacturing firms, the following **cost hierarchy** is commonly identified:

Unit-level costs: For any given product, these costs change in a more-or-less linear fashion with the number of units produced. For example, fabric and thread are unit-level costs for an apparel manufacturer: if the company wants to double production, it will need twice as much fabric and thread.

Batch-level costs: These costs change in a more-or-less linear fashion with the number of batches run. Machine setup costs are often batch-level costs. The time required to prepare a machine to run one batch of product is usually independent of the number of units in the batch: the same time is required to prepare the machine to run a batch of 100 units as a batch of 50 units. Hence, batch-level costs do not necessarily vary in a linear fashion with the number of units produced.

Product-level costs: These costs are usually fixed and direct with respect to a given product. An example is the salary of a product manager with responsibility for only one product. The product manager's salary is a fixed cost to the company for a wide range of production volume levels. However, if the company drops the product entirely, the product manager is no longer needed.

Facility-level costs: These costs are usually fixed and direct with respect to the facility. An example is property taxes on the facility, or the salaries of front office personnel such as the receptionist and office manager.

One reason why ABC provides more accurate product cost information is that traditional costing systems frequently allocate all overhead, including batch-level, product-level, and facility-level overhead, using an allocation base that is appropriate only for unit-level costs. The better information obtained from explicitly incorporating the cost hierarchy is illustrated in the following example:

Milwood Mills:

Milwood Mills makes decorative woodcut prints for sale to restaurants. Its Billings, Montana factory makes two of the company's more popular designs: *Bull and Matador* and *Dogs Playing Poker*. Following is selected information for a typical month:

	Bull	*Dogs*	*Total*
Number of woodcuts produced	500	1,500	2,000
Direct materials costs	$2,500	$3,300	$5,800
Direct labor costs	$1,400	$1,600	$3,000
Number of batches	10	30	40
Total overhead			$42,000
Batch setup costs (included in total overhead)			$12,000

The traditional costing system allocates all overhead based on number of units produced. This method allocates overhead of $21 ($42,000 ÷ 2,000 units) to each *Bull and Matador* woodcut and to each *Dogs Playing Poker* woodcut, of which $6 ($12,000 ÷ 2,000 units) represents batch setup costs.

The manager of the *Bull and Matador* production line develops a technique for doubling the batch size on her line without incurring any additional costs. Hence, she can now make 500 woodcuts per month using only 5 setups. She thinks this should cut her batch setup costs in half. She reasons as follows:

> What “drives” batch setup costs? It is the number of batches. The cost per batch is $300. ($300 per batch x 40 batches = $12,000, which agrees to the monthly information provided above.) Using the new batch size, the batch setup cost is still $300, but instead of spreading this $300 over 50 units, the $300 will be spread over 100 units, lowering my per-unit batch setup cost from $6 to $3, and lowering my total unit cost by $3.

However, the following month, after implementation of the manager’s increased batch size, reported costs are as follows: Total overhead drops by $1,500, which represents the cost savings from eliminating five batch setups for the *Bull and Matador* production line. Hence, total overhead drops from $42,000 to $40,500. The traditional costing system allocates this $40,500 to 2,000 units as $20.25 per unit. This new overhead rate represents a savings of $0.75 per unit for every woodcut: every *Bull and Matador* woodcut, and every *Dogs Playing Poker* woodcut. The manager of the *Bull and Matador* production line is disappointed. Her reported costs did not decrease by as much as she had anticipated, because most of the benefit from the reduction in batch setups has been allocated to the *Dogs Playing Poker* production line.

An ABC system that explicitly recognizes the cost hierarchy would correct this problem. Under the old production process, ABC would have allocated costs as follows: The cost pool for batch setup costs was previously $12,000, which would have been allocated to the two product lines based on the number of batches run by each line:

> Overhead rate = total batch setup costs ÷ total number of batches
> = $12,000 ÷ 40 batches = $300 per batch
>
> Batch setup costs of $300 per batch
> x 10 batches = $3,000 would have been allocated to *Bull*,
> x 30 batches = $9,000 would have been allocated to *Dogs*.

In a second-stage allocation, the $3,000 allocated to the *Bull and Matador* production line would have been allocated to 500 units for a cost of $6 per woodcut. This allocation is the same as under the traditional costing system only because the batch size of 50 woodcuts per batch was originally the same on both production lines.

After the batch size is increased for *Bull and Matador*, production information is as follows:

	Bull	*Dogs*	*Total*
Number of woodcuts produced	500	1,500	2,000
Direct materials costs	$2,500	$3,300	$5,800
Direct labor costs	$1,400	$1,600	$3,000
Number of batches	5	30	35
Total overhead			$40,500
Batch setup costs (included in total overhead)			$10,500

Now ABC would allocate costs as follows:

In the first stage: $10,500 ÷ 35 batches = $300 per batch (same as before).

> $300 per batch x 5 batches = $1,500 to *Bull and Matador* (50% less than before),
> $300 per batch x 30 batches = $9,000 to *Dogs Playing Poker* (same as before).

In the second stage, the $1,500 is allocated to the 500 *Bull and Matador* woodcuts, for $3 per woodcut. This $3 per woodcut reflects the cost savings originally anticipated by the manager of the *Bull and Matador* production line. The cost per woodcut for *Dogs Playing Poker* remains unchanged ($9,000 ÷ 1,500 units = $6), which is appropriate because nothing has changed on the *Dogs Playing Poker* production line.

ABC in the Service Sector:

ABC is as important to companies in the merchandising and service sectors as to manufacturing companies. In fact, although the origination of ABC is generally ascribed to manufacturing companies in the 1980s, by then hospitals were already allocating overhead costs to departments and then to patient services using methods similar to ABC. Hospitals were required to implement relatively sophisticated allocation processes in order to comply with Medicare reimbursement rules. After its inception in the 1960s, Medicare established detailed rules regarding how overhead costs should be grouped into cost pools, and the choice of appropriate allocation bases for allocating overhead costs to departments and then to patients. Within these rules, hospitals were able to maximize revenues by shifting costs from areas such as pediatrics, labor and delivery, and maternity (which have low rates of Medicare utilization) to the intensive care unit, the critical care unit, and surgery (which have higher rates of Medicare utilization). Other non-manufacturing industries that have benefited from ABC include financial services firms and retailers.

ABC Implementation Issues:

Another refinement in product costing that often accompanies implementation of ABC focuses on step #2 of the five-step product costing sequence: "identify the direct costs associated with the cost object." The refinement involves the following. For a given cost object, the company attempts to identify costs currently treated as overhead that have not been—but can be—traced directly to the cost object. In other words, costs are moved from the overhead cost pool to the direct cost category. For example, an accounting firm might take certain office-support expenses formerly treated as overhead, such as printing and copying, and start tracking and assigning these costs to specific jobs (audits, tax engagements, etc.) for internal reporting and profitability analysis (but not necessarily for client billing purposes).

The successful implementation of ABC usually requires participation by managers from non-accounting functions, such as production and marketing. Because ABC focuses on activities, and activities often cut across departments and functional areas, implementing ABC can improve lines of communication and cooperation within the company. On the other hand, more accurate cost allocation does not, by itself, reduce costs. The initial move from a traditional costing system to ABC usually shifts overhead costs from some products to other products, with some managers “winning” and some “losing.” Some companies have found that hiring an outside consulting firm to assist with the ABC adoption facilitates obtaining “buy-in” by managers and employees throughout the company. Perhaps partly for this reason, ABC implementation has become an important consulting product for accounting firms and for many consulting firms.

Although ABC should provide the company more accurate information, it is not a panacea; some companies that invested time and money implementing ABC did not realize the benefits they expected. Some of these companies have reverted to simpler, more traditional costing systems.

Exercises and Problems

Discussion Question 11-1: Colorado Airlines is operating at capacity on its Denver to New York route, offering three flights each day on this route, using Boeing 737’s, each with a capacity of 120 passengers. Airline management wants to determine the least expensive way to increase daily capacity from 360 passengers to 480 passengers. One possibility is to add one more Boeing 737 per day. The other possibility is to replace the current equipment with Boeing 727’s, which hold 160 passengers each. In either case, management believes the planes will continue to operate at capacity.

To ascertain the least expensive way to increase passenger capacity on the Denver-to-New York route, management has asked you to determine what “drives” the airline’s operating costs.

Required:
Consider the following cost drivers:

a) Number of flights per day
b) Number of miles flown per day
c) Number of passengers served per day
d) Number of passenger miles (miles flown per day multiplied by number of passengers)

For each of the following costs, identify the most appropriate cost driver from the above list.

1. Passenger meals
2. Airplane fuel
3. Ground personnel who refuel the plane, and mechanics on the ground
4. Ground personnel who serve passengers at the ticket counter and at the gate.
5. Cockpit crew salaries (Federal Aviation Administration regulations limit pilots to fly no more than a certain number of hours per month).
6. Flight attendant salaries (assume that Federal Aviation Administration regulations limit flight attendants to fly no more than a certain number of hours per month, and require one flight attendant for every 40 passengers).
7. Economic depreciation of the airplane (i.e., without regard to the depreciation method chosen for accounting purposes, choose the cost driver that best captures the wear and tear on the equipment, and determines the economic life of the plane).
8. Personnel who handle baggage

11-2: You are the Chief Financial Officer of a large New York hospital that has decided to implement activity-based costing. Which of the following would you choose as the allocation base for allocating the costs of the Linen and Laundry Department to the four patient wards that utilize linen and laundry services, if your objective is to generate the most accurate cost information possible? The four wards are: (1) surgery, (2) adolescent care, (3) maternity and nursery, and (4) pediatric care.

(A) Patient occupancy rates (i.e., patient days) in each ward.
(B) The number of washing machines in the Laundry and Linen Department
(C) The number of Medicare patients in each ward.
(D) The number of patient admissions to each ward.

11-3: In which of the following situations are the techniques of activity-based costing most likely to lead to improved production or marketing decisions.

(I) The All-Direct Company, which incurs significant direct costs, but no overhead costs, to manufacture its extensive and ever-changing product line.

(II) The One-Size-Fits-All Hat Company, which makes a single product that is sold to many different kinds of retailers, in varying volumes, through various marketing channels, in many different geographic regions.

(III) The Iowa Wind Turbine Electric Cooperative, which has direct costs and fixed overhead, but no variable overhead.

(A) (I) and (II), but not (III)

(B) (I) and (III), but not (II)

(C) (I) only

(D) (II) only

11-4: For a generic manufacturing facility (i.e., without being told what the factory makes):

A) Give two examples of overhead expenses for which direct labor hours is a more appropriate allocation base than machine time.

B) Give two examples of overhead expenses for which machine time is a more appropriate allocation base than direct labor hours.

11-5: The Silver City Mining Company mines copper and aluminum in Southwestern New Mexico. Traditionally, overhead costs were allocated to the two metals based on direct labor hours. Using this method in 2005, overhead costs per ton are $50 for aluminum and $60 for copper.

The company switched to activity-based costing, using multiple cost pools, and allocating each cost pool using an allocation base that more accurately captures the cause and effect relationship between the mining operations and overhead costs. Also, several overhead cost categories were reclassified as direct costs. The company had used an Actual Costing system prior to implementing ABC (i.e., overhead rates were calculated at the end of the year, when actual amounts were known), and continued to use Actual Costing after implementation of ABC. To study the effect of the new ABC system, it was retroactively applied to 2005, in order to compare the results to the old method. Which of the following outcomes under the new system suggests that an error was made in the calculation of overhead rates?

(A) The new overhead rates were \$45 per ton of aluminum and \$62 per ton of copper.

(B) The new overhead rates were \$45 per ton of aluminum and \$58 per ton of copper.

(C) The new overhead rates were \$55 per ton of aluminum and \$58 per ton of copper.

(D) The new overhead rates were \$55 per ton of aluminum and \$62 per ton of copper.

11-6: The Santa Cruz Candy Company makes five types of candies in its sole factory, including chocolate truffles and chocolate mints. Truffles are hand-dipped, so making truffles is labor-intensive, and furthermore, only the most experienced (and highest paid) employees can make truffles. Production of mints is highly automated: they don't require much labor, but the machine operators are also highly-skilled and highly-paid. The manager of truffles production (Candy Lowenski) and the manager of mints production (Coco Hernandez) are discussing their preferences for how factory overhead should be allocated to their products. The three choices are direct labor dollars, direct labor hours, and machine hours. Of course, each manager would like to report the highest profits possible from her product line.

Required: In one, two or three (no more than three) complete sentences (each sentence must have a verb and a period, among other grammatical components), predict what position each manager will take with respect to her preferred allocation base, and explain your reasoning.

11-7: The Braintree Furniture Company manufactures two lines of furniture: an upscale, handcrafted line called Richleau, which is produced in small quantities; and a mass-produced, inexpensive line called Particleboard. Both lines are made in the same factory. Richleau is very labor intensive relative to Particleboard. Braintree just switched from a traditional costing method that allocated overhead based on direct labor hours to an activity-based costing system. Under activity-based costing, the amount of overhead allocated to Richleau will be

(A) higher than under the traditional costing method.

(B) lower than under the traditional costing method.

(C) either higher or lower than under the traditional costing method, depending on the underlying economics of the business.

(D) lower than under traditional costing, as long as activity-based costing is implemented in a way that provides more accurate cost information.

11-8: The not-for-profit health clinic Shots-Я-Us provides various types of vaccinations and other shots, especially flu shots, to the public for free or for a nominal fee. The clinic is funded by several local governmental agencies as well as by a number of charitable organizations. Since different donors wish to fund different types of shots, the clinic determines the full cost of each type of shot, by adding overhead to the direct costs, and then provides this information to current and prospective donors.

Following are actual and budgeted costs for Shots-Я-Us for 2003:

	Actual	**Budgeted**
Number of patient visits	5,000	4,000
Number of shots administered	6,000	4,500
Fixed overhead: salaries, rent for the facility, insurance, depreciation.	$94,000	$110,000
Variable overhead: nursing staff hoursly wages, utilities, disposable supplies.	$66,000	$40,500
Cost of hypodermics (a direct cost)	$1,000	$750
Cost of medications (a direct cost)	$30,000	$20,000

Which of the following is probably not a significant cost driver for variable overhead, and hence, would probably be a poor choice as the cost allocation base for allocating variable overhead?

(A) The number of shots administered

(B) The dollar value of the medication administered

(C) The number of patient visits

(D) The amount of nursing staff time spent administering each type of shot

11-9: Pink Ink, Inc. has two products and two overhead cost pools:

	Product A	**Product B**	**In Total**
Units produced	200	50	
Direct Costs (per unit):			
Materials	$10	$20	
Labor (paid $20 per hour)	$20	$40	
Materials Handling cost pool			$24,000
Everything Else cost pool			$76,000

Required:

A) Using direct labor hours as the allocation base, what is the overhead rate for Materials Handling overhead?

B) What is the total cost to make each unit of Product B, if all overhead is allocated based on units produced?

C) How much Everything Else overhead would be applied to each unit of product A, if this cost pool is allocated to product using direct materials dollars as the allocation base?

11-10: Following is information about Aztech Industries:

	Model A	**Model B**	**Model C**	**Total**
Units produced	300	500	200	1,000
Direct materials (per unit)	$50	$75	$100	
Direct labor (per unit)	$20	$50	$40	
Cost driver information:				
number of parts (per unit)	20	42	30	
direct labor hours (per unit)	3	4.60	4	
square feet (in total for all units)	400	600	1,000	
Overhead costs:				
Labor Support				$22,000
Materials Support				$33,000
Facility Cost				$90,000
Total overhead				$145,000

Use activity-based costing to calculate the total cost for each Model C heater. Allocate Labor Support using direct labor hours, Materials Support using number of parts, and Facility Cost using square feet.

11-11: The Crouse Travel Company applies overhead to its international camping tours using activity-based costing. Following is information about the three overhead cost pools:

	Total Costs	Allocation Base	Total Quantity of the Allocation Base Incurred
Administration	$200,000	Number of tours	40
Operations	600,000	Tourist travel days*	6,000
Marketing	180,000	Number of tourists	600

***** For any given tour, the number of tourist travel days is the number of tourists multiplied by the number of days in the tour. For example, 10 tourists on a seven-day tour would constitute 70 tourist travel days.

Required:

A) Calculate the overhead rates.

B) Five of the 40 tours were 10-day trips to Patagonia. These tours averaged 12 tourists per trip. How much overhead would be applied to these five Patagonia tours?

11-12 (A continuation of 6-15): Sister Rachel recently attended a seminar on activity-based costing held in Las Vegas. The other sisters were somewhat skeptical about Sister Rachel's attendance at this particular seminar, and she is eager to put to use what she learned there. She suggests that the orphanage implement a refined costing system, and she develops the following information.

Costs vary with the age of the children. The number and ages of children were as follows:

	2000	**2001**
Pre-school (ages 0 - 5)	30	15
Pre-teen (ages 6 – 12)	30	32
Teenagers (ages 13 - 18)	20	25
Total	80	72

Everyone agrees that 2000 was a very successful year for the Orphanage, so the 2001 budget was based on 2000 actual costs. The following information pertains to 2000:

- Food costs per meal were $4 for pre-schoolers, $5 for pre-teens, and $6.50 for teenagers. 3 meals are served per day, 365 days per year.
- The cost of clothing is twice as much (per child) for teenagers as for the other two age groups.
- Laundry and linen costs per child do not vary with the age of the child. However, this category also includes the cost of a diaper service. 1/3 of pre-school children are in diapers, and the cost is $15 per week, 52 weeks per year.
- Educational costs do not apply to pre-school children.
- Only teenagers receive an allowance. The allowance is $20 per week, 50 weeks per year.

Required:

A) Identify the cost drivers for the following expenses:

- (A) Diaper service
- (B) Educational costs
- (C) Allowances

B) Prepare a flexible budget for 2001, making use of the information compiled by Sister Rachel, as well as information about fixed costs from the original 2001 budget.

C) Should Sister Sarah be satisfied with the orphanage's financial results and efforts to control costs in 2001? Briefly explain.

11-13: The 601 Blue Jean Company has decided to allocate the cost of its Warehouse and Distribution Center to its customers using activity-based costing, in order to better assess profitability by customer. The warehouse manager determines that the only costs that are economically feasible to trace directly to the customer are outbound freight costs. The manager then decides that the following overhead cost pools should be allocated to customers using the following cost drivers:

Overhead Cost Pool	**Cost Driver (Allocation Base)**
Order Processing Department	Number of individual orders processed for that customer
Order Filling Department	Number of line items on all pull-tickets for that customer
Quality Control Department	Number of cartons shipped to that customer
Shipping Department	Number of cartons shipped to that customer

Following are relevant data for each overhead cost pool:

Order Processing Department	
Total costs for this department	$3,000,000
Total number of orders processed	200,000
Order Filling Department	
Total costs for this department	$4,000,000
Total number of line-items on all pull tickets	4,000,000
Quality Control Department	
Total costs for this department	$500,000
Total number of cartons shipped	2,000,000
Shipping Department	
Total costs for this department	$7,500,000
Total number of cartons shipped	2,000,000

Following is information pertaining to two customers:

7-9-11 Stores:	
Sales revenue for the year	$2,400,000
Number of orders	500
Number of pull ticket line-items	100,000
Number of cartons	50,000
Outbound freight costs	$75,000
Men's Large and Big Stores:	
Sales revenue for the year	$1,500,000
Number of orders	250
Number of pull ticket line-items	20,000
Number of cartons	40,000
Outbound freight costs	$56,000

Required:

A) Compute the overhead rates for each of the four overhead cost pools.

B) Calculate the amount of overhead that would be applied to 7-9-11 Stores

C) Calculate the amount of overhead that would be applied to Men's Large & Big Stores

D) Explain (in one or two sentences) or show (by calculation) how your answers to Parts (B) and (C) would change if the company combined Quality Control and Shipping into one overhead cost pool, and allocated overhead for this cost pool to customers based on the number of cartons shipped to that customer.

CHAPTER 12: Allocation of Service Department Costs

Chapter Contents:

Introduction:

Many companies in all sectors of the economy, and not-for-profit and governmental organizations as well, allocate service department costs to "production" or user departments, and ultimately to the products and services that they provide. For example, hospitals use sophisticated methods for allocating costs of service departments such as Housekeeping, Patient Admissions, and Medical Records to patient wards and outpatient services, and then to individual patients. Historically, these allocations were important to hospitals because Medicare reimbursement was based on actual costs. To the extent that the hospital allocated service department costs to Medicare patients, Medicare covered these costs.

Companies that allocate service department costs do so for one or more of the following reasons:

1. To provide more accurate product cost information. Allocating service department costs to production departments, and then to products, recognizes that these services constitute an input in the production process.

2. To improve decisions about resource utilization. By imposing on division managers the cost of the service department resources that they use, division managers are encouraged to use these resources only to the extent that their benefit exceeds their cost.

3. To ration limited resources. When production departments have some discretion over their utilization of a service department resource, charging production departments for the resource usually results in less demand for it than if the resource were "free" to the production departments.

The motivation for the first reason, to provide more accurate product cost information, can be to improve decision-making within the organization, to improve the quality of external financial reporting, or to comply with contractual agreements in regulatory settings where cost-based pricing is used. As discussed above, Medicare was historically a cost-based reimbursement scheme. As another example, defense contractors that provide the U.S. military "big ticket" items such as airplanes and ships often operate under cost-plus contracts, under which they are reimbursed for their production costs plus a guaranteed profit. In such settings, the calculation of cost includes a reasonable allocation of overhead, including overhead from service departments.

The distinction between the second and third reasons is important in the context of fixed versus variable costs. In connection with the second reason, to improve decisions about resource utilization, from the company's perspective, a division manager making a short-term decision about whether to utilize service department resources should incorporate into that decision the service department's marginal costs, which are usually the variable costs. The manager should ignore the service department's fixed costs if these costs will not be affected by the manager's decision. This reasoning suggests that only the service department's variable costs should be charged out.

However, in connection with the third reason, to ration a scarce resource, if the service department controls a fixed asset, and if demand for the asset exceeds capacity, charging users a fee for the asset allows the service department to balance demand with supply. The fee need not relate to the cost of obtaining the asset; rather, it is a mechanism for managing demand. Examples would be charging departments a "rental fee" for their use of vehicles from the motor pool, or for their use of a corporate conference facility.

Service department costs can be allocated based on actual rates or budgeted rates. Actual rates ensure that all service department costs are allocated. Budgeted rates provide service department managers incentives to control costs, and also provide user departments more accurate information about service department billing rates for planning purposes. In either case, service department costs should be allocated using an allocation base that reflects a cause-and-effect relationship, whenever possible. Here are some examples:

- Allocate building maintenance costs based on square footage;
- Allocate costs of the company airplane based on miles flown;
- Allocate costs of the data processing department based on CPU time.

In some cases, companies benefit from allocating fixed costs using a different allocation base than variable costs. For example, fixed costs might be allocated based on an estimate of long-term usage by the production departments.

Historically, there have been three alternative methods for allocating service department costs. These methods differ in the extent to which they recognize that service departments provide services to other service departments as well as to production departments. All three methods ultimately allocate all service department costs to production departments; no costs remain in the service departments under any of the three methods.

The Direct Method:

The **direct method** is the most widely-used method. This method allocates each service department's total costs directly to the production departments, and ignores the fact that service departments may also provide services to other service departments.

Example: Human Resources (H.R.), Data Processing (D.P.), and Risk Management (R.M.) provide services to the Machining and Assembly production departments, and in some cases, the service departments also provide services to each other, as reflected in the following table:

Total Cost	**Service Dept**	% of services provided by the service department listed at left to:				
		H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
$ 80,000	**H.R.**	--	20%	10%	40%	30%
120,000	**D.P.**	8%	--	7%	30%	55%
40,000	**R.M.**	--	--	--	50%	50%
$240,000						

The amounts in the far left column are the costs incurred by each service department. The percentages in the other columns are the percentage of each service department's services provided to each department that utilizes the services of that service department. These percentages are derived from some relevant measure of service department activity. For example, the percentages for human resources might be based on the number of employees in each department, or the number of new hires in each department. The percentages for data processing might be based on the number of computers in each department. Any services that a department provides to itself are ignored, so the intersection of the row and column for each service department shows zero. The rows sum to 100%, so that all services provided by each service department to the other departments are accounted for.

Under the direct method, each service department is allocated separately, and the order in which the service departments are allocated does not matter. Taking one row at a time, the percentages of the production departments are normalized, so that they add up to 100% while still reflecting the relative usage by the production departments (relative to all of the other production departments). For example, in applying the direct method for the costs of human resources, Machining and Assembly are the only ***production*** departments that used the services of the Human Resources Department in March, so the percentages in the columns for machining and assembly are the only percentages that are relevant (the 20% for data processing and the 10% for risk management are ignored). The denominator in the normalization process is the sum of the percentages of all of the production departments. For example, for the human resources row in the table below, the 70% is the sum of 40% for machining and 30% for assembly in the table above.

Total Cost	**Service Dept**	Normalized percentage of services provided by the service department listed at left to the production departments:				
		H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
$ 80,000	**H.R.**	--	--	--	40% ÷ 70% = 57%	30% ÷ 70% = 43%
120,000	**D.P.**	--	--	--	30% ÷ 85% = 35%	55% ÷ 85% = 65%
40,000	**R.M.**	--	--	--	50%	50%
$240,000						

The risk management service department percentages do not require normalization, because this service department provided services only to the production departments, it did not provide any services to the other service departments. The normalized percentages are then used to allocate each service department's total costs to the production departments:

Total cost	**Service dept.**	**Machining**	**Assembly**
$ 80,000	**H.R.**	57% x $80,000 = $45,600	43% x $80,000 = $34,400
120,000	**D.P.**	35% x $120,000 = $42,000	65% x $120,000 = $78,000
40,000	**R.M.**	50% x $40,000 = $20,000	50% x $40,000 = $20,000
$240,000		$107,600	$132,400

The normalization process ensures that the sum of the costs allocated to the production departments equals the total costs incurred by each service department, even though service-department-to-service-department services are ignored. For example, $42,000 of data processing costs are allocated to machining and $78,000 are allocated to assembly, and these two amounts sum to $120,000, the total costs incurred by data processing.

The Step-Down Method:

The **step-down method** is also called the **sequential method**. This method allocates the costs of some service departments to other service departments, but once a service department's costs have been allocated, no subsequent costs are allocated back to it.

The choice of which department to start with is important. The sequence in which the service departments are allocated usually effects the ultimate allocation of costs to the production departments, in that some production departments gain and some lose when the sequence is changed. Hence, production department managers usually have preferences over the sequence. The most defensible sequence is to start with the service department that provides the highest percentage of its total services to other service departments, or the service department that provides services to the most number of service departments, or the service department with the highest costs, or some similar criterion.

Example: Human Resources (H.R.), Data Processing (D.P.), and Risk Management (R.M.) provide services to the Machining and Assembly production departments, and in some cases, the service departments also provide services to each other:

Total Cost	**Service Dept**	**% of services provided by the service department listed at left to:**				
		H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
$ 80,000	H.R.	--	20%	10%	40%	30%
120,000	D.P.	8%	--	7%	30%	55%
40,000	R.M.	--	--	--	50%	50%
$240,000						

The amounts in the far left column are the costs incurred by each service department. Any services that a department provides to itself are ignored, so the intersection of the row and column for each service department shows zero. The rows sum to 100%, so that all services provided by each service department are charged out.

The company decides to allocate the costs of Human Resources first, because it provides services to two other service departments, and provides a greater percentage of its services to other service departments. However, a case could be made to allocate Data Processing first, because it has greater total costs than either of the other two service departments. In any case, the company decides to allocate Data Processing second.

In the table below, the row for each service department allocates the total costs in that department (the original costs incurred by the department plus any costs allocated to it from the previous allocation of other service departments) to the production departments as well as to any service departments that have not yet been allocated.

	H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
Costs prior to allocation	$ 80,000	$120,000	$40,000	--	--
Allocation of H.R.	($ 80,000)	16,000	8,000	$32,000	$24,000
Allocation of D.P.		(136,000)	10,348	44,348	81,304
Allocation of R.M.			(58,348)	29,174	29,174
	0	0	0	$105,522	$134,478

After the first service department has been allocated, in order to derive the percentages to apply to the production departments and any remaining service departments, it is necessary to "normalize" these percentages so that they sum to 100%. For example, after H.R. has been allocated, no costs from D.P. can be allocated back to H.R. The percentages for the remaining service and production departments sum to 92% (7% + 30% + 55%), not 100%. Therefore, these percentages are normalized as follows:

Risk Management:	7% ÷ 92%	= 7.61%
Machining:	30% ÷ 92%	= 32.61%
Assembly:	55% ÷ 92%	= 59.78%
Total:		100.00%

For example, in the table above, 59.78% of $136,000 (= $81,304) is allocated to assembly, not 55%.

The characteristic feature of the step-down method is that once the costs of a service department have been allocated, no costs are allocated back to that service department. As can be seen by adding $105,522 and $134,478, all $240,000 incurred by the service departments are ultimately allocated to the two production departments. The intermediate allocations from service department to service department improve the accuracy of those final allocations.

The Reciprocal Method:

The **reciprocal method** is the most accurate of the three methods for allocating service department costs, because it recognizes reciprocal services among service departments. It is also the most complicated method, because it requires solving a set of simultaneous linear equations.

Using the data from the step-down method example, the simultaneous equations are:

H.R. = \$ 80,000 + (0.08 x D.P.)
D.P. = \$120,000 + (0.20 x H.R.)
R.M. = \$ 40,000 + (0.10 x H.R.) + (0.07 x D.P.)

Where the variables H.R., D.P. and R.M. represent the total costs to allocate from each of these service departments. For example, Human Resources receives services from Data Processing, but not from Risk Management. 8% of the services that Data Processing provides, it provides to Human Resources. Therefore, the total costs allocated from Human Resources should include not only the \$80,000 incurred in that department, but also 8% of the costs incurred by Data Processing. Solving for the three unknowns (which can be performed using spreadsheet software):

H.R. = **\$ 91,057**
D.P. = **\$138,211**
R.M. = **\$ 58,781**

Hence, costs are allocated as follows:

	H.R.	**D.P.**	**R.M.**	**Machining**	**Assembly**
Costs prior to allocation	\$80,000	\$120,000	\$40,000	--	--
Allocation of H.R.	**(\$91,057)**	18,211	9,106	\$36,423	\$ 27,317
Allocation of D.P.	11,057	**(138,211)**	9,675	41,463	76,016
Allocation of R.M.			**(58,781)**	29,390	29,390
	\$ 0	\$ 0	\$ 0	\$107,276	\$132,723

To illustrate the derivation of the amounts in this table, the \$36,423 that is allocated from Human Resources to Machining is 40% of H.R.'s total cost of \$91,057.

Summary of Service Department Cost Allocation Methods:

The direct method and step-down method have no advantages over the reciprocal method except for their simplicity, and the step-down method is sometimes not very simple. Nevertheless, the reciprocal method is not widely used. Given advances in computing power, the reciprocal method would seem to be accessible to many companies that are not using it. Presumably, these companies believe that the benefits obtained from more accurate service department cost allocations do not justify the costs required to implement the reciprocal method. In fact, many companies do not allocate service department costs at all, either because they do not think these allocations are beneficial, or because they do not believe that the benefits justify the costs.

Dysfunctional Incentives from Service Department Cost Allocations:

The incentives that service department cost allocations impose on managers and employees should be carefully considered. In some cases, these allocations have unintended and undesirable consequences. For example:

1. At one university, professors are "charged" for office telephone usage, which includes a fixed monthly fee similar to the flat fee that is charged for residential telephone service. The "charge" comes out of the professor's "research allowance," which can otherwise be used for professional expenses such as journal subscriptions, professional organization dues, and travel to conferences. Since the flat fee (as opposed to the long distance charges) is unavoidable, it does not affect the professors' behavior, but it is viewed negatively, because the research allowance is effectively several hundred dollars a year less than "advertised" by the administration.

2. At another university, state-of-the-art computer equipment in the classrooms is purchased out of student fees. Consequently, this equipment is readily available and "free" to the faculty when they teach. However, when a professor reserves a room for a non-teaching purpose, such as a research presentation to fellow faculty, the Instructional Technology service center "charges" the professor's department approximately $50 to use the equipment, which is far in excess of the equipment's marginal cost (the depreciation on the bulb in the projector). The $50 charge is sufficient to dissuade many departments from using the equipment for non-instructional purposes, so the equipment sits idle, and the professors use a "low tech" solution: an overhead projector and transparencies.

Exercises and Problems

12-1: The Bola Tie Company has two service departments (Departments A and B) and three production departments (Departments X, Y and Z). Service Department A provides services to all three production departments as well as to Service Department B. However, Service Department B only provides services to the other service department (Department A). In other words, Service Department B provides no services directly to the production departments. Which of the following methods for allocating service department costs makes the most sense in this situation?

(A) The direct method.

(B) The step-down method, beginning with Service Department A.

(C) The step-down method, beginning with Service Department B.

(D) We would want to know the costs incurred by each service department before determining which allocation method makes the most sense.

12-2: The "Big One" accounting firm has three divisions: audit, tax and consulting; two support departments: administration and human resources. The following table shows the utilization of support department services by the user departments:

	Administration	Human Resources	Audit	Tax	Consulting
Administration		10%	30%	25%	35%
Human Resources	10%		30%	35%	25%

Which of the following allocation methods will result in the smallest allocation of support department costs to the Consulting Division?

(A) The direct method.

(B) The step-down method, beginning with Administration.

(C) The step-down method, beginning with Human Resources.

(D) Cannot be determined from the information given.

12-3: One advantage of the step-down method of allocating service department costs to production departments, over the direct method, is the following:

(A) Some interaction among service departments (i.e., service departments providing services to other service departments) is accounted for.

(B) The step-down method is easier to apply (i.e., it is less complicated).

(C) All service department costs are eventually allocated to production departments.

(D) All interaction among service departments (i.e., service departments providing services to other service departments) is accounted for.

12-4: The MIS department of Coldwater Industries provides services to two other service departments (Accounting and Personnel) and two factories. The cost of operating the MIS department is $100,000 annually. The volume of services provided to Accounting, Personnel, and the factories is measured by the number of computer terminals in each area.

	Factory X	**Factory Y**	**Accounting**	**Personnel**
Number of terminals	30	10	40	20

Using the direct method of service department allocation, calculate the allocation of MIS costs to Factory X.

12-5: Amber Industries has two service departments: Human Resources (H.R.) and Accounting. These two service departments provide services to each other, and to three factories, as shown in the following table:

Service Department	Service Dept Operating Costs	**Percentage of services provided by the service department indicated in the far left column to each of the factories and service departments**				
		H.R.	**Accounting**	**Factory A**	**Factory B**	**Factory C**
H.R.	$350,000		15%	35%	40%	10%
Accounting	$880,000	25%		25%	15%	35%

Required: Calculate the amount of service department costs that will be allocated to each of the factories, using the Direct Method of service department cost allocation.

12-6: Global-Mega-Corp allocates the costs of three service departments to its three production departments. The following table shows the percentage of services that each service department provides to each production department and to the other two service departments:

	Human Resources	Data Processing	Legal Department	Production Dept 1	Production Dept 2	Production Dept 3
Human Resources		15%	15%	35%	15%	20%
Data Processing	15%		10%	25%	30%	20%
Legal Department	15%	25%		25%	20%	15%

The following table shows the costs incurred by each service department, prior to the allocation of any service department costs to the other service departments:

Human Resources	$101,000
Data Processing	$324,000
Legal Department	$253,000

Required: Using the Direct Method of service department cost allocation, calculate the total service department costs that are allocated to each production department.

12-7: Xancar Corporation has three factories, and allocates the costs of two service departments to these factories using the Direct Method of service department cost allocation. The table below shows the costs incurred by these two service departments for the most recent year, the allocation base used to allocate the costs of each department, and the amount of the allocation base incurred by the factories and service departments.

	Costs incurred	Allocation base	Accounting & Computing	Human Resources	Factory in Zancobar	Factory in Yebasta	Factory in Quinzotet
Accounting & Computing	$850,000	Operating costs	$850,000	$930,000	$1,200,000	$1,100,000	$1,700,000
Human Resources	$930,000	Number of employees	45	33	110	75	145

Required: Calculate service department costs allocated to each factory.

12-8: A company has three service departments that provide services to each other and to four production departments. Details for 2005 are shown below:

	Human Resources	**Accounting**	**Data Processing**
Costs incurred to run the department:	$700,000	$1,200,000	$1,400,000
Allocation base used to allocate costs of the service department to the four production departments:	FTE's (full-time employee equivalents)	Invoices processed	# of computers
Amount of services provided by the service department to itself and to each of the recipient departments, as measured by the quantity of the allocation base incurred in each department:			
Human Resources	9	467	13
Accounting	23	117	25
Data Processing	32	83	40
Production Department A	101	223	32
Production Department B	157	319	44
Production Department C	33	444	37
Production Department D	69	190	17
Total quantity of the allocation base	424	1,843	208

Required: Using the Direct Method of service department cost allocation, what are the total service department costs from the three service departments that will be allocated to production department B?

12-9: The Franklin Corporation allocates the costs of three service departments to its three production departments. The following table shows the percentage of services that each service department provides to each production department and to the other two service departments:

	Service Dept A	Service Dept B	Service Dept C	Production Dept 1	Production Dept 2	Production Dept 3
Service Dept A		20%	20%	30%	10%	20%
Service Dept B	15%		10%	25%	30%	20%
Service Dept C	15%	25%		30%	20%	10%

The following table shows the costs incurred by each service department, prior to the allocation of any service department costs to the other service departments:

Service Dept A	$ 80,000
Service Dept B	$124,000
Service Dept C	$153,000

Required:

A) Using the Direct Method of service department cost allocation, calculate the total service department costs that are allocated to each production department.

B) Use the Step-Down Method of service department cost allocation, and calculate the total service department costs allocated to Production Department 1. Assume that Service Department A is allocated first, then Service Department C, and finally Service Department B.

12-10: State Farmers Insurance Company has three revenue-generating divisions: Property Insurance, Life Insurance, and Automobile Insurance. The Legal Department is a service department that provides services to these three revenue-generating divisions, and not to any other department. To allocate legal department costs to the user departments, the lawyers in the Legal Department track the hours they spend providing services to each department. (These hours are called “lawyer-billed” hours.) Relevant information about lawyer-billed hours is as follows:

	Peak Demand	**Average Demand**	**Actual May Usage**
Property Insurance Division	600 hours	300 hours	420 hours
Life Insurance Division	200 hours	180 hours	170 hours
Automobile Insurance Division	200 hours	180 hours	180 hours

The Legal Department budgets fixed costs at $100,000 monthly, and variable costs at $16 per lawyer-billed hour. During May, actual costs incurred were as follows: $70,000 in fixed costs, and $7,000 in variable costs.

Required:

A) What is the actual cost per lawyer-billed hour, using actual costs (fixed and variable) and the actual level of activity for the month?

B) Allocate May legal costs to the Auto Division, using the rate calculated in Part (A), based on actual usage.

C) What amount of legal costs for May will be allocated to the Life Division if a dual allocation rate is used, in which budgeted fixed costs are allocated based on peak usage requirements, and budgeted variable costs are allocated based on actual usage?

CHAPTER 13: The Role of Cost in Setting Prices

Chapter Contents:

Introduction:

This chapter discusses the role that product costs play in setting sales prices. For most companies operating in competitive markets, as well as for unregulated monopolies (such as a pharmaceutical company that has a drug under patent with no close substitutes), the most important factor in setting the profit-maximizing sales price is the elasticity of demand (the sales demand as a function of price). The elasticity of demand is affected by such factors as competitors' prices, consumers' preferences, and the availability of substitute goods. Ignoring the elasticity of demand, and setting the sales price based on cost of production (such as full cost plus 30%) is generally a really bad idea.

Nevertheless, production costs do play a supporting role in setting prices generally, and for a relatively small number of products and markets, production costs play the lead role.

Short-Run Pricing Decisions:

Occasionally, a company faces a sales opportunity for which the only relevant costs and revenues are the incremental costs and revenues for that one transaction. In this situation, accurate information about marginal costs are important, because the company should be willing to set the sales price at any amount in excess of marginal cost (marginal production cost plus any marginal non-manufacturing costs such as distribution and marketing costs). Typically, marginal production costs consist of all variable production costs.

These opportunities probably occur relatively infrequently (certainly less often, for example, than one might infer from Eliyahu Goldratt's popular business novel *The Goal*). Among the conditions that are typically required for the optimal sales price to depend *only* on the variable costs of the one transaction the company now faces are: (1) excess production capacity (so that the sales order does not displace existing orders); (2) a one-time customer (since the price the customer is willing to pay in the future might depend on the price the customer pays today); and (3) a customer not in the company's normal sales channels (because if other customers learn that the company has given another customer a price break, they are likely to demand similar concessions).

Intermediate-Run Pricing Decisions:

Over the course of several months to a year or two, costs associated with many fixed assets are unavoidable, but the company can make meaningful decisions about product prices, production levels and product mix. For these decisions, microeconomics provides analytical tools for jointly determining the optimal sales price and production level to maximize profits. The solution to this problem depends on the elasticity of demand and also on variable production costs (marginal production cost, in the terminology of economics).

Long-Run Pricing Decisions:

In the long-run, all fixed costs become relevant costs. Factories and warehouses can be built, rebuilt, purchased or sold. Salaried employees can be hired, fired, reassigned, or given incentives to resign or retire. Long-term leases and other contracts come up for renewal. In the long-run, the company's revenues must exceed its costs, if it is to survive. Therefore, the management accounting system should provide managers information about whether sales prices for products are sufficiently in excess of their full cost of production to cover non-manufacturing costs and still provide the company a reasonable rate of return. Management should consider dropping products that are unable to cover their full costs (manufacturing costs plus non-manufacturing costs), unless there are extenuating circumstances such as a product that serves as a "loss leader" (e.g., sell the inkjet printer at or near cost, and make high profit margins on sales of ink cartridges). The timing for eliminating unprofitable products might depend on when the costs of fixed assets associated with those products can be avoided.

Pricing Decisions when the Demand Function is Unknown:

For new products, the demand function is often unpredictable. Also, important macro-economic, political and technological changes can create significant uncertainty about the demand function. In these situations, the sales price might be based on cost of production. As better information about the demand function becomes known over time, this information should then be incorporated into pricing decisions.

Regulated Monopolies:

Natural monopolies that provide essential services are usually regulated. Traditionally, utility companies that provide electricity, natural gas and telephone service have been natural monopolies in their local service areas. When these services are provided by a for-profit company, as opposed to a municipality or cooperative, a regulatory agency determines the rates that the company is allowed to charge customers, in order to cover its costs and earn a reasonable return on its investment. Hence, rate-setting requires the determination of the utility company's cost of providing the service. In effect, sales prices for the utility company are based on its costs.

In the telecommunications industry, changes in technology have created competition that did not exist before. For example, one can easily purchase cellular phone service from one of a number of providers, and entirely avoid the company that provides local land-line telephone service. Changes in laws and technology permit customers to purchase long distance telephone service from any of a number of providers. Attempts have been made to deregulate the electric and natural gas markets, although the results have been mixed with respect to consumer welfare. When an industry that was previously a natural monopoly becomes a competitive market, regulatory rate-setting is no longer necessary.

Cost-Plus Contracts:

In a few specialized markets, sales prices are often based on cost. The U.S. Defense Department frequently contracts with companies for the design and manufacture of military equipment using cost-plus contracts: the contractor receives reimbursement for production costs plus a negotiated profit. Cost-plus contracts are useful when it is difficult for the manufacturer to predict production costs, when product specifications may have to change after the contract is signed, or when there is only one logical supplier. Military equipment with long design and production lead-times, such as complex weapons systems and aircraft, often meet one or more of these criteria.

An important purpose of cost-plus contracts is to transfer risk from the seller to the buyer. For example, given the uncertainty surrounding the cost of building the next-generation Navy submarine, it is possible that no company capable of undertaking the project would be willing to do so, if the company were required to commit to a price beforehand. A significant cost overrun could bankrupt the company. Conversely, if the contracted price significantly exceeded actual cost, the large profits that would be earned by the defense contractor could cause the military considerable political embarrassment. Cost-plus contracts avoid both issues by ensuring that the defense contractor earns a reasonable profit.

Medicare, which was discussed earlier, is another government program that originally used a cost-plus reimbursement scheme. Another example is Federal support of scientific research. National Science Foundation grants usually allow grant money to be used to cover the direct costs of the research as well as a share of institutional overhead. The indirect cost reimbursement rate is based on estimates of the indirect costs of the grant recipient. In other words, the indirect cost reimbursement rate is institution-specific. When the researcher is employed by a university, which is often the case, these indirect costs can include general and administrative expenses that sometimes appear far removed from the researcher and department that receives the grant.

In the entertainment industry, actors and writers sometimes sign contracts that provide them a percentage of the profits from a movie or television show. These contracts are not cost-plus contracts, but they do incorporate cost in the determination of the amount to be received by the actor or writer. Risk sharing in this situation does not apply so much to uncertainty about the cost of production, as to uncertainty about revenue. These contracts allow the actor or writer to share in the upside potential of the project.

Disputes under Cost-Plus Contracts:

There are fairly complex guidelines for how government contractors can allocate overhead. These rules have been promulgated by the Cost Accounting Standards Board. Within these guidelines, contractors that are working on a mix of cost-plus contracts and traditional fixed fee contracts have incentives to allocate as much overhead as possible to the cost-plus contracts and away from fixed fee contracts. The fixed fee contracts could represent sales to government agencies or to commercial enterprises. To the extent that overhead is allocated to the cost-plus contracts, the contractor will be reimbursed for those overhead costs. Headlines sometimes report apparently excessive charges under cost-plus contracts, such as $500 toilet seats for military airplanes. Usually, these amounts reflect the allocation of large amounts of overhead, including research and design, to a relatively small production run and they are not improper.

On the other hand, contractors also have incentives to shift ***direct*** costs from fixed fee contracts to cost-plus contracts, and this type of cost-shifting constitutes fraud. Several cases have arisen over the past few decades in which defense contractors have been accused of this practice, as well as other practices involving the improper treatment of overhead.

In the 1990s, Stanford University came under public scrutiny for allegedly including in its indirect cost pool, for the purpose of determining reimbursement rates on Federal grants, the cost of depreciation on a yacht that had been donated to the University, and the cost of expensive linen at the University President's house. The inclusion of these costs was apparently not a concerted effort to increase the reimbursement rate. In point of fact, however, Stanford had one of the highest reimbursement rates of any university in the nation, and Stanford put on seminars, attended by personnel from other universities, on how to maximize reimbursement under Federal grants. At one point, University President Donald Kennedy remarked "I expect our controllers to do their best on behalf of the university." There were Congressional hearings, and the scandal prompted Kennedy to resign.

There have been so many public allegations over the years by actors and writers that film and television studios overstate costs, and thus significantly reduce or completely eliminate the incentive component of the actor's or writer's contract, that it is difficult to understand why artists continue to sign these contracts. Stan Lee, creator of Spiderman, sued Marvel in 2002, claiming that his contract entitled him to 10% of Marvel's profits whenever his characters were used in film or television. The lawsuit asserted that the first Spiderman movie had grossed more than $400 million, that Marvel had reported millions of dollars in earnings from the movie, but that Lee had not received a penny. Marvel issued a statement that Stan Lee was well-compensated for his contributions to the industry, and that Marvel was in compliance with its contract with Lee, which probably meant that there were no "profits" from the movie as "profits" are defined in the company's contract with Lee.

Actors and writers would be on surer ground signing contracts based on a percentage of revenues, which are less susceptible to manipulation than profits.

Intra-Company Sales:

The cost of production is often used as the basis for setting the sales price for internal sales of product that sometimes occur from one part of a company to another part of the same company. These internal sales are called transfers, and the topic is referred to as transfer pricing. Chapter 23 discusses transfer pricing. Most companies that use a cost-based transfer price include an allocation of fixed costs in the determination of cost.

The role of cost in the legal resolution of disputes over pricing:

For the most part, aside from the exceptions noted above, most companies conducting business in the U.S. are free to charge whatever they want for their products. There are, however, laws that prevent certain types of price discrimination and predatory pricing practices. Price discrimination consists of charging different customers different amounts for the same product. Predatory pricing consists of charging low prices in an attempt to drive a competitor out of business (or out of the local market).

The Sherman Act of 1890 prohibits companies from monopolizing trade, conspiring in restraint of trade, or engaging in predatory pricing. The Clayton Act of 1914 elaborated on the Sherman Act, and made price discrimination illegal. The concern at that time was that manufacturers were granting lower prices to large customers, and the purpose of the Clayton Act was to encourage competition among retailers by allowing small retailers to buy merchandise at the same price as large retailers. In effect, the concern that Congress was addressing at the beginning of the last century mirrors the concern of many people today about the proliferation of large, national retail chains like Wal-Mart at the expense of small, locally-owned “Main Street” stores.

The Clayton Act was amended by the Robinson-Patman Act in 1936. This Act delineates three defenses against a charge of price discrimination. The first defense is that the manufacturer is allowed to offer volume discounts. This defense gives large retailers a great advantage. The second defense is that price can reflect differences in manufacturing costs, which might arise, for example, from different product specifications by different customers. The third defense is that manufacturers are allowed to meet competitors’ prices, even if doing so results in charging lower prices in one geographic market (where the competitor has a presence) than in other locations.

The resolution of disputes that arise under these laws usually involves a determination of the manufacturer’s costs. However, the Congressional Acts identified above do not specify how cost is to be determined. Hence, this issue was left to the courts. Case law has resulted in a determination that marginal cost is to be used.

Considering the three defenses specified in the Robinson-Patman Act, the courts’ determination of how costs are to be calculated, and the fact that price discrimination applies only to manufacturing companies (not to service sector companies), it would seem very difficult for any plaintiff to prevail in a lawsuit alleging either price discrimination or predatory pricing. Recently, the Supreme Court defined predatory pricing as a situation in which a company sets prices below average variable cost, with plans to raise prices later to recover the temporary losses (*Brooke Group Ltd. vs. Brown & Williamson Tobacco Corp.*, 1993). The Supreme Court then interpreted economic theory as indicating that predatory pricing does not work. In effect, the Court appears to have asserted that predatory pricing cannot succeed, and that therefore, it is unreasonable to assert that any company would engage in it. In the subsequent 37 predatory pricing cases, the defendants prevailed. In 2001, a Federal judge threw out a high-profile legal action brought by the Justice Department against American Airlines that alleged predatory pricing in the Dallas/Fort Worth market.

Predatory pricing also applies to international trade. Anti-dumping laws preclude foreign companies from dumping product onto domestic markets, which refers to selling large quantities of product at unusually low prices. Such actions by foreign competitors can drive domestic industries out of business, and in fact, there are frequent accusations that this is the intent of dumping. U.S. anti-dumping laws stipulate that the import price into the U.S. cannot be lower than the cost of production. The World Trade Organization found that the number of cases brought under anti-dumping laws increased 35% from 1995 to 2000.

The Downward Demand Spiral:

If sales price is established based on cost of production, and if cost of production includes an allocation of fixed costs, then the cost-based price will be a decreasing function of sales volume. Thus, if sales volume increases, the per-unit sales price decreases; and if sales volume decreases, the per-unit sales price increases. If in addition, the demand function is decreasing in price, which normally would be the case, then this situation can result in something called the **downward demand spiral** (occasionally called the **death spiral**; we accountants are so dramatic).

Start with either a decrease in demand for the product, or an increase in fixed costs. The downward demand spiral refers to the reduction in demand that can occur if prices are raised to recover the higher fixed cost per unit of product, which in turn induces another price increase, because fixed costs must be recovered from a smaller customer base, which leads to another drop in demand, etc., etc.

The downward demand spiral does not occur often, and when it does, it probably occurs most frequently for “internal sales” by service departments. In this setting, service departments might view demand as relatively inelastic, when in fact, user departments might be surprisingly creative in finding either less costly external service providers, or alternative in-house solutions. For example, there is a story about a downward demand spiral that supposedly occurred in the typing pool of a high-tech company in the 1970s or 1980s. The typing pool charged out its services on a per-page basis at a time when managers were becoming increasingly proficient with desktop computers and word-processing software. As managers became more proficient with the technology, their demand for the typing pool decreased, which resulted in higher per-page costs, which prompted more managers to avoid the typing pool, to the point where the cost-per-page was ridiculously high.

Exercises and Problems:

13-1: In a controversial decision, Congress withdraws funding from the next generation of aircraft carriers and reassigns the money to public schools, particularly for improving education in art history and comparative literature.

In a move that stuns the nation, the Secretary of the Navy takes advice from a bumper sticker and announces that the Navy will hold a bake sale to fund the new aircraft carrier. Navy personnel have minimal training in baking, so the Navy decides to outsource some production, including the purchase of 570,000 lemon bars from Nabisco.

The Navy is accustomed to buying equipment like jet fighters and missiles under cost-plus contracts. Under a cost-plus contract, the Navy pays the defense contractor for the cost of production plus a predetermined profit. Cost-plus contracts have the advantage of encouraging defense contractors to accept projects for which there is a great deal of uncertainty about the cost. In other words, cost-plus contracts minimize risk to the contractor.

Not knowing any better, the Navy's procurement officer signs a cost-plus contract with Nabisco on March 1st for the lemon bars. The Navy agrees to pay Nabisco the full cost (variable plus fixed) of manufacturing each lemon bar, plus 20 cents. These costs are based on actual costs (not budgeted costs). Nabisco must manufacture all of the lemon bars by March 31st. Because each lemon bar has powdered sugar on top forming the outline of an anchor, none of Nabisco's current inventory of lemon bars can be used for the contract.

Nabisco will manufacture the lemon bars in its factory in Eureka, California. This factory is already dedicated to lemon bar production. It is currently producing 400,000 lemon bars per month for supermarkets. (This satisfies demand; lemon bars are not as popular as they once were.) At this production level, variable manufacturing costs (mostly ingredients, utilities and factory labor) total $300,000 per month. The factory's fixed costs are $500,000 per month (mostly depreciation expense on building and equipment, administrative costs and managerial salaries). Factory capacity is one million lemon bars per month, so the factory has sufficient unused capacity to meet current demand and also fulfill the Navy contract. The variable manufacturing cost per bar should be the same for the Navy contract as for current production. Variable marketing and selling costs are 10 cents per lemon bar for sales to supermarkets, but these costs are not incurred in connection with lemon bars produced for the navy contract. Nabisco sells lemon bars to supermarkets at an average sales price of $1.50 per bar.

Required:

A) Calculate the total price per lemon bar that the Navy will pay Nabisco.

B) Calculate the total profits that the contract will generate for Nabisco.

C) Now assume that the factory stops manufacturing lemon bars for its usual customers, and only makes lemon bars for the Navy (so production is reduced to 570,000 bars). Now calculate the total price per lemon bar that the Navy will pay Nabisco.

13-2: The Children's Carousel in the municipal park in Lake Wobegon is evaluating its ticket prices and operating hours. It is open Friday through Tuesday during the summer months for 15 weeks. The following information pertains to last year's summer season. Costs are expected to remain the same for this year.

Average riders per day	250
Variable operating costs per day when open (e.g., operator's salary, ticket taker's salary, electricity, fee assessed by the city for park security and maintenance)	$820
Fixed overhead costs per year	$36,000
Marketing costs per year	12,500
Customer service costs per year	1,000
Ticket sales price	6.50

Required:

A) What is the unit cost basis (i.e., cost per rider) for establishing a long-run price for ride tickets?

B) It is April, and the carousel has not yet opened for the year. The manager, Hillary Grover Cleveland Clinton, wants to open the carousel all week, including Wednesdays and Thursdays. She is willing to do this as long as it doesn't decrease her overall profits for this year. A study suggests that attendance on these two days would average 200 riders daily, but that attendance on the other days of the week would drop by 50 per week. A special one-time promotion to advertise the Wednesday and Thursday hours will cost $1050. How much should the manager charge per ticket for Wednesdays and Thursdays this summer if she wants to break even from the decision to expand the hours of the carousel? In other words, her incremental profits *this year* from the expansion should be zero. How much should she charge on Wednesdays and Thursdays, if she keeps the current $6.50 ticket price for the other days of the week?

C) Assume Hillary decides to open on Wednesdays and Thursdays and charges the price you calculated in Part B plus $0.25 more. She has excess capacity on Wednesdays of on average 100 rides. A tour operator, Clarence Bunsen, offers Hillary $2.00 per ride for 30 rides each Wednesday for next season. Should Hillary accept the offer? What are her relevant costs for making this decision?

D) Despite taking Cost Accounting as an undergraduate, Hillary is confused by your answer to Part C, and puts off her decision about the tour operator's offer until the end of the month. In the meantime, the new Federal Assistance Program "Pork for Toddlers" offers to contract with the carousel for 50 rides per week. The Program will pay Hillary the carousel's full cost per ride plus 20% (i.e., 120% of full cost). Being socially progressive, and believing she won't lose money on the program, she immediately accepts the government contract. Now it is the end of the month, and she has to decide about the tour operator's offer (see Part C). Now what are the relevant costs and revenues for deciding whether to accept the tour operator's offer?

13-3: Jeff Wong is an entrepreneur on a small island in the South Pacific. Following is the demand function for cell phone service on the island, which is a new service that Jeff is going to introduce on the island. The table shows the elasticity of demand: the number of residents who would subscribe if the monthly fee were as indicated. For example, if Jeff charges $140 per month (actually, any amount between $126 and $140), he will have 14 subscribers. If he lowers the price to $125, he will have 18 subscribers, and he will continue to have 18 subscribers until he gets down to $115, at which point he will have 20 subscribers. He will never have more than 20 subscribers.

Price	# of customers willing to pay up to the amount indicated in the left-hand column for the service
$115	20
$125	18
$140	14
$155	12
$170	11
$210	10
$300	5
$400	2

Jeff has the following cost function for providing the service. First, he must pay a flat fee of $1,000 per month to rent the transmission equipment and to act as an authorized dealer for the cell phone carrier. After that, he pays $50 per month per subscriber to the carrier for the service. For example, if he has 10 subscribers, he will pay $1,500: the $1,000 fixed cost, plus $500 ($50 x 10) in variable costs.

Jeff does not know the information about the demand function presented in the above table. Jeff mistakenly believes that at a sales price of $115 per subscriber, demand will be 22 subscribers. He then estimates his profits as follows:

22 x ($115 – $50) – $1,000 = $430.

“Great!” Jeff says to himself. “I can make over $400 per month.” Jeff then sets the price at $115. However, at the end of the month, he only makes $300 for the month, calculated as follows:

20 x ($115 – $50) – $1,000 = $300.

"That's no good," Jeff says to himself. "I want to earn $400 per month." Jeff then decides to raise his sales price just enough to make exactly $400 per month, under the assumption that he is not going to lose any existing customers. (Remember, Jeff does not know the demand function shown above.) Furthermore, Jeff decides that if he loses customers, he will keep raising the sales price to make up for the loss in customer base, to plan to make $400 in profit at the new sales price. In other words, Jeff always fails to anticipate that he will lose additional customers as he raises his price. But Jeff is mistaken, because he is ignoring the elasticity of demand, and because whenever he raises his monthly fee, customers are allowed to cancel their contracts.

Required: Given Jeff's pricing strategy, and the demand function that Jeff does not know but that you do know, derive each successive price that Jeff will charge for phone service. Is there an equilibrium sales price that Jeff will attain (i.e., a sales price that gives Jeff $400 profit ***that he will arrive at given his pricing strategy***). If so, what is that final sales price?

13-4: The Epomeo Company is a defense contractor with both cost-plus and fixed price contracts with the U.S. military. The company currently has two active contracts. The first contract is a fixed price contract with the Navy that involves the sale of 20,000 HD units in 2008 at $150 per unit. The variable cost per unit is $55, which consists of $45 of variable manufacturing costs and $10 of variable non-manufacturing costs. The second contract is a cost-plus contract with the Marines that involves the sale of 12,000 RD units in 2008, at a sales price of 130% of the full (fixed plus variable) manufacturing cost. The variable cost per RD unit is $135, consisting of $115 of direct manufacturing costs and $20 of non-manufacturing costs. Fixed manufacturing overhead costs for 2008 are budgeted for $500,000, and fixed non-manufacturing costs are budgeted for $230,000. There is no variable manufacturing overhead. Epomeo allocates fixed manufacturing overhead based on variable manufacturing costs (i.e., variable manufacturing cost is the allocation base).

Required: What is the sales price per unit for 2008 for each unit sold to the Marines?

13-5: Cessna makes a particular type of airplane for both the Army and the domestic market in a factory dedicated to that one product. Fixed costs at the factory are $28,000,000 per month. Variable costs at the factory (direct materials, direct labor and variable overhead) are $3,200,000 per airplane. In the domestic market, the airplane sells for $4,100,000. The Army reimburses Cessna the full cost of each airplane plus 22%. Production is currently 36 airplanes per month, and sales are currently 27 airplanes to the domestic market and 9 airplanes to the Army, per month.

Required: What will be the change in total monthly profit earned from sales of this type of plane, if the Army continues to buy 9 airplanes per month, but domestic sales and production increase by 5 airplanes per month?

13-6: Many people support the concept of school voucher programs. The general idea of school vouchers is that a family that enrolls a child in a private school instead of the public school system receives a voucher. The family gives the voucher to the private school to help pay the child's tuition. The private school is then reimbursed by the government for the amount of the voucher. The philosophy of the program is that families that use private schools are not utilizing public school resources, so they should receive a partial refund of taxes that support the public schools. The vouchers constitute this refund.

Another goal of voucher programs is to provide public schools incentives at the local level to improve the quality of education. Under most voucher programs, each school's funding is based on enrollment. If the public school attracts more students, its funding is increased. If public school enrollment drops, its funding is cut. This aspect of the program is similar to cost-plus contracting, except that "cost" is determined using a "base-line" year, and the "plus" component does not constitute corporate profits, but rather constitutes additional resources for the school to improve the quality of its programs.

Required:
Briefly discuss how effective each of the following reimbursement schemes would be in

(1) providing incentives and resources for the local public schools to improve quality, and

(2) minimizing the risk that public school funding, and hence, quality, will decline in the short-run.

In each case, "base-line" refers to information for the year immediately prior to the first year of the voucher program.

A) Each public school receives funding equal to its base-line fixed costs, plus an amount calculated as follows: the school's base-line variable cost per student plus a small increment, multiplied by the number of students enrolled after the voucher program is initiated.

B) Each public school receives funding equal to its base-line fixed costs, plus its base-line variable cost per student multiplied by the number of students enrolled after the voucher program is initiated.

C) Each public school receives funding equal to the number of students enrolled after the voucher program is initiated, multiplied by its base-line full cost per student. Base-line full cost refers to base-line variable cost per student plus an allocation of fixed costs calculated by dividing base-line fixed costs by the base-line number of students.

D) Each public school receives funding equal to the sum of its base-line fixed and variable costs, plus a small variable amount for each student in excess of its base-line enrollment.

13-7: Sedgewik makes a turbine for both the military and the domestic market. Fixed costs at the factory are $2,000,000 per month. Variable costs at the factory (direct materials, direct labor and variable overhead) are $20,000 per turbine. In the domestic market, the turbine sells for $45,000. The military reimburses Sedgewik the full cost of each turbine plus 18%.

Required: Assume the company sells 30 turbines to the military at full cost plus 18%. Let Y equal the total number of unit sales in both markets (so that Y – 30 is the number of units sold in the domestic market). Write down an equation that expresses the company's breakeven point in terms of Y. (You only need to write down the equation; you do not need to attempt to solve it, or even to isolate Y on one side of the equation.)

PART 4

DETERMINING THE COST OF INVENTORY

"Do you agree that inventory is a liability?"

"Of course, everybody knows that. …"

"… but under what heading are we forced to report it on the balance sheet? … All my life I've gathered numbers and compiled reports. I've seen myself … as an impartial, objective observer. … I wasn't an objective observer; I was following, almost blindly, some erroneous procedures without understanding the far-reaching, devastating ramifications.

- Conversation between the factory manager and factory controller in *The Goal*, by Eliyahu Goldratt and Jeff Cox (1992)

CHAPTER 14: Work-in-Process

Chapter Contents:

- Equivalent unit calculations
- Exercises and problems

Equivalent unit calculations:

How does a company that uses an assembly-line or batch manufacturing process determine the cost of work-in-process at period-end, when there are hundreds or thousands of units of inventory at varying stages of completion? The answer relies on the concept of an **equivalent unit**. For example, four units that are each half-finished are equivalent to two complete units. Eight units that are each 25% finished are also equivalent to two complete units. In both examples, the cost accounting terminology is that there are two equivalent units in work-in-process. Similarly, if two units are 50% complete, and four units are 25% complete, there are still two equivalent units in work-in-process. What does it mean for a unit of inventory to be 50% complete? It means that 50% of the inputs required to make the unit have been incurred.

In some manufacturing environments, materials enter the production process early, while labor and other inputs are incurred more evenly throughout the process. For example, an apparel manufacturer cuts all of the fabric for the batch at the beginning of the production process, while sewing operator labor is incurred more-or-less evenly from the time the fabric is cut until the garments are completed. In this situation, companies frequently calculate equivalent units separately for materials and conversion costs (labor and overhead). In fact, companies can calculate equivalent units separately for as many different types of inputs as desired, breaking materials and labor into subcategories. However, the additional accuracy of the cost accounting information thus obtained seldom justifies the additional costs to track it.

The following nine examples illustrate how equivalent units are used to calculate the cost of work-in-process, beginning with a simple setting and progressing to more complicated scenarios. Each example involves a company that assembles personal computers from purchased components. As shown in some of these examples, the company's assumption about inventory flow is relevant.

Example 1:

	Beginning Inventory	Activity during the week		Ending Inventory
Units	0	Units made and shipped (sold):	10	0
Costs incurred	$0*	Materials: Conversion costs:	$1,900 940	

*Throughout these examples, the box for "costs incurred—beginning inventory" reports the beginning balance in the WIP account for the week.

Question: What is the cost per unit for each unit made and sold?

Answer:
Total costs: $1,900 + $940 = $2,840
Cost per unit: $2,840 ÷ 10 units = $284 per unit.

Since there is no ending inventory, there is no work-in-process, and no equivalent unit calculations are necessary. The cost of ending inventory is zero.

Since 10 units were sold, the cost of goods sold is $284 x 10 = $2,840.

Example 2: This example introduces ending work-in-process.

	Beginning Inventory	**Activity during the week**	**Ending Inventory**
Units	0	Units started: 10 Units completed and shipped: 9	Finished units: 0 Partially finished units: 1
Costs incurred	$0	Materials: $1,900 Conversion costs: 940	

Question: What is the cost of goods sold? What is the cost of ending work-in-process?

Answer:
Unable to determine without knowing the extent to which the partially-finished unit is completed.

Example 3: Same as Example 2, but with additional information about the status of ending work-in-process.

	Beginning Inventory	**Activity during the week**	**Ending Inventory**
Units	0	Units started: 10 Units completed and shipped: 9	Finished units: 0 Partially finished units: 1 (it is 50% complete with respect to both materials and conversion costs)
Costs incurred	$0	Materials: $1,900 Conversion costs: 940	

Questions: What is cost of goods sold? What is the cost of ending work-in-process?

Answer:
Total costs: $1,900 + $940 = $2,840

Equivalent units: 9 completed units + 1 unit 50% complete = 9.5 equivalent units

Cost per unit: $2,840 ÷ 9.5 units = $299 per equivalent unit

Cost of goods sold: 9 units were sold. The cost of goods sold is $299 x 9 = $2,691.

Work-in-process: $299 per unit x 1 unit 50% complete = $149.50

Example 4: This example separates materials from conversion costs (labor and overhead).

	Beginning Inventory	Activity during the week	Ending Inventory
Units	0	Units started: 10 Units completed: 9 Units shipped 9	Finished units: 0 Partially finished units: 1 (it is 100% complete with respect to materials, 40% complete with respect to conversion costs.
Costs incurred	$0	Materials: $1,900 Conversion Costs: 940	

Questions: What is cost of goods sold? What is the cost of ending work-in-process?

Answer:

Equivalent Units	
Materials:	10 units (9 sold plus 1 unit in WIP 100% complete with respect to materials)
Conversion costs:	9.4 units (9 sold plus 1 unit in WIP 40% complete with respect to conversion costs)
Cost per equivalent unit	
Materials:	$1,900 ÷ 10 equivalent units = $190 per equivalent unit
Conversion costs:	$940 ÷ 9.4 equivalent units = $100 per equivalent unit
Total:	$190 for materials + $100 for conversion costs = $290
Cost of goods sold:	$290 x 9 units sold = $2,610
Work-in-process	
Materials:	$190 x 1 unit 100% complete = $190
Conversion costs:	$100 x 1 unit 40% complete = $40
Total:	$190 + $40 = $230

Example 5: This example introduces beginning inventory.

	Beginning Inventory	Activity during the week	Ending Inventory
Units	Finished units: 1	Units started: 10 Units completed: 10 Units shipped: 10	Finished units: 1
Costs incurred	$300 beginning balance in finished goods inventory	Materials: $1,900 Conversion Costs: 940	

Questions: What is cost of goods sold? What is the ending balance in finished goods inventory?

Answer: Although total costs to account for is easily calculated ($300 + $1,900 + $940 = $3,140), it is impossible to determine the break-out between cost of goods sold and finished goods inventory without knowing the company's inventory flow assumption.

Example 6: Data and questions are the same as in Example 5. Assume the company uses the FIFO (first in, first out) inventory flow assumption.

Answer: The cost per unit for production this week is $284, as calculated in Example 1.

Cost of goods sold:	(1 unit at $300) + (9 units at $284) = $300 + $2,556 = $2,856
Ending balance in finished goods:	1 unit at $284 = $284
All costs are accounted for:	$2,856 + $284 = $3,140

Example 7: Data and questions are the same as in Example 5. Assume the company uses the LIFO (last in, first out) inventory flow assumption.

Answer:

Cost of goods sold:	10 units at $284 = $2,840
Ending balance in finished goods:	1 unit at $300 = $300
All costs are accounted for:	$2,840 + $300 = $3,140

Example 8: Data and questions are the same as in Example 5. Assume the company uses the weighted average method for calculating cost of goods sold.

Answer: The weighted average method averages between the cost of goods on hand at the beginning of the period, and the cost of goods produced during the period.

Total costs to account for: $3,140

Total equivalent units: 1 unit from beginning inventory + 10 units made = 11 units

Cost per equivalent unit: $3,140 ÷ 11 units = $285.45

Cost of goods sold: 10 units at $285.45 = $2,854.50

Ending balance in finished goods: 1 unit at $285.45 = $285.45

All costs are accounted for: $2,854.50 + $285.45 = $3,140

Example 9: This example has partially finished units in both beginning inventory and ending inventory. Assume the company uses the weighted average method.

	Beginning Inventory	**Activity during the week**	**Ending Inventory**
Units	1 unit that is 50% complete with respect to both materials and conversion costs	The 1 unit coming into the period is completed. 10 units are started and completed. 1 unit is started but not completed.	1 unit 20% complete with respect to both materials and conversion costs.
Costs incurred	$150 beginning balance in work-in-process	Materials: $1,900 Conversion costs: 940	

Questions: What is the cost of each unit made? What is the cost of ending work-in-process? If each unit completed is also sold, what is cost of goods sold?

Answer:

Total costs to account for: $150 + $1,900 + $940 = $2,990

Total equivalent units: 11 units finished during the period plus one unit that is 20% complete = 11.2 units

Cost per equivalent unit: $2,990 ÷ 11.2 equivalent units = $266.96

Ending work-in-process: $266.96 per unit x 1 unit 20% complete = $53.39

Cost of goods sold: $266.96 x 11 units = $2936.56

Note: One might think that the calculation of equivalent units needs to include the beginning inventory that is 50% complete. However, we would be double-counting if we did so, because the unit that is 50% complete in beginning inventory is one of the 11 units identified as finished during the period in the equivalent unit calculation. In the schedule below, the costs to account for are highlighted in green, and the physical units to account for are highlighted in yellow.

	Beginning Inventory	Activity during the week	Ending Inventory
Units	1 unit 50% complete with respect to both materials and conversion costs	The **1** unit coming into the period is completed. **10** units are started and completed. 1 unit is started but not completed.	**1** unit **20%** complete with respect to both materials and conversion costs.
Costs incurred	**$150** beginning balance in WIP	Materials: **$1,900** Conversion costs: **940**	

Exercises and Problems:

14-1: In applying the weighted-average method for equivalent unit cost calculations, which of the following information do you not need to know?

(A) Production costs incurred during the period.

(B) The equivalent units in beginning work-in-process inventory.

(C) The cost of beginning work-in-process inventory.

(D) All of the above must be known, in order to calculate the cost per equivalent unit.

14-2:

A) Six units were in beginning work-in-process (WIP) at the beginning of May. These units were 100% complete with respect to direct materials, and 50% complete with respect to conversion costs. During the period, these six units were completed, and another eight units were started. At the end of the period, four of these eight units were completed, and the other four units were 100% finished with respect to direct materials, and 75% complete with respect to conversion costs. Following is pertinent cost information:

	Beginning WIP	Costs added in May
Direct Materials	$600	$3,600
Conversion costs	$600	$2,200

Required: Calculate the cost per equivalent unit, using the weighted-average method.

B) 250 units were in beginning work-in-process at the beginning of September. These units were 100% complete with respect to direct materials, and 50% complete with respect to conversion costs. At the end of September, 100 units were in ending work-in-process. These units were 80% complete with respect to direct materials, and 40% complete with respect to conversion costs. 80 units were started during the period.

Required: How many units were transferred out of the Work-in-Process account and into the Finished Goods account during September?

14-3:

A) A company starts the week with zero units of work-in-process inventory and zero units of finished goods inventory. The company starts and completes production of nine units. The company starts a tenth unit, but it is not complete by the end of the week. It is 60% complete with respect to both materials and conversion costs. $1,900 in materials was transferred during the week from raw materials inventory to work-in-process inventory. $940 in conversion costs was incurred and debited to work-in-process inventory during the week.

Required: Calculate the cost per equivalent unit for units transferred from WIP to finished goods inventory.

B) A company starts the week with zero units of work-in-process inventory and zero units of finished goods inventory. The company starts and completes production of nine units. The company starts a tenth unit, but it is not complete at the end of the week. It is 100% complete with respect to materials and 50% with respect to conversion costs. $1,900 in materials was transferred during the week from raw materials inventory to work-in-process inventory. $940 in conversion costs was incurred and debited to work-in-process inventory during the week.

Required: Calculate the cost per equivalent unit for units transferred from WIP to finished goods inventory.

C) The company starts the week with zero units in finished goods inventory, and one unit in work-in-process. The one unit in WIP is 60% complete with respect to both materials and conversion costs, and it is carried at a cost of $150. During the week, the company completes this one unit, starts and completes ten more units, and starts production of yet another unit, but this last unit is only 30% complete with respect to both materials and conversion costs at the end of the week. The company incurred $2,840 in materials and conversion costs during the week (i.e., this was the cost transferred into WIP during the week).

Required: What is the cost of each unit transferred to finished goods inventory during the week, using the weighted-average method?

14-4: The factory started the period with 10 units. These units were 40% complete with respect to materials, and 50% complete with respect to conversion costs. The cost of this beginning WIP was $100 with respect to materials, and $70 with respect to conversion costs. During the period the factory completed these 10 units, and started production of another 6 units. Of the 6 units started during the period, 2 were finished, and 4 were still in WIP at the end of the period. These 4 units were 50% complete with respect to materials and 25% complete with respect to conversion costs. Manufacturing costs incurred during the period were $2,700 for materials and $1,230 for conversion costs.

Required: Calculate the cost per equivalent unit using the weighted-average method.

14-5:

A) In the mixing department, all the direct materials are added at the beginning of the processing. Beginning work-in-process inventory consists of 2,000 units with a direct materials cost of $31,860. During the period, 15,000 units are started and direct materials costing $250,000 are charged to the department. If there are 1,000 units in ending inventory, what is the cost per equivalent unit using the weighted-average method?

(A) $15.93
(B) $15.63
(C) $14.83
(D) $16.58

B) The molding department started 15,250 units in September and finished 16,625 units. If the ending work-in-process inventory was 500 units, what was the beginning work-in-process inventory?

(A) 875 units
(B) 1,375 units
(C) 2,375 units
(D) 1,875 units

C) Alex Company has 15,000 units in ending work-in-process inventory, which are 100% complete with respect to materials and 60% complete with respect to conversion costs. The cost per unit for the month for materials is $3.00 and for conversion is $1.30. What is the value of the ending work-in-process using the weighted-average method?

(A) $64,500
(B) $38,700
(C) $45,780
(D) $56,700

14-6: The factory has zero beginning inventory, starts and completes 400 units, and starts production of another 200 units, but these 200 units are not finished at the end of the period. These 200 units are 50% complete with respect to materials, and 30% complete with respect to labor and overhead. During the period, the factory spent $10,000 on materials and $4,600 on labor and overhead. Calculate the cost per equivalent unit using the weighted-average method.

14-7: Kent Plastics began the period with 50 units that were 100% complete with respect to materials and 50% complete with respect to conversion costs. During the period, Kent began production of another 100 units. At the end of the period, there were 60 units, 100% complete with respect to materials and 50% complete with respect to conversion costs. Calculate the equivalent units *produced* during the period with respect to conversion costs. (**Note**: This is *not* the denominator in the weighted-average method for determining the cost of production. Rather, it is a measure of the level of production activity during the period.)

14-8: 60 units were in beginning WIP. These units were 50% complete with respect to materials and conversion costs. 50 units were in ending WIP. These units were also 50% complete with respect to materials and conversion costs. During the period, 90 units were transferred from WIP to Finished Goods. How many units were started during the period?

14-9: VHI company started 2003 with 100 units in beginning work-in-process (WIP) that were 100% complete with respect to materials and 50% complete with respect to conversion costs. The cost of this beginning WIP was $5,000 for materials and $3,000 for conversion costs. During 2003, VHI complete these 100 units, and started another 100 units. At the end of 2003, VHI had 50 units in ending WIP that were 100% with respect to materials and 10% complete with respect to conversion costs. VHI incurred materials costs of $4,000 and conversion costs of $1,500 in 2003. Compute the cost per equivalent unit using the weighted-average method.

14-10: The factory has zero beginning inventory, starts and completes 100 units, and starts production of another 200 units, but these 200 units are not finished at the end of the period. These 200 units are 100% complete with respect to materials, but only 50% complete with respect to labor and overhead. During the period, the factory spent $3,000 on materials and $8,000 on labor and overhead. Calculate the cost per equivalent unit.

14-11: The factory started the period with 20 units on hand. These units were 100% complete with respect to materials and 50% complete with respect to conversion costs. The factory shipped 200 finished units to the warehouse. The factory ended the period with 40 units. These 40 units were 100% complete with respect to materials and 20% complete with respect to conversion costs. Each unit requires one yard of fabric. How many yards of fabric did the factory need to move from the storeroom to the factory floor during the period (this is also the number of units started during the period)?

CHAPTER 15: Alternative Inventory Valuation Methods

Chapter Contents:

Introduction:

This chapter addresses the question: What costs are capitalized as the cost of inventory? In other words, what costs constitute the debit balance on the balance sheet for inventory, and the debit balance on the income statement for cost of goods sold? The answer to this question determines the extent to which the matching principle is honored for production costs.

The following table illustrates three alternative rules for determining which costs are capitalized. All three are used in managerial accounting practice. The three methods are **absorption costing**, **variable costing**, and **throughput costing**. The colored bars identify the costs that each method capitalizes as inventory.

Cost Category	Cost Classification	Absorption Costing	Variable Costing	Throughput Costing
Direct materials	Direct, variable costs	🟦	🟧	🟥
Direct labor	Direct, variable costs	🟦	🟧	
Variable manufacturing overhead	Indirect, variable costs	🟦	🟧	
Fixed manufacturing overhead	Indirect, fixed costs	🟦		
All non-manufacturing costs	Direct and indirect, variable and fixed.			

As the table indicates, non-manufacturing costs are never capitalized as part of the cost of inventory. The three methods differ with respect to their treatment of one or more categories of manufacturing costs, but they all agree that non-manufacturing costs should not be debited as part of the cost of inventory.

For external financial reporting under Generally Accepted Accounting Principles, as well as for tax reporting, companies are required to use absorption costing (also called **full costing**). Hence, there is no choice from the above table for external financial reporting.

For internal reporting purposes, survey data suggests that approximately half of manufacturing companies use absorption costing and approximately half use variable costing. Throughput costing is a relatively recent phenomenon, and does not seem to be used extensively yet.

Absorption Costing:

The theoretical justification for absorption costing is to honor the matching principle for all manufacturing costs. Fixed manufacturing overhead costs are only incurred with the expectation that the resources represented by these costs will be used in the production of inventory. Hence, these costs should be matched against the revenue generated from the sale of that inventory.

Absorption costing requires computing an overhead rate for applying all manufacturing overhead to units produced during the period (or else two overhead rates, one for variable manufacturing overhead and one for fixed manufacturing overhead; or else multiple overhead rates if the company uses activity-based costing). There are important issues related to choosing the denominator in the overhead rate for fixed manufacturing overhead, which are discussed in the next chapter of this book.

Variable Costing:

The theoretical justification for variable costing is that fixed manufacturing overhead (FMOH) will be incurred in the short-run regardless of how much inventory is produced. In many companies, even if a factory is idle, a significant portion of the FMOH is unavoidable in the short run. For this reason, FMOH is treated as a period expense.

Variable costing used to be called **direct costing** with some frequency, but less so today. Direct costing is a particularly confusing name, because the implication is that only direct manufacturing costs are capitalized, whereas in fact, variable manufacturing overhead is also capitalized. Even the name "variable costing" is perhaps less than ideal, because not all variable costs are capitalized: non-manufacturing costs are not capitalized as part of the cost of inventory under any circumstances.

Under variable costing, the cost of ending inventory consists of direct manufacturing costs (usually materials and labor) and variable manufacturing overhead. Hence, these are the costs for which variable costing honors the matching principle, and nothing else is capitalized as part of the cost of inventory.

Absorption Costing and Variable Costing Compared:

The *only* difference between absorption costing and variable costing is the treatment of fixed manufacturing overhead (FMOH). Under absorption costing, FMOH is allocated to units produced, so that there is a little bit of FMOH included in the cost of every unit of inventory. Under variable costing, FMOH is treated as a period expense, appearing on the income statement as a lump-sum in the period incurred.

Comparing income under absorption costing to income under variable costing, the following observations can be made:

- When there are beginning and ending inventories, absorption costing and variable costing will *generally* result in different inventory valuations for beginning inventory, different inventory valuations for ending inventory, and different incomes, but *it is possible* for the inventory balances and income to be the same under the two methods.
- If beginning and ending inventory levels are zero, absorption costing and variable costing will always result in the same income.
- If beginning inventory is zero and ending inventory is positive, absorption costing will always result in higher income than variable costing, and a higher valuation for ending inventory.
- If beginning inventory is positive and ending inventory is zero, absorption costing will always result in lower income than variable costing, and a higher valuation for beginning inventory.
- When inventory levels are increasing from period-end to period-end, as would be expected when the company is growing, absorption costing *will generally* result in higher ending inventory valuations than variable costing, and also higher income in each period. The reason is that absorption costing postpones recognizing ever-increasing amounts of fixed manufacturing overhead on the income statement, because increasing amounts of fixed manufacturing overhead are capitalized as ending inventory.

Over the life of the company (or from any point in time at which there is zero inventory to any other point in time at which there is zero inventory), the sum of income over all periods must be equal under the two methods. The difference between absorption costing and variable costing is only a timing difference: the question of when fixed manufacturing overhead is taken to the income statement.

Income Statement Presentation:

Absorption costing, variable costing and throughput costing are each associated with an income statement format:

> Absorption costing uses a **gross margin income statement**, which starts with revenues and subtracts cost of goods sold to derive gross margin, then subtracts non-manufacturing costs to derive operating income. Virtually every income statement presented in connection with external financial reporting uses a gross

margin format. Gross margin income statements separate manufacturing costs from non-manufacturing costs, which is helpful for certain types of analyses.

Variable costing uses a **contribution margin income statement**, which starts with revenues and subtracts variable costs (variable manufacturing costs related to units sold, plus all variable non-manufacturing costs) to derive contribution margin, then subtracts all fixed costs (manufacturing and non-manufacturing) to derive operating income. Contribution margin income statements facilitate cost-volume-profit analysis. It should be emphasized that under variable costing, not all variable costs appear on the income statement in the period incurred. Variable manufacturing costs that have been incurred to make inventory that hasn't been sold yet appear on the balance sheet as part of the cost of finished goods inventory.

Throughput costing starts with revenues and subtracts direct material costs associated with units sold to derive **throughput margin**, then subtracts all other costs.

These income statement formats do not define the costing methods. The costing methods are defined by which manufacturing costs are capitalized, as indicated in the table at the beginning of this chapter. It is possible, for example, to cost inventory and determine income using the rules of absorption costing, but to then present the data in a contribution margin format by making certain reclassifications.

Numerical Example of Absorption Costing and Variable Costing:

Following is information about the operations of Ultimate DNA, Inc., for the year ended December 31, 2006.

Direct materials used in production	$300,000
Direct labor costs incurred	$100,000
Variable manufacturing overhead costs incurred	$ 50,000
Variable non-manufacturing costs incurred	$ 40,000
Fixed manufacturing overhead costs incurred	$ 80,000
Fixed non-manufacturing costs incurred	$ 20,000

There was no beginning inventory. 100 units were produced, and 50 units were sold at a price of $20,000 per unit. The variable non-manufacturing costs consist of two items: a sales commission paid for units sold, and a transportation cost to ship finished product from the factory to various warehouses where product is stored until it is sold.

Required: Prepare a Contribution Margin income statement, using Variable Costing.

Variable manufacturing costs:
In total: $300,000 materials + $100,000 labor + $50,000 variable O/H = $450,000
Per unit: $450,000 ÷ 100 units = $4,500 per unit

Ultimate DNA, Inc.
Income Statement
For the Year Ended December 31, 2006

Sales	$1,000,000
Variable Costs	
Manufacturing ($4,500 per unit x 50 units)	225,000
Non-manufacturing	40,000
Contribution Margin	735,000
Fixed Costs	
Manufacturing	80,000
Non-manufacturing	20,000
Operating Income	$635,000

The only costs matched to revenues are the variable manufacturing costs. All other costs are expensed as incurred.

Required: Prepare a Gross Margin income statement, using Absorption Costing.

Fixed and variable manufacturing costs:
In total: $450,000 variable (from above) + $80,000 fixed = $530,000
Per unit: $530,000 ÷ 100 units = $5,300 per unit

Ultimate DNA, Inc.
Income Statement
For the Year Ended December 31, 2006

Sales	$1,000,000
Manufacturing COGS ($5,300 per unit x 50 units)	265,000
Gross Margin	735,000
Non-manufacturing Costs	
Variable	40,000
Fixed	20,000
Operating Income	$675,000

The matching principle is honored for all manufacturing costs (fixed and variable), but not for any of the non-manufacturing costs.

Required: Calculate the cost of ending inventory under Variable Costing.

$4,500 per unit x 50 units = $225,000

Only variable manufacturing costs are capitalized. All other costs are expensed as incurred.

Required: Calculate the cost of ending inventory under Absorption Costing.

$5,300 per unit x 50 units = $265,000

Only manufacturing costs (fixed and variable) are capitalized. All non-manufacturing costs are expensed as incurred.

Under both Variable and Absorption Costing, all non-manufacturing costs are expensed as incurred. For example, the variable non-manufacturing costs include a sales commission for units sold, and a transportation cost incurred for all units shortly after they are manufactured. Even though the transportation cost includes shipping costs for units in the warehouse and not yet sold, this cost cannot be capitalized as part of the cost of inventory, because the transportation cost is not a manufacturing cost, and inventory is ready for sale at the time it leaves the factory.

Absorption Costing and Generally Accepted Accounting Principles:

In 2004, the Financial Accounting Standards Board issued Statement of Financial Accounting Standards (SFAS) No. 151, to amend and clarify generally accepted accounting principles for the calculation of inventories under absorption costing. The Board's stated purpose for issuing the new standard was to improve the comparability of cross-border financial reporting, by aligning U.S. GAAP with the International Accounting Standards Board's Statement No. 2.

SFAS No. 151 was the first new pronouncement on absorption costing issued by a U.S. accounting standard-setting body in fifty years. Until SFAS No. 151, neither the Financial Accounting Standards Board nor its predecessor, the Accounting Principles Board, had specifically addressed absorption costing in a broad-based way. Rather, each board had incorporated GAAP that existed at the time the board was founded. Using this genealogy, prior to SFAS No. 151, GAAP for absorption costing could be traced to Accounting Research Bulletin (ARB) No. 43, issued in 1953 by the Committee on Accounting Procedure (the predecessor to the Accounting Principles Board).

Key provisions of ARB No. 43, Chapter 4 on inventory pricing, included the following:

> A major objective of accounting for inventories is the proper determination of income through the process of matching appropriate costs against revenues.
>
> \- ARB No. 43, Chapter 4,
> Statement No. 2

> As applied to inventories, cost means in principle the sum of the applicable expenditures and charges directly or indirectly incurred in bringing an article to its existing condition and location.
>
> \- ARB No. 43, Chapter 4,
> Statement No. 3

> The definition of cost as applied to inventories is understood to mean acquisition and production cost, and its determination involves many problems. … Under some circumstances, items such as idle facility expense, excessive spoilage, double freight, and rehandling costs may be so abnormal as to require treatment as current period charges rather than as a portion of the inventory cost.
>
> - ARB No. 43, Chapter 4
> Discussion of Statement No. 3

SFAS No. 151 amends ARB No. 43 by eliminating the "so abnormal" criterion in this last paragraph. Hence, items such as idle facility expense and excessive spoilage must now be recognized as current-period charges.

With respect to idle facility expense, SFAS No. 151 requires fixed production overhead to be allocated to inventory based on the "normal capacity" of the production facility. The Statement defines normal capacity: "normal capacity refers to a range of production levels, and is the production level expected to be achieved over a number of periods or seasons under normal circumstances, taking into account the loss of capacity resulting from planned maintenance." The Statement notes that some variation in production levels from period to period is expected, that normal capacity will vary based on business-specific and industry-specific factors, and that these variations will establish the range of normal capacity. Fixed manufacturing overhead can be allocated based on the actual level of production when actual production approximates normal capacity. The Statement observes that judgment is required to determine when a production level is abnormally low (i.e., outside the range of the expected variation in production). Examples of factors that might cause an abnormally low production level include significantly-reduced customer demand, labor and materials shortages, and unplanned facility or equipment downtime.

Although SFAS No. 151 conveys the view of the Financial Accounting Standards Board that the new pronouncement would not lead to significant changes in inventory accounting practice, some companies' financial statements may be affected. There is some evidence that prior to SFAS No. 151, companies did not apply absorption costing in the same manner. The vagueness in the wording of ARB No. 43 seemed to permit alternative treatments. Furthermore, because ARB No. 43 did not require companies to disclose how they applied absorption costing, information was generally not available about the extent to which these alternative treatments were employed.

Survey data on this issue was provided in two articles that appeared in *Management Accounting* by Michael Schiff (February 1987) and Steve Landekich (March 1973). These surveys identify factory depreciation related to excess manufacturing capacity as an example of fixed overhead that some but not all companies treated as a period expense. Under SFAS No. 151, "The amount of fixed overhead allocated to each unit of production is not increased as a consequence of abnormally low production or idle plant." Hence, if the survey data in Schiff and Landekich was still descriptive of practice in 2004, some companies will have had to change their accounting treatment for idle capacity for inventory costs incurred during fiscal years beginning after June 15, 2005 (the effective date of SFAS No. 151).

Another area that Schiff and Landekich identified where companies differed in their application of absorption costing is the decision of whether to allocate corporate service department costs. Under ARB No. 43, the decision not to allocate these costs seemed justified by materiality and expediency, rather than on theoretical grounds. SFAS No. 151 states that under most circumstances, general and administrative expenses should be included as period charges, except for the portion of such expenses that may be clearly related to production. This wording seems to continue to allow some latitude, and so companies might continue to differ in their treatment of these costs.

The Value Chain:

The **value chain** is the sequence of activities that add value in a company. The following table provides a typical list of activities in the value chain of a manufacturing firm, although some manufacturers might outsource some of these activities.

Value Chain for a Manufacturing Firm
Research and development
Manufacturing
Marketing
Distribution
Sales
Customer service

For many industries, manufacturing costs constitute the majority of costs incurred in the value chain. For companies in these industries, the decision to capitalize most or all manufacturing costs as inventory, and to run these costs through the income statement when the related inventory is sold, provides the benefits of the matching principle that are discussed in introductory financial accounting courses.

However, there are some industries in which manufacturing costs are small relative to one or more of the other activities in the value chain. For example, pharmaceutical companies incur large research and development (R&D) costs. Under all three costing methods that are discussed in this chapter, R&D does not become a part of the cost of inventory. In most situations, R&D is expensed when incurred for financial reporting purposes, which clearly fails to honor the matching principle in a significant way. Large expenditures are incurred and taken to the income statement for many years before any revenue is realized for that drug, and then after the drug is approved by the Food and Drug Administration, revenue is generated for many years with no directly-related offsetting R&D expenditures. The actual manufacturing cost of the drug can be quite small relative to the R&D expenditures that were incurred to bring the drug to market. Of course, the situation is somewhat more complicated for large pharmaceutical companies, because there are numerous drugs at various stages in their lifecycles, so that R&D on some projects offset revenue from drugs for which the R&D is already complete, and also, there are many R&D projects that never result in a saleable product.

Another industry in which manufacturing costs are small relative to some of the other activities in the value chain is the soft drink industry. The ingredients and processes used in the manufacture of soft drinks are fairly inexpensive, and there are few barriers to entry. Consequently, soft drink companies spend large amounts on marketing and advertising. These marketing efforts are anticipated to provide long-term benefits by turning consumers into life-long Coca-Cola® or Pepsi® drinkers. However, these costs are not capitalized as part of the cost of inventory or as any other type of asset; rather, they are expensed when incurred (subject to the usual accrual accounting practices).

Throughput Costing:

Also called **super-variable costing**, throughput costing is a relatively new development. Throughput costing treats all costs as period expenses except for direct materials. In other words, the matching principle is honored only for direct materials.

A company should probably meet two criteria before it chooses throughput costing. The first criterion relates to the nature of the manufacturing process. Throughput costing only makes sense for companies engaged in a manufacturing process in which most labor and overhead are fixed costs. Assembly-line and continuous processes that are highly automated are most likely to meet this criterion. For example, thirty factory employees might be required to work a given shift, regardless of whether the machinery is set at full capacity or less. The second criterion is that management prefers cost accounting information that is helpful for short-term, incremental analysis, such as whether the company should accept a one-time special sales order at a reduced sales price. In this respect, a company's choice of throughput costing is a logical extension of the company's choice of variable costing over absorption costing.

Eliyahu Goldratt, who developed the theory of constraints, advocates throughput costing in his popular business novel *The Goal*. Although throughput costing has not gained wide acceptance, Goldratt's support for it has been influential.

Exercises and Problems:

15-1: Which of the following items account for the difference in income between Variable Costing and Absorption Costing when inventory levels are changing? (Check all that apply.)

(A) Fixed manufacturing costs

(B) Fixed non-manufacturing costs

(C) Variable manufacturing costs

(D) Variable non-manufacturing costs

15-2: At a production level of 100 units, the per unit cost under Absorption Costing is $8, which consists of $2 of direct materials, $2 of direct labor, $2 of variable manufacturing overhead, and $2 of fixed manufacturing overhead. Calculate the Absorption Costing per unit cost assuming the production level is increased to 200 units?

15-3: Hank's Hot Dog Factory manufactures hot dogs. The factory's cost structure is as follows: fixed manufacturing costs per month are $8,000. Variable manufacturing costs are $0.40 per hot dog. Fixed non-manufacturing costs are $7,000 per month. Variable non-manufacturing costs consist of a $0.20 sales commission for every hot dog sold. The sales price per hot dog is $2.20.

Required: If the company begins the month with zero inventory, makes 10,000 hot dogs, and sells 7,000 hot dogs, what is the total cost of inventory on the Balance Sheet at the end of the month under Variable Costing? What is income (loss) for the month under Variable Costing?

15-4: The Esquimau Pie Company makes and sells the famous Esquimau Pie ice cream bar. The company's cost structure is as follows: fixed manufacturing overhead is $5,000 monthly. Variable manufacturing costs are $1.40 for each Esquimau Pie. Fixed non-manufacturing costs are $3,000 monthly. There are no variable non-manufacturing costs. The company begins the month with no inventory, makes 2,000 Esquimau Pies, and sells 1,000 Esquimau Pies for $10 per pie.

Required:

A) What is the cost of ending inventory under Absorption Costing?

B) What is the cost of ending inventory under Variable Costing?

C) What is income under Absorption Costing?

D) What is income under Variable Costing?

15-5: The Impatients-To-Go Silk Flower Company began operations on January 1, 2004. Which of the following circumstances ensures that the company's net income will be the same under Absorption Costing as under Variable Costing for 2005, its second year of operations?

(I) The company has no inventory on January 1, 2005, and no inventory on December 31, 2005.

(II) The company incurred no fixed manufacturing overhead in 2005, and has no inventory on December 31, 2005.

(III) The company incurred no fixed manufacturing overhead in 2004, and has no inventory on December 31, 2005.

(A) I only

(B) I and II are each sufficient

(C) I and III are each sufficient

(D) I, II and III are each sufficient

15-6: The Foster Company has variable and fixed manufacturing costs, and also some variable and fixed non-manufacturing costs. For the year 2005, the company has zero beginning inventory, and positive ending inventory. Which statement is true?

(A) Income in 2005 is the same under both Absorption Costing and Variable Costing

(B) Income in 2005 is higher under Absorption Costing than under Variable Costing

(C) Income in 2005 is lower under Absorption Costing than under Variable Costing

(D) Unable to determine, from the information given, whether income is higher or lower under Absorption Costing than under Variable Costing.

15-7: O'Brien and Hwang started 2006 with zero inventory, produced 100 units of product, and sold 90 units. They incurred the following costs: variable manufacturing costs of $10 per unit; fixed manufacturing costs of $2,000; variable non-manufacturing costs of a $2 sales commission per unit sold; and fixed non-manufacturing costs of $700.

A) What will the 2006 year-end balance sheet show for ending inventory if the company uses Variable Costing?

B) Calculate net income for 2006 under Variable Costing. The sales price is $50 per unit.

15-8: John Smith owned a flour mill. He started 1803 with no inventory, produced 50 tons of flour, and ended the year with five tons of flour. Sales were $22,500. He had no variable manufacturing overhead. His only direct cost was grain, for which he paid $8,000. Non-manufacturing variable costs were $5,000, non-manufacturing fixed costs were $4,000, and manufacturing fixed costs were $6,000.

A) What was Smith's contribution margin for 1803?

(A) $9,500

(B) $10,300

(C) $10,800

(D) The answer depends on whether Smith uses Absorption Costing or Variable Costing

B) What was operating income for 1803 under Variable Costing?

(A) Loss of $500

(B) Income of $800

(C) Income of $900

(D) Income of $300

15-9: The following information pertains to Booz Audio, a manufacturer of high-end speakers for home audio systems. Each "Unit" is actually two speakers (i.e., a pair of speakers). The sales price per unit is $1,500 in both years. Beginning inventory in 2004 was zero.

2004	
Units manufactured	5,000
Units sold	4,500
Direct manufacturing costs(materials and labor)	$2,000,000
Variable manufacturing overhead	500,000
Fixed manufacturing overhead	1,000,000
Variable non-manufacturing overhead	50,000
Fixed non-manufacturing overhead	100,000

<u>2005</u>

Units manufactured	4,000
Units sold	4,100
Direct manufacturing costs (materials and labor)	$1,600,000
Variable manufacturing overhead	400,000
Fixed manufacturing overhead	1,000,000
Variable non-manufacturing overhead	40,000
Fixed non-manufacturing overhead	100,000

Required:

A. Prepare a contribution margin income statement for 2005, using variable costing, assuming the company uses FIFO.

B. Prepare a gross margin income statement for 2005, using absorption costing, assuming the company uses FIFO.

C. Compute cost-of-goods-sold for 2005, using absorption costing, assuming the company uses LIFO.

15-10: The Arcata Bicycle Company began operations on January 1, 2000 with no inventory. The company makes one product, a touring bike. Following is information for production and sales for Arcata's first two years of operations.

	For the year 2000	**For the year 2001**
Units produced	100	100
Units sold	85	80
Selling price per unit	$2,000	$2,000
Direct materials per unit	$100	$90
Direct labor per unit	$60	$60
Sales commission per unit	$20	$20

In each year, total variable manufacturing overhead was $50,000; total fixed manufacturing overhead was $60,000; and total fixed non-manufacturing overhead was $20,000. There were no variable non-manufacturing costs other than sales commissions.

Required:

A) How many units are in ending inventory at the end of 2001?

B) Using FIFO (First-in First-out) and Absorption Costing, what is the cost of ending inventory on the Balance Sheet at the end of 2001?

C) Using Variable Costing and LIFO, what is income for 2001?

15-11: Onen Corporation makes just one product: a hydraulic pump that sells for $1,000 per unit. In May, Onen started with zero units in beginning inventory, manufactured 400 pumps, and sold 350 pumps. The variable manufacturing cost is $600 per unit, which consists of $300 in direct materials, $200 in direct manufacturing labor, and $100 in variable manufacturing overhead. The fixed manufacturing overhead costs are $50,000. The only variable non-manufacturing cost is a warehousing fee incurred each time a unit is manufactured, and this fee is $60 per unit. Fixed non-manufacturing costs are $70,000.

Required:

A) What will appear on the balance sheet at the end of May for the cost of ending inventory under Variable Costing?

B) Prepare an income statement for May using Variable Costing. Use a contribution margin format for the income statement.

C) What will appear on the balance sheet at the end of May for the cost of ending inventory under Absorption Costing?

D) Prepare an income statement for May using Absorption Costing. Use a Gross Margin format for the income statement.

E) Calculate operating income for May under Throughput Costing.

15-12: Claypool Corporation can make three models of barbecue grills. Following is information about production cost and sales demand for one year, which is the company's planning horizon.

	Portable	**Standard**	**Deluxe**
Sales price	$400 per unit	$200 per unit	$800 per unit
Maximum sales demand	1,000 units	500 units	400 units
Beginning inventory	zero	zero	zero
Inputs:			
Direct materials	$85 per unit	$40 per unit	$280 per unit
Direct labor	10 hours per unit	4 hours per unit	15 hours per unit
Metal-working time	2 hours per unit	1 hour per unit	3 hours per unit
Fixed manufacturing overhead	$3,000 in total	$1,000 in total	$5,000 in total

The capacity of the factory is determined by the metal-working machine. This machine can run 2,000 hours annually. The table shows how much time each unit requires on this machine. The company anticipates that at the end of this year, this machine will have to be replaced.

The factory has a single production line, and must retool the line when switching from one model of grill to another. The out-of-pocket cost to retool is $5,000 each time production is switched. Production downtime for retooling is determined by the downtime on the metal-working machine, which is 100 hours. There is no need to run more than one production-run of any one product annually (meaning that even if all three models are produced, total downtime on the metal-working machine is only 2 x 100 hours = 200 hours for the year).

The average labor wage rate is $15 per hour. The variable overhead rate is the same for all three products. It is $20 per hour on the metal-working machine (e.g., $40 for each portable grill).

The fixed overhead in the table shows product-level costs. These costs are incurred if any amount of that model is produced. If no units of that model are produced, these costs are completely avoidable. Facility-level fixed manufacturing overhead costs are $30,000 per year. These costs are unavoidable.

Required:

A) What is the most profitable product? Explain your reasoning.

B) What is the profit-maximizing product mix? Assuming that the company uses this product mix, show an income statement for each product produced.

C) Without regard to your answers to parts A and B, assume that the company decides to produce only the portable heater. Halfway through the year, the metal-working machine breaks down, injuring the machine operator, and prompting the labor union to call a strike. The machine cannot be repaired or replaced for the rest of the year, and in any case, the workers remain on strike. During the first six months, the company produced 500 portable heaters, and by the end of the year, the company sold 400, leaving 100 units in ending finished goods inventory. Value this ending inventory for financial reporting purposes, in accordance with S.F.A.S. 151.

15-13: ZFN Scandinavia is a new affiliate of ZFN International. ZFN Scandinavia manufactures bell-bottom jeans in a single manufacturing facility. Following is pertinent data for 2005, its first year of operations (hence, there is no beginning inventory).

Factory capacity:	250,000 jeans per year
Units manufactured in 2005:	192,000 jeans
Variable manufacturing costs:	$10 per jean
Fixed manufacturing overhead costs:	$1,344,000
S. G. & A. expenses:	$2 per jean (this is a sales commission)
Sales:	150,000 jeans at $25 per jean

Sales demand, sales price, and variable costs are all expected to remain unchanged in 2006 from 2005. Fixed manufacturing overhead costs are expected to increase by 10%.

Required:

Calculate 2005 income and projected 2006 income under Absorption Costing, under each of the following sets of assumptions:

A) The company accounts for inventory using FIFO, allocates fixed manufacturing overhead costs based on units produced, manufactures enough units in 2006 to plan for 60,000 units in ending inventory at the end of the year.

B) The company accounts for inventory using FIFO, allocates fixed manufacturing overhead costs based on units produced, manufactures at capacity in 2006.

C) The company accounts for inventory using LIFO, allocates fixed manufacturing overhead costs based on units produced, manufactures enough units in 2006 to plan for 60,000 units in ending inventory at the end of the year.

D) The company accounts for inventory using LIFO, allocates fixed manufacturing overhead costs based on units produced, manufactures at capacity in 2006.

Calculate 2005 income and projected 2006 income under Variable Costing, under FIFO, assuming the company manufactures enough units in 2006 to plan for 60,000 units in ending inventory at the end of the year.

15-14: Aztech Industries makes only one product. In 2001, the company started the year with zero beginning inventory. The company reported the following results for 2005 and 2006:

	2005	**2006**
Units made	20	10
Units sold	18	7
Average unit sales price	$1,000	$1,000
Variable manufacturing costs	$1,400	$ 700
Fixed overhead manufacturing costs	$3,500	$3,500
Variable non-manufacturing costs	$ 180	$ 90
Fixed non-manufacturing costs	$ 900	$ 900

Required:

A) How many units are in ending inventory at the end of 2006?

B) Calculate the cost of ending inventory at the end of 2006, assuming the company uses Absorption Costing, and the FIFO (first-in, first-out) inventory flow assumption.

C) Calculate operating income for 2006, assuming the company uses Absorption Costing, and the LIFO (last-in, first-out) inventory flow assumption.

D) Calculate operating income for 2006, using either FIFO or LIFO (whichever you prefer), assuming the company uses Variable Costing.

E) Calculate the cost of ending inventory at the end of 2006, assuming the company uses Variable Costing, using either FIFO or FIFO (whichever you prefer).

F) Assume the company uses Absorption Costing. What is the Gross Margin in 2005?

G) Assume the company uses Variable Costing. What is the contribution margin (i.e., the total contribution margin) for 2005?

15-15: A factory has fixed manufacturing overhead of $10,000,000 per year. Production capacity (practical capacity) is 20,000 units per year. The normal range of production, for purposes of SFAS No. 151, ranges from 12,000 units to 18,000 units annually. In the past, the company had always used actual production to calculate the fixed cost per unit. The company uses the FIFO inventory flow assumption. The company started the year with 3,000 units, produced 10,000 units, and sold 11,000 units.

Required: How much more income or less income will the company show this year under SFAS No. 151 than it would have shown under its old method of allocating fixed manufacturing overhead, assuming that the company uses the flexibility permitted under SFAS No. 151 to minimize the effect of this new pronouncement on its financial statements relative to its old accounting? Assume that this is the first year the company implements SFAS No. 151, and assume the pronouncement is implemented prospectively, so beginning inventory is not restated.

15-16: A factory has fixed manufacturing overhead of $10,000 per month. Practical capacity is 2,000 units per month. The normal range of production, for SFAS No. 151, ranges from 1,200 units to 1,800 units monthly. In the past, the company used practical capacity to calculate the fixed cost per unit, and recorded the volume variance in COGS. The company uses LIFO. The company started the month with 1,000 units, produced 1,200 units, and sold 1,300 units.

Required: How much more income or less income will the company show this month under SFAS No. 151 than it would have shown under its old method of allocating fixed manufacturing overhead, assuming that the company uses the midpoint of the range of normal capacity in the denominator of its fixed overhead rate? Assume that this is the first month the company implements SFAS No. 151, and assume the pronouncement is implemented prospectively, so that inventory produced in prior months and brought into the current month as beginning inventory is not restated.

The answer is zero. Since the company is on LIFO, and since current month sales exceed current month production, all fixed manufacturing overhead incurred this month is expensed this month, either as part of Cost of Goods Sold or as the volume variance.

15-17: In July, Border Industries made 1,000 units of its sole product, and sold 800 units. There were no beginning inventories. Its net income for the month using Variable

Costing was $20,000. Its net income for the month using Absorption Costing was $24,000. Its contribution margin for the month was $50,000, and its gross margin for the month was also $50,000. Sales revenue for the month was $200,000. Border is on an actual costing system (i.e., overhead is allocated using a rate and allocation base that are based on actual amounts). There are no fixed direct costs.

Required:

A) How much fixed manufacturing overhead was incurred during the month?

B) How much fixed non-manufacturing overhead was incurred during the month?

C) What was the per unit variable manufacturing cost for the month?

D) What was the total variable non-manufacturing costs incurred during the month?

E) What is the cost of ending inventory under Absorption Costing?

F) What is the cost of ending inventory under Variable Costing?

15-18: Copernicus International uses Variable Costing, and the weighted-average inventory flow assumption. The company started the period with zero finished goods and 100 units of work-in-process. These units were 30% complete with respect to materials and 70% complete with respect to labor and variable manufacturing overhead. The cost of this beginning work-in-process was $10,000 in materials and $40,000 in labor and variable manufacturing overhead. During the period, the company completed these 100 units and started production of another 50 units. At the end of the period, of the 50 units started during the period, 20 were finished, and 30 were 20% complete with respect to materials and 50% complete with respect to labor and variable manufacturing overhead. Manufacturing costs incurred during the period were $8,000 for materials and $32,000 for labor and variable manufacturing overhead. Fixed manufacturing overhead for the period was $75,000. Fixed non-manufacturing costs were $10,000. Variable non-manufacturing costs were a $20 sales commission per unit sold. 85 units were sold, at an average sales price of $2,000 per unit.

Required:

A) Prepare a Contribution Margin format income statement for the period.

B) What are the balances in the work-in-process and finished goods inventory accounts at the end of the period?

CHAPTER 16: Fixed Manufacturing Overhead

Chapter Contents:

- Alternative denominator levels
- Production incentives
- The allocation of fixed overhead and management decision-making
- Annie's Soup Company
- Exercises and problems

Recall the steps to product costing:

1. Identify the **cost object**;
2. Identify the **direct costs** associated with the cost object;
3. Identify **overhead costs**;
4. Select the **cost allocation base** for assigning overhead costs to the cost object;
5. Develop the **overhead rate** per unit for allocating overhead to the cost object.

This chapter focuses on steps #3 through #5 for fixed manufacturing overhead.

Alternative denominator levels:

It is possible to allocate overhead separately for fixed overhead and for variable overhead, and there are sometimes good reasons to do so. When fixed and variable manufacturing overhead are allocated separately, there are important issues related to how the denominator of the fixed overhead rate is calculated. Alternative denominator choices are:

Theoretical capacity: This measure of factory capacity assumes 100% efficiency 100% of the time. It is analogous to the EPA miles-per-gallon estimates that are determined for new automobiles; nobody actually achieves this gas mileage in day-to-day driving, but the EPA estimates are useful for comparison shopping.

Practical capacity: This measure of factory capacity reduces theoretical capacity for anticipated unavoidable operating interruptions, including routine maintenance.

Normal capacity: This denominator-level concept measures the level of factory activity that satisfies average customer demand over an intermediate period of time. It frequently averages over seasonal or cyclical fluctuations in demand. As discussed in the previous chapter, Generally Accepted Accounting Principles now require companies to allocate fixed production overhead based on the "normal capacity" of the production facilities for external financial reporting purposes. The definition of normal capacity provided here is similar in concept to the definition provided in SFAS No. 151, although the definition in the pronouncement provides some latitude and encompasses a range of production levels.

Budgeted production: This denominator-level concept has been introduced previously. It is the level of factory activity budgeted for the upcoming period.

Because fixed costs, by definition, do not depend on the level of output, the numerator in the fixed overhead rate is not expected to differ across these four denominator choices. Since there is no cause-and-effect relationship in the short run between the estimation of the numerator and the quantity of the allocation base in the denominator, the larger the denominator, the smaller the amount of fixed overhead costs that are allocated to each unit of product.

This situation contrasts with variable overhead. In fact, for variable overhead, the numerator cannot be estimated until the denominator is estimated. For example, an apparel factory cannot accurately estimate electricity expense for the coming year until it predicts the amount of time the machines will run, and this estimate depends on the projected level of production. Hence, for variable overhead, the allocation base is chosen, then the quantity of the allocation base is estimated, and then variable overhead costs are estimated.

Production Incentives:

Many accounting writers have emphasized the effect that the allocation of fixed overhead can have on managerial incentives to overproduce. When fixed overhead is allocated to product, the greater the production level, the lower the fixed cost per unit. The lower fixed cost per unit might increase ***perceived*** profitability, but is the company really more profitable?

The answer to this question depends on what happens to the additional inventory. If the company is producing more inventory than it can sell, and is consequently stockpiling finished goods inventory, then clearly the company is not more profitable. This situation arises in Eliyahu Goldratt's business novel *The Goal* (coauthored with Jeff Cox). Factory management in the novel is so committed to maximizing output and minimizing per-unit production cost, that they rent a warehouse to store large quantities of excess inventory.

On the other hand, if the factory can sell all of the goods that it produces, then as production increases, the factory really does become more profitable. Furthermore, when fixed costs are allocated to product, this increased profitability is reflected in the lower per-unit cost.

The key question, then, is whether managers, companies, or factories with incentives to overproduce can stockpile inventory without negative repercussions. It would seem that in the business environment of the past several decades, this risk has been overrated. Excess inventory is highly visible, physically and on the balance sheet, both for managerial accounting and financial reporting purposes. Hence, while it is important for managers and management accountants to be aware that the allocation of fixed overhead can provide incentives to overproduce, the risk posed by these incentives probably need not dictate the decision of whether to allocate fixed overhead for management accounting purposes. (Recall from Chapter 15 that for financial accounting purposes, companies must allocate fixed manufacturing overhead.)

The Allocation of Fixed Overhead and Management Decision-Making:

A more difficult question than perverse production incentives is whether the allocation of fixed overhead assists or hinders sourcing, marketing and pricing decisions. This question, which can be characterized as a debate of the merits of absorption costing versus contribution margin analysis, has probably generated more controversy than any other issue in management accounting. Following are three views from prominent accounting faculty.

In the second edition of his textbook *Managerial Accounting* (copyright 2004), James Jiambalvo, Dean of the Business School at the University of Washington, states that the major limitation of activity-based costing is that most companies use ABC to develop the full cost of products (Chapter 6, p. 208). Jiambalvo also offers only one answer to the question of why GAAP requires absorption costing: that "company managers may be concerned that variable cost information will prove helpful to competitors" (Chapter 5, p. 169). It is clear from these statements and others in his textbook that Professor Jiambalvo perceives little benefit from absorption costing for managerial decision-making.

Robert Kaplan, Professor at Harvard University, participated in a Panel Discussion on contribution margin analysis at the Annual Meeting of the American Accounting Association. Professor Kaplan, who was one of the most persuasive early advocates of activity-based costing and one of the originators of the Balanced Scorecard (discussed in Chapter 24), commented:

> Interestingly, many companies have resisted for the most part the attempts by academic accountants to convince them to ignore their fixed costs. … Most companies persist in performing full cost allocations.
>
> \- *Journal of Management Accounting Research*, 1990 (Fall), p. 4

In fact, surveys suggest that for internal reporting purposes, approximately 50% of companies use variable costing and 50% use absorption costing.

In 1989, John Shank participated in the same panel discussion as Bob Kaplan. Professor Shank's comments included the following:

> I now believe at the broadest possible level that my [former] support for the contribution margin concept was misplaced and short-sighted. … I have been looking for some big successes from contribution margin analysis for 25 years, and I have come up empty. … In fact, it almost seems to be axiomatic, and let me call it Shank's Axiom.
>
> - If the problem is small enough so that contribution margin analysis is relevant then it can't have a very big impact on a company.
> - And if the possible impact in a decision setting is major, if it can really affect a company in a major way, then it's silly to consider most of the factors to be fixed.

> … Not only can I find no notable big successes from contribution margin concepts in the real world, I can point to many examples of what I consider to be notable failures from the application of the contribution margin mind-set. … I believe that more than one entire industry has competed itself to the brink of insolvency using contribution-based pricing.
>
> - *Journal of Management Accounting Research*, 1990 (Fall), p. 17

Professor Shank refers to the trucking and airline industries in the years following their deregulation as two examples to illustrate his point. If an airplane is about to leave the gate with empty seats, the marginal cost of adding additional passengers to fill those seats is almost zero (a small increase in fuel consumption, and a few bags of pretzels, perhaps). Hence, an airline applying contribution margin analysis will make every effort to try to fill the plane to capacity, including offering deeply-discounted, last-minute fares. However, it is an open question as to whether the numerous bankruptcies and near-bankruptcies that have occurred in the airline industry in the years following deregulation resulted from a "contribution margin mind-set," as Professor Shank suggests, or rather from the underlying economic characteristics of the industry. Given overcapacity in the industry, the fact that airlines have high fixed costs and low variable costs, and the fact that airlines have difficulty differentiating the services that they offer from their competitors, it is not clear that any one airline would have improved its situation using a full costing approach to pricing.

Annie's Soup Company:

The following fictional example illustrates the general nature of the debate between contribution margin analysis and absorption costing.

Annie's Soup Company manufactures twelve types of soup in its facility in Eureka, California. Each soup is produced on its own equipment, in a portion of the facility dedicated exclusively to it. The facility is running at 70% of capacity.

Annie's Soup Company has traditionally reported the full cost of products for internal performance evaluation purposes, allocating facility-level costs to each product based on machine hours. Annie's philosophy is to encourage product managers to set sales prices that will support the company's overall profit targets, and she believes that full costing supports this objective. If facility-level costs were not allocated, then each product might show a profit, yet the company as a whole could show a loss.

The product manager of the cream soup line has proposed a new product: a cream spinach soup that would be called Annie's Ultimate Spinach soup. The product manager admits that initial demand for this product probably would not support a sales price that would cover the full cost of the product including an allocation of facility-level costs. However, the product manager convinces Annie that because the facility has excess capacity, the new soup should be required to meet only its marginal costs (unit-level, batch-level and product-level costs in the cost hierarchy, but not facility-level costs). At a sales price of $1.75 per can to retailers, without an allocation of facility-level costs the profit margin would be $0.25 per can, but with facility-level costs allocated to Ultimate Spinach soup, it would be projected to show a loss of $0.25 per can.

The product manager's argument persuades Annie to approve the production of Ultimate Spinach soup, and to evaluate it, at least initially, based on a cost that excludes facility-level costs.

The following year, the product manager of the tomato-based soups proposes a new tomato bisque soup. She asserts that since the latest soup introduced by the cream soup manager does not have facility-level costs allocated to it, neither should her new tomato bisque. Annie agrees.

Three years pass. The situation is now as follows. The company has 14 soups. Twelve soups have facility-level costs allocated to them, two do not. Is this situation acceptable, and if not, what should be done about it?

The current situation seems problematic. Annie cannot directly compare profitability across all 14 soups. As time passes, and as the date each soup was introduced becomes less salient, it is increasingly difficult to view Annie's Ultimate Spinach Soup and the Tomato Bisque as the "marginal products." In any case, as discussed in Caplan, Melumad and Ziv (The Denim Finishing Company, *Issues in Accounting Education*, 2005), it is not at all clear that contribution margin analysis can be effectively applied by always treating the newest product as the marginal product.

Should Annie start allocating facility-level overhead to all 14 products? If so, there is no obvious point in time at which to initiate this allocation to the two new products. Furthermore, if one of the new products shows a loss when facility-level costs are allocated to it, and if the factory still has excess capacity, it is not clear that the unprofitable product should be dropped. Marginal cost analysis applied to the decision of whether to drop a product is as relevant now as the initial marginal cost analysis that supported introducing the product in the first place.

Should Annie stop allocating facility-level overhead to all 14 products, and convert to a variable costing approach to product profitability analysis? The disadvantage of this approach is that without an allocation of facility-level costs, each of the 14 products could generate a positive contribution margin, which might be viewed positively by each of the product managers, yet the company as a whole could still be unprofitable. Rather, full costing helps ensure that product managers attempt to set sales prices that support the company's overall profitability goals.

Exercises and Problems:

Discussion Question 16-1:
The Taos Ski and Tennis Resort has a Summer manager and a Winter manager. These managers receive a substantial portion of their income in the form of a bonus based on profitability. They constantly argue about how certain costs should be allocated across the two seasons. For example, they both wanted a new espresso bar constructed, and they convinced the owner to build it by agreeing to have the construction cost depreciated over the life of the building, and to have each year's depreciation expense allocated between the Summer season and the Winter season for purposes of calculating each manager's profits. This convinced the owner that the managers really believed the espresso bar would cover its costs. However, although the two managers agreed that these fixed costs should be allocated, and although they believe that the incremental revenue will more than cover the costs, including the cost to build the espresso bar, they can't agree on how to allocate depreciation expense between the two seasons. The summer manager suggests splitting depreciation expense 50/50, since the number of visitors is about the same for each season. The Winter manager suggests splitting depreciation expense 70/30 (70% to Summer), since this roughly represents the length (in days) of each season.

The best way for the owner to resolve this dispute is to

(A) Not allocate depreciation expense at all, since the cost of the building was relevant before it was built, but is irrelevant now that it is a sunk cost.

(B) Allocate depreciation 50/50, since all else equal, this will not favor either manager.

(C) Allocate depreciation 70/30, because this method is consistent with depreciating the entire cost of the building over its useful life.

(D) Allocate the cost based on actual espresso bar revenues, since this allocates costs on an "ability to bear" basis, and recognizes the fact that guests are more likely to buy coffee when the weather is cooler, so that the Summer manager is not penalized.

Discussion Question 16-2:
The Bernalillo Tortilla Factory manufactures a variety of packaged Mexican food products in a large factory in Northern New Mexico. In general, each product has its own equipment, factory personnel, and product manager. Many of these products are currently very popular, and in the short-term, there is not enough space in the factory to meet consumer demand. Which of the follow statements are true?

(A) Allocating fixed manufacturing overhead to production will encourage product managers to set sales prices on individual products that will help achieve the company's overall profitability goals.

(B) Allocating fixed manufacturing overhead to production using factory square feet as the allocation base will assist management in determining the most profitable product mix.

(C) Allocating fixed manufacturing overhead to production during the year will provide product cost information that is more consistent with the company's year-end financial statements (prepared in accordance with Generally accepted Accounting Principles) than would treating fixed manufacturing overhead as a period expense.

(D) Fixed manufacturing overhead costs are sunk in the short-run, and hence, are independent of the level of production. Therefore, there is no purpose in allocating these costs to production.

16-3: Milwood Mills makes decorative woodcut prints. Each design is run in a single batch once during the year. Milwood Mills allocates machine set-up costs using set-up hours as the allocation base. Following is budgeted information for next year for two of the company's numerous designs: *Bull and Matador* and *Dogs Playing Poker*.

	Bull	Dogs
Number of woodcuts	5,000	15,000
Direct materials cost	$25,000	$33,000
Direct labor cost	$14,000	$16,000
Number of machine set-up hours	120	150
Pounds of material	5,000	10,000
Kilowatt hours	2,000	3,000

Required:

A) What is the anticipated effect of making the 5,000 "Bull" woodcuts in two batches instead of one, holding all else constant, if machine set-up costs are variable, in a linear fashion, in the number of setups?

(A) The unit cost of "Bull" will increase, and the unit cost of "Dogs" will decrease.

(B) The unit cost of "Bull" will increase, and the unit cost of "Dogs" will remain unchanged.

(C) The unit cost of "Bull" will decrease, and the unit cost of "Dogs" will remain unchanged.

(D) The unit cost of both "Bull & Matador" and "Dogs" will remain unchanged.

B) What is the anticipated effect of making the 5,000 woodcuts of "Bull" in two batches instead of one, holding all else constant, if machine set-up costs include both fixed and variable components?

(A) The unit cost of "Bull" will increase, and the unit cost of "Dogs" will decrease.

(B) The unit cost of "Bull" will increase, and the unit cost of "Dogs" will remain unchanged.

(C) The unit cost of "Bull" will decrease, and the unit cost of "Dogs" will remain unchanged.

(D) The unit cost of both "Bull & Matador" and "Dogs" will remain unchanged.

16-4: The not-for-profit health clinic Shots-Я-Us provides various types of vaccinations and other shots, especially flu shots, to the public for free or for a nominal fee. The clinic is funded by several local governmental agencies as well as by a number of charitable organizations. Since different donors wish to fund different types of shots, the clinic determines the full cost of each type of shot, by adding overhead to the direct costs, and then provides this information to current and prospective donors.

Following are actual and budgeted costs for Shots-Я-Us for 2003:

	Actual	**Budgeted**
Number of patient visits	5,000	4,000
Number of shots administered	6,000	4,500
Fixed overhead: salaries, rent for the facility, insurance, depreciation.	$94,000	$110,000
Variable overhead: nursing staff hoursly wages, utilities, disposable supplies.	$66,000	$40,500
Cost of hypodermics (a direct cost)	$1,000	$750
Cost of medications (a direct cost)	$30,000	$20,000

Assume the clinic allocates fixed overhead separately from variable overhead, and allocates fixed overhead using the number of shots as the allocation base. Clinic management believes that the facility could deliver as many as 7,000 shots per year. Which of the following overhead rates will result in underallocated fixed overhead for the year?

I. Actual level of activity in the denominator, and actual costs in the numerator.

II. Budgeted level of activity in the denominator, and budgeted costs in the numerator.

III. Practical capacity in the denominator, and budgeted costs in the numerator.

(A) III only

(B) II and III only

(C) II only

(D) I only

(E) neither I, II, nor III

16-5: The Carl-Carlson Corporation uses Absorption Costing, begins the year with zero inventory, and has both fixed and variable manufacturing costs. Relative to the benchmark in which the company produces the same number of units that it sells, which of the following statements is true?

(A) By producing above its sales level, the company will increase the total cost of ending inventory on the balance sheet, and will also increase net income.

(B) By producing above its sales level, the company will increase the total cost of ending inventory on the balance sheet, but will not affect net income.

(C) By producing above its sales level, the company will increase the total cost of ending inventory on the balance sheet, but will decrease net income.

(D) None of the above statements can be made with certainty, unless the actual costs and unit volumes are known.

16-6: For the year 2004 (his first year of operations), Harvey Mudd sold 7,500 units at $350 per unit, and produced 10,000 units, of his sole product, a combination espresso machine and rug steamer. Factory capacity is 15,000 units. Other information for the year included the following:

Direct manufacturing labor	$750,000
Variable manufacturing overhead	400,000
Direct materials	600,000
Variable selling expense (a sales commission)	400,000
Fixed non-manufacturing expenses	400,000
Fixed manufacturing overhead	800,000

Required: On January 1, 2005, Harvey predicts that his sales demand and cost structure (total fixed cost and variable cost per unit) will remain exactly the same in 2005 as it was in 2004. Harvey doesn't want to change his sales price, uses FIFO for financial reporting, and wants to show the same profits under Variable Costing as under Absorption Costing in 2005. Is there an attainable production level that will accomplish this goal? If so, what is that production level?

16-7: For the year 2049, its first year of operations, Montgomery Scott Enterprises sold 7,500 units at $350 per unit, and produced 10,000 units, of its sole product, a Shuttlecraft navigational device. Other information for the year included:

Direct manufacturing labor	$750,000
Variable manufacturing overhead	400,000
Direct materials	600,000
Variable selling expenses	400,000
Fixed administrative expenses	400,000
Fixed manufacturing overhead	800,000

Required: On January 1, 2050, Scott uses a new software program, Econ-forecast, which predicts that his sales demand and cost structure will remain exactly the same in 2050 as it was in 2049. Scott doesn't want to change his sales price, uses LIFO for financial reporting, and wants to show zero profits (i.e., wants to break even) in 2050. Is there a production level under absorption costing that will accomplish this goal? If so, what is it?

16-8: The Eureka Company began operations on January 1, 2005 with no inventory. The company makes one product, an electric lawn mower. Following is information for production and sales for 2005, and projected information for 2006:

	Actual for 2005	**Projections for 2006**
Units produced	190	To be determined (by you)
Units sold	100	210
Selling price per unit	$2,500	$2,600
Direct materials per unit	$190	$220
Direct labor per unit	$70	$70
Variable non-manufacturing costs:		
Sales commission per unit	$40	$45

Factory capacity is 200 units per year. In 2005, total variable manufacturing overhead was $85,500; total fixed manufacturing overhead was $200,000; and total fixed non-manufacturing overhead was $30,000. There were no variable non-manufacturing costs other than the sales commissions. The total fixed costs and the per-unit variable overhead costs are expected to be the same in 2006 as in 2005. The company uses LIFO (Last-in, First-out) and Absorption Costing.

Required:

A) Prepare a Gross Margin format income statement for 2005.

B) Is there a production level for 2006 that will allow the company to earn profits of $100,000 in 2006, if all goes according to plan? If so, what is that production level?

16-9: The Well-Managed Manufacturing Company is concerned about how much income it will report for the year ending December 31, 2006. It is now mid-November, and the estimated (pro forma) income statement for the year, calculated on a Variable Costing basis, is as follows:

Sales	50,000 units	$750,000
Variable costs:		
Manufacturing costs	$200,000	
Selling and administrative costs	100,000	300,000
Contribution margin		$450,000
Fixed costs:		
Manufacturing costs	$300,000	
Selling and administrative costs	100,000	400,000
Operating income		$ 50,000

Well-Managed began the year with zero inventory and was anticipating ending the year with zero inventory. However, the managers have been promised a bonus if income is at least $100,000 calculated according to Generally Accepted Accounting Principles. One of the managers wants to increase income by increasing production, even though the level of sales for the year will not be affected.

Required:

A) What is the cost per unit of inventory, and operating income, using Absorption Costing, assuming the company has no inventory at year-end, as planned?

B) How much inventory would have to be produced for ending inventory, in order to raise income to $100,000? In other words, what would the balance in ending inventory have to be?

C) One manager believes that producing unneeded inventory to generate income is a bad idea. What do you think?

CHAPTER 17: Cost Variances for Variable and Fixed Overhead

Chapter Contents:

Cost Variances for Variable Overhead:

The formulas for splitting the flexible budget variance for variable overhead into a "price" variance and an "efficiency" variance are the same as the formulas for direct materials and direct labor explained in Chapter 7. The "price" variance for variable overhead is called the variable overhead **spending variance**:

Spending variance = **PV** = **AQ** x (**AP** – **SP**)

Efficiency variance = **EV** = **SP** x (**AQ** – **SQ**)

Where **AP** is the actual overhead rate used to allocate variable overhead, and **SP** is the budgeted overhead rate. The "**Q's**" refer to the quantity of the allocation base used to allocate variable overhead, so that **AQ** is the actual quantity of the allocation base used during the period, and **SQ** is the standard quantity of the allocation base. The standard quantity of the allocation base is the amount of the allocation base that should have been used (i.e., would have been budgeted) for the actual output units produced.

Given the use of the allocation base in these formulas for the cost variances for variable overhead, the meaning of these variances differs fundamentally from the interpretation of the variances for direct materials and direct labor. Consider a company that allocates electricity using direct labor as the allocation base. A negative variable overhead efficiency variance does not necessarily mean that the factory used more electricity than the flexible budget quantity of kilowatt hours for the actual outputs produced. Rather, the negative variance literally means that the factory used more direct labor than the flexible budget quantity for direct labor. If there is a cause-and-effect relationship between the allocation base and the variable overhead cost category (i.e., if more direct labor hours implies more electricity used), then the negative efficiency variance suggests that more electricity was used than the flexible budget quantity, but the efficiency variance does not measure kilowatts directly.

Similarly, a negative spending variance for variable overhead does not necessarily mean that the cost per kilowatt-hour was higher than budgeted. Rather, a negative spending variance for variable overhead literally states that the actual overhead rate was higher than the budgeted overhead rate, which could be due *either* to a higher cost per kilowatt-hour, *or more kilowatt hours used per unit of the allocation base*. Hence, what one might think should be included in the efficiency variance (kilowatt hours required per direct-labor-hour being higher or lower than budgeted) actually gets included as part of the spending variance.

Cost Variances for Fixed Overhead:

Whereas the cost variances for direct materials, direct labor, and variable overhead all use the same two formulas, the cost variances for fixed overhead are different, and do not use these formulas at all.

Also, whereas cost variances for direct materials, direct labor, and variable overhead can be calculated for individual products in a multi-product factory, cost variances for fixed overhead can only be calculated for the factory or facility as a whole. (More precisely, fixed overhead cost variances can only be calculated for the combined operations to which the resources represented by the fixed costs apply.)

There are two fixed overhead cost variances: the spending variance and the volume variance.

The Fixed Overhead Spending Variance:

The **fixed overhead spending variance** is the difference between two lump sums:

Actual fixed overhead costs incurred – Budgeted fixed overhead costs

The fixed overhead spending variance is also called the **fixed overhead price variance** or the **fixed overhead budget variance**.

The Fixed Overhead Volume Variance:

The **fixed overhead volume variance** is also called the **production volume variance**, because this variance is a function of production volume. The volume variance attaches a dollar amount to the difference between two production levels. The first production level is the actual output for the period. The second production level is the denominator-level concept in the budgeted fixed overhead rate, expressed in units. As discussed in the previous chapter, there are two common choices for this denominator:

1. budgeted production
2. factory capacity

The interpretation of the volume variance depends on which of these two denominators are used, but in either case, the production volume variance is the difference between budgeted fixed overhead (a lump sum), and the amount of fixed overhead that would be allocated to production under a standard costing system using this fixed overhead rate.

The volume variance with budgeted production in the denominator of the O/H rate:

First we use budgeted production to calculate the volume variance. In this case:

$$\text{volume variance} = \left(\frac{\text{budgeted fixed overhead}}{\textbf{budgeted production}} \times \text{units produced} \right) - \text{budgeted fixed overhead}$$

The term in parenthesis equals the amount of fixed overhead that would be allocated to production under a standard costing system, when budgeted production is the denominator-level concept.

Since

$$\text{budgeted fixed overhead} \div \text{budgeted production} = \text{budgeted overhead rate}$$

the above expression for the volume variance is algebraically equivalent to the following formula:

$$\text{volume variance} = (\text{units produced} - \text{budgeted production}) \times \text{budgeted overhead rate}$$

This formula for the volume variance illustrates the statement above; that the volume variance attaches a dollar amount to the difference between two production levels. In this case, the two production levels are actual production and budgeted production. The interpretation of the volume variance, when budgeted production is used in the denominator of the overhead rate, is the following. When actual production is less than budgeted production, the volume variance represents the fixed overhead costs that are not allocated to product because actual production is below budget. In this case, the volume variance is ***unfavorable***. When actual production is greater than budgeted production, then the volume variance represents the additional fixed overhead costs that are allocated to product because actual production exceeds budget. In this case, the volume variance is ***favorable***.

The intuition for when the volume variance is favorable and when it is unfavorable is the following. If the company can produce more units of output using the same fixed assets (i.e., the resources that comprise fixed overhead), then assuming those additional units can be sold, the company is more profitable. When fixed overhead is allocated to production, this greater profitability is reflected in a lower per-unit production cost, because the same amount of total fixed overhead is spread over more units. On the other hand, if fewer units are produced than planned, then the same fixed overhead is spread over fewer units, the per-unit production cost is higher, and the company is less profitable. This higher or lower profitability that arises from changes in production levels is not an artifact of the accounting system. Even if the company uses Variable Costing, and expenses fixed overhead as a lump-sum period cost, when the company makes and sells fewer units than planned using the same fixed overhead resources, it really is less profitable than was budgeted, and when the company makes and sells more units than planned using the same fixed overhead resources, it really is more profitable than was budgeted.

The volume variance with factory capacity in the denominator of the O/H rate:
Next we use factory capacity to calculate the volume variance. In this case:

$$\text{volume variance} = \left(\frac{\text{budgeted fixed overhead}}{\text{factory capacity}} \text{ x } \text{units produced} \right) - \text{budgeted fixed overhead}$$

Since

$$\text{budgeted fixed overhead} \div \text{factory capacity} = \text{budgeted overhead rate}$$

the above expression for the volume variance is algebraically equivalent to the following formula:

$$\text{volume variance} = (\text{units produced} - \text{factory capacity}) \text{ x } \text{budgeted overhead rate}$$

The interpretation of the volume variance, when factory capacity is used in the denominator of the overhead rate, is the following. Actual production is almost always below capacity. The volume variance represents the fixed overhead costs that are not allocated to product because actual production is below capacity. Hence the volume variance represents the cost of idle capacity, and this variance is typically ***unfavorable***. For this reason, this volume variance is sometimes called the **idle capacity variance**. In the unlikely event that the factory produces above capacity (which can occur if the concept of practical capacity is used, and actual down-time for routine maintenance, etc., is less than expected), then the volume variance represents the additional fixed overhead costs that are allocated to product because actual production exceeds capacity. In this case, the volume variance is ***favorable***.

Additional Issues Related to the Volume Variance:
Under what circumstances would a company calculate the volume variance using budgeted production as the denominator-level concept, and under what circumstances would a company use factory capacity as the denominator-level concept?

The use of budgeted production in the calculation of the volume variance attaches a lump sum benefit or cost to actual production levels that exceed or fall short of budgeted production levels. For this reason, many companies consider this calculation of the volume variance to be an important performance measure for the factory manager and marketing managers responsible for making and marketing the product.

The use of factory capacity in the calculation of the volume variance provides an indication of how low the per-unit cost can go, if demand equals or exceeds factory capacity. If senior management would like product managers to make pricing and operating decisions based on a long-term expectation that demand for the product will equal or exceed factory capacity, even though current or short-term demand is below capacity, calculating the per-unit cost in this manner will encourage product managers to take this long-run perspective. For example, consider the launch of a new product line in a new factory. If fixed overhead is allocated based on budgeted production, then product managers might feel pressured to set sales prices that will cover full product costs at initially-low production levels, but these sales prices might be too high to generate sufficient initial consumer interest in the product for a successful product launch.

Another reason to use factory capacity in the denominator of the fixed overhead rate, and in the calculation of the volume variance, is that doing so isolates the cost of idle capacity. Often, the decision to build a factory that is larger than current demand warrants is a strategic decision made at high levels within the organization. If the fixed overhead associated with this factory is allocated based on budgeted or actual production, the per-unit cost of every unit manufactured includes a small portion of the cost of this strategic decision, and the cost reports of factory managers and the product profitability statements of product managers are negatively affected by this unused capacity. Some companies prefer to isolate the cost associated with this strategic decision, and to either show the cost of idle capacity as separate line-items on the cost reports and profit statements of the factory manager and product managers, or remove this cost entirely from these performance reports, and report it only at the corporate level.

Allocating fixed overhead using actual production can provide managers short-run incentives to overproduce, because as production increases, the per-unit cost decreases. Similarly, calculating the volume variance using budgeted production in the denominator of the overhead rate can provide managers short-run incentives to overproduce, because as production exceeds budget, the volume variance becomes increasingly favorable. For this reason, some companies choose not to allocate fixed overhead at all. However, the use of factory capacity in the denominator of the fixed overhead rate accomplishes the same objective, because it isolates the volume variance such that the performance reports of these managers need not be affected by it.

We have assumed, throughout this section, that fixed overhead is allocated based on units of output. However, we saw in the chapter on activity-based costing that units of production is often a poor choice of allocation base in a multi-product factory, and many companies that use standard costing systems use allocation bases that are more sophisticated, such as direct labor hours or direct materials dollars. The question might arise, how does the use of a different allocation base, such as direct labor hours, affect the calculation of the volume variance? The answer is: *Not at all.* Because of the way in which standard costing systems work, the amount of fixed overhead that will be allocated to product does not depend on the choice of allocation base.

For example, assume that a one-product company budgets two direct labor hours to make each unit, and assume that if fixed overhead is allocated based on output units, the budgeted fixed overhead rate is $10 per unit. Then using direct labor hours as the allocation base, the budgeted fixed overhead rate is $5 per direct labor hour. Because of the mechanics of standard costing systems, no matter whether the $10-per-unit rate is used, or the $5-per-direct-labor-hour rate is used, $10 of fixed overhead will be allocated to every unit produced, no matter how many direct labor hours are actually used per unit. (If this fact is not obvious to you, refer back to Chapter 10 on standard costing.)

Therefore, for the purpose of calculating the volume variance, we might as well use the easiest allocation base, which is units-of-output.

It is important to recognize that even though most manufacturing companies use a standard costing system, and even though the calculation of the fixed overhead volume variance relies on the concept of standard costing, companies can calculate the volume variance even if they do not use a standard costing system. In this case, the calculation is identical to the discussion above, but the company will not be able to obtain the required information from the cost accounting system itself, but rather, will need to make a separate calculation.

Comprehensive Example of Fixed Overhead Variances:

The Coachman Company makes pencils. The pencils are sold by the box. Following is information about the company's only factory:

	Budget	**Actual**	**Capacity**
Number of boxes	10,000	12,000	20,000
Direct labor hours	200	250	
Machine hours	500	650	
Fixed overhead	$40,000	$42,000	

The outputs here are boxes of pencils. The inputs are direct labor hours and machine hours. First we calculate a fixed overhead rate using actual amounts, and output units as the allocation base:

$42,000 ÷ 12,000 boxes = $3.50 per box.

Using this overhead rate, every box of pencils is costed at the variable cost of production plus $3.50 in allocated fixed overhead.

Next: we calculate a fixed overhead rate using budgeted costs, and budgeted output units as the denominator-level concept:

$40,000 ÷ 10,000 boxes = $4.00 per box.

Next: we calculate a fixed overhead rate using budgeted costs, and factory capacity as the denominator-level concept (expressed in terms of output units).

$40,000 ÷ 20,000 boxes = $2.00 per box.

The advantage of using capacity in the denominator is that this denominator-level concept shows how low the fixed cost per unit can go, and hence, how low the total cost per unit can go, as production increases.

The fixed overhead spending variance is calculated as follows:

$42,000 actual – $40,000 budgeted = $2,000 unfavorable.

Next: we calculate the volume variance using capacity as the denominator-level concept:

volume variance = ($2.00 per box x 12,000 boxes) – $40,000 = $16,000 unfavorable

or equivalently:

volume variance = $2.00 per box x (12,000 boxes – 20,000 boxes) = $16,000 unfavorable

If the company uses a standard costing system, the amount of overallocated or underallocated fixed overhead is the difference between actual fixed overhead incurred, and fixed overhead allocated to product, calculated as follows:

actual fixed overhead – fixed overhead allocated

= $42,000 – ($2.00 per box x 12,000 boxes)

= $42,000 – $24,000 = $18,000 underallocated

This $18,000 of underallocated fixed overhead is equal to the sum of the $2,000 unfavorable fixed overhead spending variance and the $16,000 unfavorable volume variance.

Next: we calculate the volume variance using budgeted production as the denominator-level concept:

volume variance = ($4.00 per box x 12,000 boxes) – $40,000 = $8,000 favorable

or equivalently:

volume variance = $4.00 per box x (12,000 boxes – 10,000 boxes) = $8,000 favorable

If the company uses a standard costing system, the amount of overallocated or underallocated fixed overhead is the difference between actual fixed overhead incurred, and fixed overhead allocated to product, calculated as follows:

actual fixed overhead – fixed overhead allocated

= $42,000 – ($4.00 per box x 12,000 boxes)

= $42,000 – $48,000 = $6,000 overallocated

This $6,000 of overallocated fixed overhead is equal to the sum of the $2,000 unfavorable fixed overhead spending variance (which did not change when we changed the denominator-level concept from capacity to budgeted production) and the $8,000 favorable volume variance.

To illustrate that the choice of allocation base does not affect the calculation of the volume variance, we recalculate the volume variance assuming the company allocates overhead using machine hours as the allocation base and budgeted production as the denominator-level concept. The budgeted overhead rate is now

$40,000 ÷ 500 machine hours = $80 per machine hour.

Since the standard for machine time is one hour for every twenty boxes (derived from the budget column in the box at the beginning of the example), the standard costing system will allocate fixed overhead as follows:

Budgeted overhead rate x (**standard inputs allowed** for actual outputs achieved)

= $80 per machine hour x (12,000 boxes ÷ 20 boxes per machine hour)

= $80 per machine hour x 600 machine hours = $48,000

And the volume variance is

fixed overhead allocated to product – budgeted fixed overhead

= $48,000 – $40,000 = $8,000 favorable, as before.

Exercises and Problems:

17-1: Following is selected information about the Hopi Popcorn company. All information represents total amounts, not per unit amounts.

	Static Budget	Actual Results
Units made and sold	100	50
Direct materials costs	$5,000	$2,700
Direct materials used in production	1,000 pounds	450 pounds
Fixed overhead	$3,000	$4,000

Hopi had no beginning or ending inventory of either finished product or raw materials. Hopi allocates fixed overhead using units of output as the allocation base, and a budgeted overhead rate with budgeted production in the denominator.

Required: Calculate the fixed overhead volume variance.

17-2: Border Construction Company is a road-paving company. Such companies are characterized by high fixed costs in plant and equipment. The company allocates fixed overhead to its jobs based on miles of road paved. The company has an unfavorable fixed overhead spending variance, and overallocated fixed overhead. This set of facts is consistent with

(A) Unexpected capital expenditures and the use of practical capacity in the denominator of the fixed overhead rate.

(B) An unexpected decrease in fixed overhead costs, the use of budgeted activity in the denominator of the fixed overhead rate, and an unexpected increase in business.

(C) An unexpected increase in appropriations by the State Legislature for road work, resulting in more business for the company, and unexpected capital expenditures.

(D) The use of actual miles in the denominator of the fixed overhead rate, actual fixed overhead costs in the numerator, and significant unexpected capital expenditures.

17-3: Assume the following information for the Centerville 2 plant of Polypar, which manufactures only butyl.

Budgeted fixed overhead	$12,000,000
Plant production capacity	1,000,000 tons of butyl
Budgeted butyl production	500,000 tons of butyl
Actual butyl production	600,000 tons of butyl

Required:

A) Using budgeted butyl production in the denominator of the fixed overhead rate, calculate the fixed overhead volume variance.

B) Using plant capacity in the denominator of the fixed overhead rate, calculate the fixed overhead volume variance.

C) In one or two sentences, interpret what each of these variances represents.

17-4: Yellow Company budgeted fixed manufacturing overhead of $1,000,000, but actually incurred fixed manufacturing overhead of $1,200,000. The company expected to produce 100,000 units of product, but actually produced 80,000 units. The company allocates fixed overhead using a budgeted rate, based on budgeted production in the denominator.

Required:

A) Calculate the fixed overhead spending variance. Is this variance favorable or unfavorable?

B) Calculate the fixed overhead volume variance. Is this variance favorable or unfavorable?

C) Calculate the overallocated or underallocated fixed overhead.

17-5: The Plutonium Fruitcake Company allocated variable overhead based on pounds of direct materials. The company's production level (units of output) and direct materials prices (cost per pound) in 1957 were exactly as planned in the static budget for that year, but the company used more pounds of direct materials per unit of output than planned. This set of circumstances certainly resulted in

(I) an unfavorable variable overhead efficiency variance.

(II) an unfavorable flexible budget variance for variable overhead.

(III) an unfavorable static budget variance for variable overhead.

(A) (I), (II) and (III)

(B) neither (I), (II) nor (III) need be true

(C) (I) only

(D) (I) and (II) only

17-6: Following is information about December production at the Doorstop Fruitcake Company, and the principal ingredient used in the manufacture of fruitcakes: flour. All flour purchased during the month was used in production. There was no flour on hand at the beginning of the month. Fixed manufacturing overhead was budgeted at $90,000, but was actually $100,000. Fixed manufacturing overhead is allocated using pounds of flour as the allocation base. The factory expects to be operating at capacity in December.

	# of Fruitcakes produced	Pounds of flour used	Cost of flour
Actual	1,150	5,980	$2,840.50
Budget	1,200	6,000	$3,000.00

If the company allocates variable overhead based on pounds of flour, the variable overhead efficiency variance will be

(A) Zero

(B) Unfavorable

(C) Favorable

(D) Unable to determine from the information provided

17-7: Which of the following scenarios might not result in an unfavorable production volume variance?

I. Actual production is below practical capacity, when budgeted production is used in the denominator to calculate the overhead rate.

II. Actual production is below practical capacity, when practical capacity is used in the denominator to calculate the overhead rate.

III. Actual production is below budget, when budgeted production is used in the denominator to calculate the overhead rate.

IV. Actual production is above budget, when practical capacity is used in the denominator to calculate the overhead rate.

(A) I and IV

(B) I only

(C) I, II, III and IV

(D) I and III

17-8: Assume the following information for the Pittsfield factory of Carnegie Steel.

Budgeted fixed overhead	$12,000,000
Production capacity	1,000,000 tons
Budgeted production	500,000 tons

Required:

A) Assume we are at the beginning of the year. If the volume variance will be calculated using plant capacity in the denominator of the fixed overhead rate, what would the plant manager have to do to ensure that the production volume variance will be zero?

B) Again, assume we are at the beginning of the year. If the volume variance will be calculated using budgeted production in the denominator of the fixed overhead rate, what would the plant manager have to do to ensure that the production volume variance will be favorable?

C) Assume that we are at the beginning of the year, and that the factory manager is told that the production volume variance, favorable or unfavorable, will be recorded at the corporate level, and not on the factory income statement that forms the basis for the manager's performance review. Assume also that the factory manager is given the choice of the denominator-level concept for calculating the volume variance (actual, budget, or practical capacity), but that the manager must make the choice at the beginning of the year, knowing only the information in the table at the start of this question, but not knowing actual production or actual fixed overhead costs. What denominator-level concept do you think the factory manager will choose, and why? Would your answer change if, instead of budgeting production of 500,000 tons, production was budgeted for factory practical capacity of 1,000,000 tons?

17-9: If a factory is on a Standard Costing System, and has overallocated fixed overhead, which of the following statements is certainly true?

(A) The factory made more units than planned.

(B) The factory has a favorable spending variance.

(C) The factory has a favorable production volume variance.

(D) The actually amount spent for fixed overhead was less than the amount of fixed overhead allocated to inventory.

17-10: The Large and Expensive Widget Company allocates overhead based on direct labor hours. If the company uses more total direct labor hours than planned, but the actual labor wage rate is the same as the budgeted labor wage rate, which of the following statements might not be true?

(A) There will be an unfavorable static budget variance for labor.

(B) The labor wage rate variance will be zero.

(C) There will be an unfavorable labor efficiency variance.

(D) The labor efficiency and overhead efficiency variances will be in the same direction (i.e., either both variances will be favorable, they will both be unfavorable, or they will both be equal to zero).

17-11: McConnell McDowell McQueen Enterprises makes cotton shirts in a single factory in Cold Spring, VT. The company uses a Standard Costing System. The company allocates fixed and variable overhead separately. Variable overhead is allocated using direct labor hours as the allocation base. Fixed overhead is allocated based on output units (i.e., the allocation base is shirts), and factory practical capacity is the denominator-level concept. Practical capacity is 2,000 shirts per month. Following is budgeted and actual information for the month.

	Static Budget Information	**Actual Results**
Production		
Number of shirts	1,200	1,000
Direct Materials		
Cost per yard of fabric	$4.50	$4.20
Yards of fabric per shirt	2.00	2.50
Direct labor		
Direct labor cost for all of the shirts	$27,000	$30,000
Hours of direct labor for all of the shirts	3,000	3,400
Variable Overhead	$18,000	$18,500
Fixed Overhead	$15,000	$10,500

Required:

A) Calculate the spending and efficiency variances for variable overhead.

B) Compute the fixed overhead volume variance. Is it favorable or unfavorable?

C) Compute the spending variance for fixed overhead.

D) Compute the amount of underallocated or overallocated fixed overhead.

17-12: Li, Lee and Levy Industries makes widgets in its factory located in the Marina Shores district of Seattle. The company uses a standard costing system. Following is budgeted and actual information for the month.

	Static Budget Information	**Actual Results**
Widgets produced	1,000	900
Direct materials: copper fibers	15,000 pounds for a total cost of $31,500	12,600 pounds for a total cost of $25,200
Direct labor	1,000 hours for a total cost of $9,000	950 hours for a total cost of $8,075
Variable overhead (allocated based on machine hours)	$18,000	$14,553
Fixed costs (allocated based on units of output, and budgeted production in the denominator)	$56,000	$57,000
Machine hours	800	630

Required: Calculate the variances for variable and fixed overhead.

17-13: NPX Company reports the following information for October:

	Static Budget	**Actual Results**
Production	1000 units	1,100 units
Direct labor	20 minutes per unit	15 minutes per unit
Variable overhead	$3,333	$3,666
Fixed overhead	$47,000	$47,000
Machine hours	200	220

NPX allocates overhead based on direct labor hours, using a standard costing system, and allocates fixed overhead using the denominator-level concept of budgeted production.

Required:

A) How much of the flexible budget variance for variable overhead is due to the fact that NPX produced more units than planned?

B) The variable overhead efficiency variance is $917 favorable (rounded to the nearest dollar). Recalculate the variable overhead efficiency variance assuming the company allocates overhead based on machine hours instead of labor hours.

C) Calculate the variable overhead spending variance assuming the company allocates variable overhead based on machine hours instead of labor hours.

D) Calculate the fixed overhead spending variance. Is it favorable or unfavorable?

E) How much of the fixed overhead spending variance is due to the fact that production was higher than planned?

F) Calculate the fixed overhead volume variance.

G) How much of the fixed overhead volume variance is due to the fact that production was higher than planned?

H) Calculate the amount of overapplied or underapplied fixed overhead.

17-14: The Electric Sound Opera Company makes three models of an electronic keyboard. Budgeted and actual information for the year follows:

	Model A	**Model B**	**Model C**	**Total**
Units produced:				
actual	315	450	226	991
budgeted	275	400	300	975
Direct materials (per unit)				
actual	$50	$76	$100	
budgeted	$52	$73	$105	
Direct labor (per unit)				
actual	$24	$56	$38	
budgeted	$20	$50	$40	
Cost driver info:				
number of parts (per unit)				
actual	32	56	43	
budget	32	56	43	
direct labor hours (per unit)				
actual	3.50	4.60	4.50	
budget	4	5	5	
total square feet (budget = actual)	3,000	6,000	10,000	19,000
Overhead costs:				
Labor Support (variable overhead)				
actual				$ 535,000
budget				$ 600,000
Materials Support (variable overhead)				
actual				$ 780,000
budget				$ 860,000
Fixed Overhead				
actual				$1,250,000
budget				$1,000,000
Total Overhead				
actual				$2,565,000
budget				$2,460,000

Notes:

1. The company uses a Normal Costing System.

2. Total square feet refers to the square feet of factory floor space used in the production of each model of product. It is expressed as total square feet for that model, not square feet per unit.

3. Variable manufacturing overhead is divided into two cost pools, one for labor support and one for materials support.

Required:

A) Assume that the Labor Support overhead cost pool is allocated based on direct labor hours (labor hours is the allocation base), that the Materials Support overhead cost pool is allocated based on number of parts (parts is the allocation base), and that the Fixed Overhead cost pool is allocated based on square feet. Calculate the cost per unit for each Model A.

B) Now assume that the Variable Overhead Labor Support cost pool is allocated to product based on direct labor dollars. Calculate the variable overhead spending and efficiency variances for this overhead cost pool category.

C) Calculate the fixed overhead production volume and spending variances, assuming that fixed overhead is allocated using output units as the allocation base, and budgeted production as the denominator-level concept.

17-15: Silverstream Company makes travel trailers. The following information pertains to the company's Ohio Division, which manufactures and markets only one model of trailer: the 32-foot Ambassador trailer. Following is budgeted and actual information for the Ohio Division for 2004:

	Budgeted		**Actual**
	Per Unit	Total	
Trailers manufactured in 2004		1,000	800
Trailers sold in 2004		1,000	600
Sales price per trailer		$45,000	$45,000
Direct materials costs (all variable costs):			
Aluminum	$4,000	$4,000,000	$3,400,000
Steel	$2,000	$2,000,000	$1,600,000
Other	$4,000	$4,000,000	$3,800,000
Total materials costs	$10,000	$10,000,000	$8,800,000
Direct labor costs (all variable costs)	$5,000	$5,000,000	$3,800,000
Variable overhead manufacturing costs	$8,000	$8,000,000	$6,400,000
Fixed overhead costs:			
Manufacturing fixed overhead		$10,000,000	$11,000,000
Non-manufacturing fixed overhead		$2,000,000	$2,100,000

Additional information:
The Ohio Division started the year with no inventory of finished trailers or direct materials.

Direct labor standard:	250 hours per trailer
Actual direct labor hours incurred:	195,000 hours
The budgeted quantity of aluminum:	100 lbs. per trailer
The budgeted cost of aluminum:	$40 per lb.
The actual quantity of aluminum purchased	84,000 lbs.
The actual quantity of aluminum used	82,927 lbs.
The output capacity of the factory:	2,000 trailers

The division allocates overhead based on direct labor hours. The only non-manufacturing costs are certain fixed overhead costs, as shown above.

Required: Calculate the following:

(A) The flexible budget variance for variable manufacturing overhead.

(B) The variable manufacturing overhead spending variance.

(C) The variable manufacturing overhead efficiency variance.

(D) Recalculate the variable manufacturing overhead rate, assuming the company applies variable overhead based on pounds of aluminum, instead of direct labor hours.

(E) Using the overhead rate calculated in part (D), recalculate the variable manufacturing overhead spending variance.

(F) Using the overhead rate calculated in part (D), recalculate the variable manufacturing overhead efficiency variance.

(G) Using the overhead rate calculated in part (D), recalculate the variable manufacturing overhead flexible budget variance.

(H) The fixed manufacturing overhead spending or budget variance.

(I) The flexible budget variance for fixed manufacturing overhead.

(J) The fixed manufacturing overhead production volume variance, assuming the volume variance is calculated based on budgeted production.

(K) The fixed manufacturing overhead production volume variance, assuming the volume variance is calculated based on factory capacity.

(L) The amount of overapplied or underapplied fixed manufacturing overhead, if the company applies overhead based on budgeted production.

CHAPTER 18: Joint Products

Chapter Contents:

- Definition and overview
- Reasons for allocating common costs
- Alternative methods for allocating common costs
- Conclusion
- Exercises and problems

Definition and Overview:

In some production processes, particularly in agriculture and natural resources, two or more products undergo the same process up to a **split-off point**, after which one or more of the products may undergo additional processing. An oil company drills for oil and obtains both crude oil and natural gas. A second-growth forest is harvested, and lumber of various grades are milled. A farmer maintains a herd of dairy cows, and after the cows are milked, the milk naturally separates into skim and cream or can be separated into various products characterized by the amount of milkfat. Some of these products then constitute raw materials in the manufacture of other products such as butter and cheese.

Following are some important terms:

Common costs: These costs cannot be identified with a particular joint product. By definition, joint products incur common costs until they reach the split-off point.

Split-off point: At this stage, the joint products acquire separate identities. Costs incurred prior to this point are common costs, and any costs incurred after this point are separable costs.

Separable costs: These costs can be identified with a particular joint product. These costs are incurred for a specific product, after the split-off point.

The characteristic feature of joint products is that all costs incurred prior to the split-off point are common costs, and cannot be identified with individual products that are derived at split-off. Furthermore, the costs incurred by the dairy farmer to feed and care for the cows do not significantly affect the relative amounts of cream and skim obtained, and the costs incurred by the lumber company to maintain and harvest the second-growth timber do not significantly affect the relative quantities of lumber of various grades that are obtained.

Reasons for Allocating Common Costs:

Given the lack of a cause-and-effect relationship between the incurrence of common costs and the relative quantities of joint products obtained, any allocation of these common costs to the joint products is arbitrary. Consequently, there is no management accounting purpose served by the allocation of these common costs. Literally, there is no managerial decision that becomes better informed by such an allocation. Consider the possibilities:

1. Can the allocation of common costs prompt the manager to favor some joint products over other joint products and to therefore change the production process, and hence the quantities of joint products obtained?

   No. By definition, the relative quantities obtained from the joint process are inherent in the production process itself, and cannot be managed. In fact, the manager probably does have strong preferences for some joint products over others (high-grade lumber over low-grade lumber; cream over skim milk), but the manager's preferences are irrelevant.

2. Can the allocation of common costs prompt the manager to change the sales prices for the joint products, or to change decisions about whether to incur separable costs to process one or more of the joint products further?

   No. The decision to sell a joint product at split-off or to process it further depends only on the ***incremental*** costs and revenues of the additional processing, not on the common costs. In fact, the common costs can be considered sunk at the time the additional processing decision is made. As for pricing, most joint products are commodities, and producers are generally price-takers. To the extent that the producer faces a downward sloping demand curve, determining the optimal combination of price and production level depends on the variable cost of production, but this calculation would have to be done simultaneously for all joint products, in which case no allocation of common costs would be necessary.

3. Can the allocation of common costs inform the manager that the entire production process is unprofitable and should be terminated? For example, does this allocation tell the dairy farmer whether the farmer should sell the herd and get out of the dairy business?

   No. Such an allocation is unnecessary for the decision of whether to terminate the joint production process. For this decision, the producer can look at the operation in its entirety (total revenues from all joint products less total common costs and total separable costs).

Yet despite the fact that allocating common costs to joint products serves no decision-making purpose, it is required for external financial reporting. It is necessary for product costing if we wish to honor the matching principle for common costs, because these common costs are manufacturing costs. For example, if the dairy sells lowfat milk shortly after split-off, but processes high milkfat product into cheese that requires an aging process, the allocation of common costs is necessary for the valuation of ending inventory (work-in-process for cheese) and the determination of cost-of-goods sold (lowfat milk).

Alternative Methods for Allocating Common Costs:

Here are four methods of allocating common costs:

1. **Physical measure:** Using this method, some common physical measure is identified to describe the quantity of each product obtained at split-off. For example: the weight of the joint products, or the volume. Common costs are then allocated in proportion to this physical measure. This method presumes that the quantities of all joint products can be expressed using a common measure, which is not always the case. For example, crude oil is a liquid, while natural gas is, naturally, a gas, and volumes of liquids and gasses are not normally measured in the same units.

2. **Sales value at split-off:** If a market price can be established for the products that are obtained at split-off, common costs can be allocated in proportion to the sales value of the products at split-off. The sales value of each joint product is derived by multiplying the price per unit by the number of units obtained. For example, if the dairy farmer obtains 20 gallons of cream, and if cream can be sold for $3 per gallon, then the sales value for cream is $60. If the farmer also obtains 40 gallons of skim milk that sells for $2 per gallon, then the sales value of skim milk is $80. The total value of both products is $140, and 43% ($60 ÷ $140) of common costs would be allocated to all 20 gallons of cream. This method can be used whether or not one or more of the joint products are actually processed further, as long as a market price exists for the product obtained at split-off. In other words, even if the farmer does not sell any cream, but processes all of the cream into butter, the fact that there is a market price for cream is sufficient for the farmer to be able to apply this method of common cost allocation.

3. **Net Realizable Value:** The net realizable value of a joint product at split-off is the sales price of the final product after additional processing, minus the separable costs incurred during the additional processing. If the joint product is going to be sold at split-off without further processing, the net realizable value is simply the sales value at split-off, as in the previous method. Under the net realizable value method of common cost allocation, common costs are allocated in proportion to their net realizable values. As with the previous method, the allocation is based on the total value of all quantities of each joint product obtained (the net realizable value per unit, multiplied by the number of units of each joint product).

4. **Constant Gross Margin Percentage:** This method allocates common costs such that the overall gross margin percentage is identical for each joint product. The gross margin percentage is calculated as follows:

   Gross Margin Percentage = (Sales – Cost of Goods Sold) ÷ Sales

Cost of Goods Sold for each product includes common costs and possibly some separable costs. The application of the Constant Gross Margin Percentage requires solving for the allocation of common costs that equates the Gross Margin Percentage across all joint products.

Conclusion:

The choice of method for allocating common costs should depend on the ease of application, the perceived quality of information reported to external parties, and the perceived fairness of the allocation when multiple product managers are responsible for joint products. However, as discussed above, the allocation of common costs is arbitrary, and no method is conceptually preferable to any other method. All methods of allocating common costs across joint products are generally useless for operational, marketing, and product pricing decisions.

Exercises and Problems:

18-1: Herz Corporation processes soybeans into soybean oil and other products in a joint process. The common costs allocated to soybean oil are $2.00 per gallon. The soybean oil can either be sold for $1.90 or processed into margarine. The cost to process one gallon of soybean oil into margarine is $1.20. Each gallon of soybean oil yields 3 pounds of margarine, which sells for $0.80 per pound.

Required:
A) What is the net benefit of processing the soybean oil into margarine, relative to selling the soybean oil at the split-off point?

(A) A gain of $1.20 per gallon of soybean oil processed
(B) A gain of $1.30 per gallon of soybean oil processed
(C) A loss of $0.80 per gallon of soybean oil processed
(D) A loss of $0.70 per gallon of soybean oil processed

B) What should Herz Corporation do?

(A) Process the soybean oil into margarine.
(B) Sell the soybean oil at the split-off point.
(C) Stop producing soybean oil.
(D) Herz’s best course of action cannot be determined from the information provided.

18-2: A joint process produces a batch of product that consists of 5 lbs of Compound X, 2 lbs of Compound Y and 3 lbs of Compound Z. Common costs to produce one batch are $60.

Compound X sells for $4 per pound. Compound Y sells for $20 per pound. Compound Z sells for $10 per pound, but can be processed further into Compound ZZ. Compound ZZ sells for $18 per pound, and the additional processing costs are $9 per batch.

Required: How much joint cost would be allocated to each pound of Compound X, if joint costs are allocated using the Net Realizable Value method of joint cost allocation?

18-3: Ryan Company makes two products from a joint process and has the following information:

	Units Produced	Sales value per unit at split-off	Total additional processing costs beyond split-off	Sales value per unit after additional processing
Product A	60,000	$20	$300,000	$27
Product B	30,000	$11	$300,000	$19

The common costs incurred to produce the two products to the split-off point are $800,000.

Required:

A) What common costs will be allocated to each unit of Product A using the relative sales value at split-off as the allocation method?

B) Which products should be processed further?

C) What common costs will be allocated to each unit of Product B using the net realizable value method of joint cost allocation (and assuming that NRV is calculated based on the profit-maximizing production choice).

18-4: Michael Hearns is a commercial fisherman and he has just returned from a trip off the coast of Alaska. Michael has calculated the cost of his trip at $72,000. This entire amount represents joint costs with respect to the different types of fish that Michael caught. Michael's nets yielded a catch of 1,000 pounds of salmon, 1,000 pounds of halibut, and 2,000 pounds of flounder. Salmon sells for $4 per pound, halibut for $3 per pound, and Flounder for $1 per pound.

Required: Allocate the joint costs to the three types of fish based on their relative sales value.

18-5: In harvesting maple syrup, two grades of maple syrup are obtained from a joint process. We will call these two grades of syrup Grade A syrup and Grade Z syrup. The common costs are $50 to obtain 10 gallons of Grade A syrup and 15 gallons of Grade Z syrup. Grade A can be sold at the split-off point for $2 per gallon, or alternatively, $1 of additional processing costs can be incurred per gallon and Grade A can then be sold for $6.50 per gallon. Grade Z can be sold at split-off for $1 per gallon, or alternatively, $0.50 of additional processing costs can be incurred per gallon, and Grade Z can then be sold for $3.50 per gallon.

Required:

A) Calculate the common costs allocated to all 15 gallons of Grade Z syrup, allocating common costs based on physical quantities.

B) Calculate the common costs allocated to each gallon of Grade A syrup using the net realizable value method of joint cost allocation.

18-6: The Tara Dairy incurs joint costs of $110 per day in order to obtain 50 gallons of raw milk. This raw milk is then separated to obtain 20 gallons of cream and 30 gallons of skim milk. The dairy allocates joint costs based on physical quantities. Calculate the joint costs that would be allocated to cream.

18-7: Joint costs are $720. Joint products are 100 feet of product A, 100 feet of product B, and 200 feet of product C. Product A sells for $4 per foot at the split off point, but for $1 of additional processing costs, can be sold for $6 per foot. Product B sells for $3 per foot, but for $2 of additional processing costs, can be sold for $4 per foot. Product C sells for $1 per foot, and cannot be processed further.

Required: Allocate the joint costs to the three products based on Net Realizable Value.

18-8: Dowd Chemicals generates the following two joint products, incurring $6,000 annually in common manufacturing costs to do so:

	Product X1	**Product Y1**
Pounds of joint product at split-off	100	300
Per-pound sales value at split-off	$15	$25
Per-pound additional processing costs	$ 3	$ 5
Per-pound sales value after additional processing	$19	$33
Name of product after further processing	**X2**	**Y2**

The additional processing generates one pound of X2 for every one pound of X1 used, and one pound of Y2 for every one pound of Y1 used. In 2007, Dowd produced 100 pounds of X2, of which 80 pounds were sold, and 300 pounds of Y2, of which 270 pounds were sold.

Required: Assume that Dowd allocates common costs using the net realizable method (based on units produced). The product manager of the Y1/Y2 product line wants to earn a gross margin of $1,000 in 2007. At the current sales price, how many units of Y2 would have to be sold to earn this gross margin?

18-9: Walnut Farms generates the following joint products, incurring $200,000 annually in common costs to do so:

	Product A	**Product B**	**Product C**	**Product D**	**Product E**
Pounds produced	2,500	3,250	1,600	4,300	950
Per-pound sales value at split-off	$15	$25	$23	$20	$32
Per-pound additional processing costs	3	5	6	10	4
Per-pound sales value after additional processing	19	29	32	31	35
Name of product after further processing	**AA**	**BB**	**CC**	**DD**	**EE**

One pound of each product at split-off produces exactly one pound of product after further processing. In other words, if the Farm makes A into AA, it will produce 2,500 lbs. of AA, etc.

Required:

A) Calculate the total net realizable value (NRV) for all of the products combined, assuming NRV is determined by the most profitable processing decision for each product.

B) 2,300 pounds of Product AA were sold. Calculate the cost of goods sold for product AA. Assume the company allocates common costs using the net-realizable-value method of joint cost allocation, where NRV is determined by the most profitable processing decision for each product.

PART 5

PLANNING TOOLS AND PERFORMANCE MEASURES FOR PROJECTS AND DIVISIONS

Yes, I did eat $8.74, all told; but I should not thus unblushingly publish my guilt, if I did not know that most of my readers were equally guilty with myself, and that their deeds would look no better in print.

- Henry David Thoreau
Walden (1854)

CHAPTER 19: Capital Budgeting

Chapter Contents:

Overview:

Capital projects involve the acquisition of assets that generate returns over multiple periods. Examples are the construction of a factory or the purchase of a new machine. In this context, a dollar saved is as good as a dollar earned. Hence, capital investments that reduce operating expenses are equivalent to capital investments that generate additional revenues.

This chapter describes four performance measures for capital projects. These performance measures can use budgeted data as a planning tool, to decide whether to invest in a proposed capital project or for choosing among proposed projects. Also, these performance measures can be used retrospectively, to evaluate a capital project against planned performance or against other projects.

A characteristic feature of capital projects is that the bulk of the cash outflows precede the cash inflows. Although a capital project may involve cash outflows that occur over time, and cash inflows that vary from year to year, our discussion will often assume a typical scenario in which there is a single cash outflow for the acquisition of the asset that occurs at the beginning of year one (called "time zero"), followed by a series of equal cash inflows that occur at the end of each year for the life of the project. This series of cash inflows is called an annuity.

Time Value of Money:

A dollar today is worth more than a dollar one year from now. The reason for this appreciation is that cash is an asset, and like any asset, it can be invested to earn a return over time. The **discount rate** is a measure of the time value of money; it measures how much more a dollar is worth today than a dollar one year from now. For example, if you are indifferent between receiving $1.00 today and $1.20 one year from now, your discount rate is 20%. The time value of money has nothing to do with inflation, which works in the opposite direction. Inflation refers to the declining purchasing power of the dollar that occurs when prices of goods and services rise over time.

Software spreadsheet applications and financial calculators include present value functions that calculate the present value of any amount received (or paid) at any time in the future. These tools also provide the future value, for any point in time in the future, of any amount received (or paid) today. Before these electronic resources were commonplace, tables were widely available that allowed one to easily calculate present values and future values for frequently-used discount rates and time periods. Although such tables are unnecessary in practice today, we will use them in this chapter, because they visually illustrate the relevant concepts.

Table 1 at the end of this chapter is a present value table. It provides present value factors for selected discount rates that range from 6% to 20%, and time periods that range from one period to twenty periods. If the interest rates are expressed per annum, then the time periods represent years. For example, to determine the present value of any amount X received five years from now, at an interest rate of 8% per annum, one would find the factor at the intersection of Row 5 and the Column for 8% (the factor is 0.6806), and multiply this factor by the amount X.

Many situations involve a stream of equal payments or receipts over a consecutive number of periods. For example, financing the purchase of an automobile might require monthly payments of $1,000 for the next three years, or a proposed capital acquisition might increase revenues by $10,000 every year for the next seven years. Such streams of cash inflows and outflows are called **annuities**.

Software spreadsheet applications and financial calculators include functions that calculate the present value and future value of annuities. Again, before these electronic resources were widely available, tables were used to calculate the present value or future value of an annuity by multiplying the annual annuity amount by the factor in the table. Table 2 at the end of this chapter is a present value table for annuities. In order to use the table for an annuity of monthly payments or receipts (such as the example of monthly payments for the financing of an automobile), one can treat the rows as months if the interest rates in the column headings are treated as monthly percentages. For example, if the annual interest rate on the car loan is 24%, the monthly interest rate is 2%, and one would need to use the column for 2% (which is not shown in Table 2, but would have been included in tables used by practitioners).

There is an important relationship between Table 1 and Table 2. The present value of any annuity can be calculated by using Table 1 separately for each period over which the annuity occurs, and then summing these individual amounts. Table 2 (or the annuity present value function on a calculator) simplifies the task, by calculating the present value of the entire stream of payments or receipts at once. This relationship implies that one can always "build" Table 2, row by row, by summing the entries for the corresponding column in Table 1, down to that row. For example:

Table 1: Present value of $1 received (or paid) n years from now				
N	6%	7%	8%	9%
1	0.9434	0.9346	0.9259	0.9174
2	0.8900	0.8734	0.8573	0.8417
3	0.8396	0.8163	0.7938	0.7722
4	0.7921	0.7629	0.7350	0.7084

Table 2: Present value of an annuity of $1 for the next n years				
N	6%	7%	8%	9%
1	0.9434	0.9346	0.9259	0.9174
2	1.8334	1.8080	1.7833	1.7591
3	2.6730	2.6243	2.5771	2.5313
4	3.4651	3.3872	3.3121	3.2397

0.9346 + 0.8734 + 0.8163 = 2.6243

Hence, an annuity of $1 for three years at 7% equals $2.6243, which can be derived either by adding the three annual amounts provided in Table 1, or more simply by using the factor in row 3 of Table 2.

Next we examine four methods for evaluating capital projects.

Payback Period:

The payback period measures the time required to recoup the initial investment in the capital asset. Consider the following two examples.

Project	**Initial Cost**	**Cash Inflows in Year**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
A	$10,000	$2,000	$2,000	$1,000	$3,000	$2,000	$1,500	$0
B	$10,000	$2,000	$2,000	$2,000	$3,000	$2,000	$2,000	$2,000

The payback period for Project A is five years, because the sum of cash inflows for years one through five is $10,000 and $10,000 is also the initial cost of the project. The payback period for Project B is greater than four years but less than five years, because the sum of cash inflows through year four is $9,000, and the sum of cash inflows through year five is $11,000, while the initial cost is $10,000. In this situation, the payback period could be expressed as 4½ years.

If cash inflows are constant from year to year during the life of the project, the payback period can be calculated as follows:

$$\text{Payback Period} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}}$$

The payback period has two drawbacks. First, it ignores the time value of money. However, this drawback is somewhat mitigated by the fact that, in any case, the payback period tends to favor projects that recover the initial investment quickly. The second drawback is that the payback period ignores cash inflows that occur after the end of the payback period. The following example illustrates these issues:

Project	Initial Cost	Cash Inflows in Year						
		1	2	3	4	5	6	7
C	\$8,000	\$2,000	\$2,000	\$1,000	\$3,000	\$0	\$0	\$0
D	\$8,000	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000

Both projects have a payback period of four years. However, Project D is clearly preferred to Project C, both because Project D generates more cash inflows earlier during the payback period (\$2,000 in year three versus \$1,000 for Project C, which is offset in year four), and because Project D continues to generate returns after the payback period is over.

The payback period is a heuristic. A heuristic is a decision-aid that is easily understood and easily communicated, but that might not always result in the best decision.

Net Present Value:

The **net present value** (**NPV**) of a capital project answers the following question:

What is the project worth in today's dollars?

The NPV is the sum of the present value of all current and future cash inflows and outflows. Since the present value of a cashflow that occurs today is its face value, the NPV of a project is the sum of any cashflows that occur at time zero plus the present value of all future cashflows.

In the typical scenario in which there is an initial cash outlay for the acquisition of an asset, followed by cash inflows throughout the useful life of the asset, the NPV can be calculated as follows:

$$\text{NPV} = \Sigma \frac{\text{cash inflow}}{(1+\text{k})^{\text{n}}} - \text{initial outlay}$$

Where *k* is the discount rate, *n* is the number of periods from time zero in which the cash inflow occurs, and the summation is over the *n* periods of the life of the project. If the cash inflows are an annuity over the life of the project, the numerator in the above equation can be moved outside of the summation to obtain the following:

$$\text{NPV} = \text{annual cash inflow} \times \Sigma \frac{1}{(1+\text{k})^{\text{n}}} - \text{initial outlay}$$

The summation now depends only on *k* and *n*:

$$\sum \frac{1}{(1+k)^n}$$

It is exactly this term that is provided in a present value table for annuities (see Table 2 at the end of this chapter), where *k* represents the discount rate in the column heading, and *n* represents the number of years (the row).

Example: The Sunrise Bakery is considering purchasing a new oven. The oven will cost \$1,500, and the owner anticipates that the oven will increase the bakery's future net cash inflows by \$800 per year for the next five years. What is the anticipated NPV of this capital acquisition, if the bakery's discount rate is 10%?

NPV = (\$800 x 3.7908) – \$1,500 = \$3,033 – \$1,500 = \$1,533.

The factor 3.7908 comes from Table 2: the intersection of the column for 10% and row 5.

Because NPV provides an absolute measure of the return from the project, not a ratio, it tends to favor large projects. Also, the NPV calculation implicitly assumes that free cash flows can be reinvested at the discount rate. Despite these potential drawbacks, net present value is usually the most reliable criterion by which to judge capital projects on an individual basis.

Internal Rate of Return:

The internal rate of return (IRR) is the discount rate computed such that the net present value of the project equals zero. Software spreadsheet applications and financial calculators usually include a function that calculates the IRR. The following example illustrates how the IRR was approximated prior to the widespread availability of these electronic tools.

Example: The Sunrise Bakery is considering an expansion to its outdoor dining space that would require an initial cash outlay of \$26,000 and increase net cash inflows by \$8,000 per year for four years. The owner of the bakery does not anticipate any benefit from this expansion after year four, because at that time she hopes to finance a major renovation of the building that would expand the indoor dining area into the location of the patio. What is the IRR of the proposed expansion to the current outdoor dining space?

Setting the NPV equal to zero in the NPV equation, and solving for the present value factor:

0 = (\$8,000 x the present value factor) – \$26,000

$\Rightarrow$ present value factor = 3.25

Looking in Row 4 of Table 2 (since the life of the annuity is four years), the closest factor to 3.25 is 3.2397 in the column for 9%. Therefore, the IRR is approximately 9%.

Relative to NPV, the advantage of IRR is that it provides a performance measure that is independent of the size of the project. Hence, IRR can be used to compare projects that require significantly different initial investments.

An important drawback of IRR is that it can induce managers to reject proposed projects that shareholders would like the company to accept. For example, if the manager is evaluated based on the average IRR of all capital projects undertaken, and if a proposed capital project offers an IRR that is above the company's cost of capital, but below the average of all capital projects undertaken thus far, the proposed project would adversely affect the manager's performance measure, although it would increase economic returns to shareholders.

IRR implicitly assumes that free cashflows can be reinvested at the computed internal rate of return. This assumption is analogous to the assumption imbedded in the NPV calculation that free cashflows can be reinvested at the discount rate. However, in the context of IRR, the assumption is more problematic than in the context of NPV if the IRR is unusually high or low.

Net Present Value and Internal Rate of Return, Compared:

There is an important and close relationship between NPV and IRR. The NPV is greater than zero if and only if the IRR is greater than the discount rate. This relationship implies that if a single proposed capital investment is considered in isolation, both NPV and IRR will provide the same answer to the question of whether or not the investment should be undertaken.

However, NPV and IRR need not provide the same answer if projects that require different investments are compared. Consider the following example, comparing two projects each with a one-year life. Assume a 10% discount rate in the NPV calculation. In this simple setting with a one-year life, the IRR is easily calculated as the profit divided by the initial investment.

Project	Initial Investment	Payout at end of year	Net Present Value	Internal Rate of Return
A	\$1,000	\$1,200	\$91 [(1,200 ÷ 1.1) – 1,000]	20%
B	\$100	\$200	\$82 [(200 ÷ 1.1) – 100]	100%

Hence, NPV favors Project A, while IRR favors Project B. What is the "correct" answer? The answer depends on the opportunity cost associated with the additional \$900 required to finance Project A compared with financing Project B. For example, if the company has \$1,000 to invest and can replicate Project B ten times, doing so would clearly be preferable to Project A. On the other hand, if the company can earn only 1% on the \$900 additional funds available if Project B is chosen over Project A, then the company prefers Project A, calculated as follows:

Project	NPV	IRR
A	$91, as determined above	20%, as determined above
B plus $900 invested at 1%	$8 [($1,109 ÷ 1.1) – $1,000]	($1,109 – $1,000) ÷ $1,000 = 1.1%

The $1,109 in the bottom row is the total payout at the end of the year from this option, calculated as $200 from Project B plus $909 from the $900 investment that earns 1%. The NPV of $8 is actually less than the NPV from Project B alone, because the NPV of the $900 invested at 1% is negative.

In conclusion, NPV and IRR need not rank projects equivalently, if the projects differ in size.

The Discount Rate:

The discount rate is critical in determining whether the NPV of a project is positive or negative (and equivalently, whether the project IRR is greater or less than the discount rate). However, the choice of discount rate is seldom obvious.

In most situations, the appropriate discount rate is the company's cost of capital. The cost of capital is a weighted average of the company's cost of debt and its cost of equity. Interest rates on borrowings provide information about the cost of debt. Determining the cost of equity is more difficult, and constitutes an important topic in the area of finance. The Weighted Average Cost of Capital (WACC) is a concept from corporate finance that frequently serves as an appropriate discount rate for capital budgeting decisions. In some cases, however, the company would benefit from distinguishing between the existing *average* cost of capital, and the *marginal* cost of capital, because the cost of debt generally increases as companies become more highly leveraged.

Many companies establish a company-wide **hurdle rate**, to communicate to managers the appropriate discount rate for investment decisions. Often, the hurdle rate seems to exceed the company's cost of capital, which encourages managers to act conservatively in their capital budgeting decisions: an outcome that is difficult to justify with finance theory.

Another option for the discount rate is the opportunity cost associated with the funds required for the capital project. In most cases, the cost of capital and the opportunity cost should be approximately equal. However, most of us pay a higher rate to borrow funds than we earn on our financial investments. Hence, if a decision-maker has cash to either invest in a capital project or invest in the financial markets, an appropriate discount rate for the capital project is the opportunity cost of the earnings the decision-maker would have earned in the financial markets. This rate is probably lower than the cost of raising additional financing for the project.

Accounting Rate of Return:

The **accounting rate of return** (**ARR**) is sometimes called the **book rate of return**. Of the four capital project performance measures discussed in this chapter, the accounting rate of return is the only performance measure that depends on the company's accounting choices. It is calculated as follows:

$$\text{Accounting Rate of Return} = \frac{\textbf{Average Incremental Annual Income from the Project}}{\textbf{Average Net Book Investment in the Project}}$$

In the simple setting in which the capital project consists of the purchase of a single depreciable asset, the numerator is the average incremental annual cash inflow (additional revenues or the reduction in operating expenses) attributable to the asset, minus the annual depreciation expense. The denominator is the net book investment in the asset, averaged over the life of the asset.

Example: A machine costs $12,000 and increases cash inflows by $4,000 annually for four years. The machine has zero salvage value.

Depreciation expense = $12,000 ÷ 4 = $3,000 per year.

Incremental income from the machine = $4,000 – $3,000 = $1,000 per year.

Because income from the machine is identical in each year of its four-year life, the average income over the life of the asset is also $1,000 annually.

For the calculation of the Net Book Investment in the denominator, even though the asset life is four years, ***five*** points in time must be considered: time zero (the beginning of year one), and the end of years one through four. At the time the machine is purchased (time zero), the net book investment equals the purchase price of $12,000. As the machine is depreciated, the accumulated depreciation account balance increases, and the net book investment decreases.

Year	**Historical Cost**	**Accumulated Depreciation**	**Net Book Investment**
0	$12,000	$ 0	$12,000
1	12,000	3,000	9,000
2	12,000	6,000	6,000
3	12,000	9,000	3,000
4	12,000	12,000	0

The denominator in the accounting rate of return is calculated as

$$\frac{\$12,000 + \$9,000 + \$6,000 + \$3,000 + \$0}{5} = \$6,000$$

The accounting rate of return is

$$\frac{\$1{,}000}{\$6{,}000} \quad = \quad 16.7\%$$

This calculation depends on the company's depreciation method. For example, if the company used double-declining depreciation, the accounting rate of return would exceed 16.7% (the numerator does not change, but the average net book investment decreases).

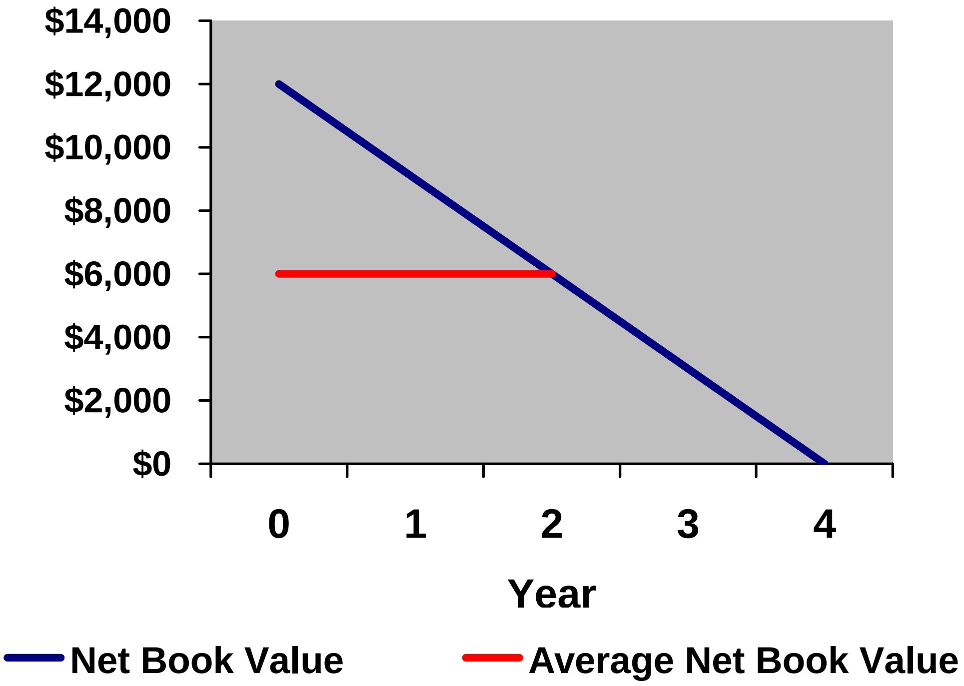
When straight-line depreciation is used, the calculation of the denominator simplifies, because the average of any straight line is the midpoint of that line. The midpoint is calculated as

$$\frac{\text{Initial book value + ending book value}}{2}$$

For the numerical example above, the calculation is

$$\frac{\$12{,}000 + \$0}{2} \quad = \quad \$6{,}000$$

Graphically, this is illustrated as follows:



If the machine has a salvage value, and if the company accounts for that salvage value by decreasing the depreciable basis of the asset, the salvage value has a counterintuitive effect on the denominator of the ARR calculation: it actually increases the company's net book investment.

For example, assume that the machine in the example above has a salvage value of \$4,000. In this case, the annual depreciation expense is (\$12,000 – \$4,000) ÷ 4 = \$2,000. The schedule of net book investment is as follows:

Year	**Historical Cost**	**Accumulated Depreciation**	**Net Book Investment**
0	\$12,000	\$ 0	\$12,000
1	12,000	2,000	10,000
2	12,000	4,000	8,000
3	12,000	6,000	6,000
4	12,000	8,000	4,000

The denominator in the accounting rate of return is then calculated as

$$\frac{\$12{,}000 + \$10{,}000 + \$8{,}000 + \$6{,}000 + \$4{,}000}{5} = \$8{,}000$$

The accounting rate of return is then

$$\frac{\$4{,}000 - \$2{,}000}{\$8{,}000} = 25\%$$

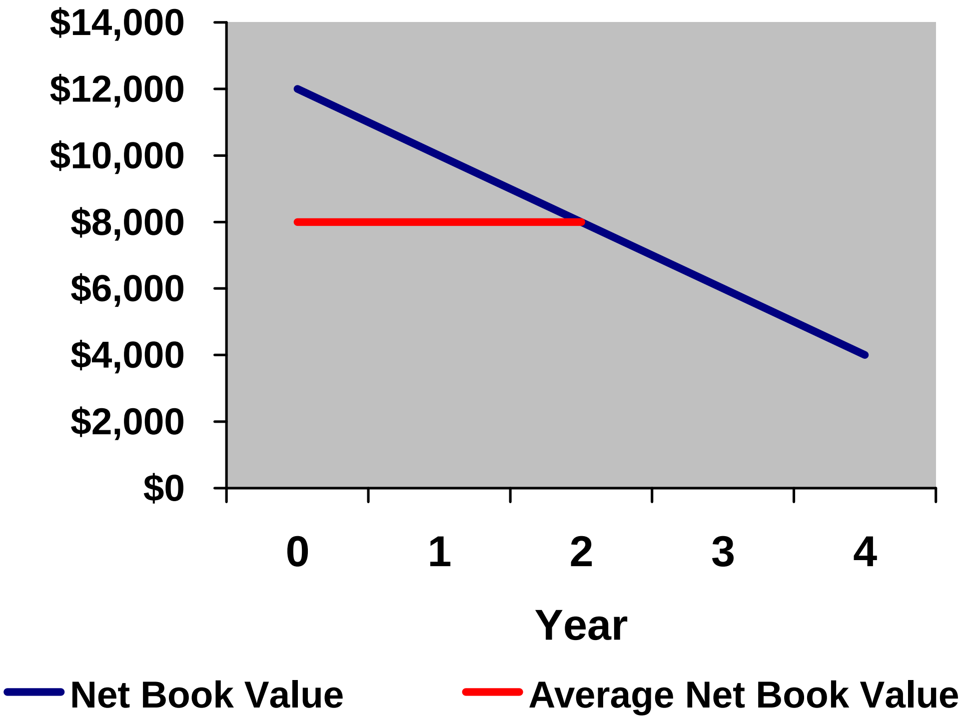
Again, because straight-line depreciation is used, the denominator can be calculated more simply as

$$\frac{\text{Initial book value + ending book value}}{2}$$

which is now

$$\frac{\$12{,}000 + \$4{,}000}{2} = \$8{,}000$$

and graphically



To illustrate how the accounting rate of return depends on the company's choice of accounting policies, assume that instead of treating the salvage value as a reduction in the depreciable basis of the asset, the company treats the salvage value as income in the year of disposal. In this case, the average annual income from the asset is calculated as follows:

$$\frac{\$1,000 + \$1,000 + \$1,000 + \$5,000}{4 \text{ years}} = \$2,000$$

The average net book investment is $6,000, as in the original example. The accounting rate of return is now

$$\frac{\$2,000}{\$6,000} = 33.3\%$$

Hence, depending on how the company chooses to treat the salvage value of the machine, the accounting rate of return is either 25% or 33.3%.

The accounting rate of return can also be calculated year by year, instead of averaging over the life of the project. In this case, the ARR provides information about the impact of the project on the company's (or division's) return on investment, which is an important performance measure discussed in Chapter 22.

Depreciation Expense, Income Taxes, and Capital Budgeting:

Because net present value and internal rate of return focus on cashflows, and depreciation expense is not a cashflow, depreciation does not enter NPV and IRR calculations directly. However, if income taxes are incorporated into the capital budgeting decision (as should normally be the case), then depreciation expense becomes relevant, because depreciation expense reduces taxable income, and hence, reduces tax expense. Obviously, the capital budgeting analysis should incorporate depreciation expense as determined for tax reporting purposes, not for financial reporting purposes, if there is a book-tax difference.

The reduction in taxes generated by depreciation expense is sometimes called the **depreciation tax shield**.

The effect of income taxes can also be incorporated into the payback period and the accounting rate of return in a straightforward manner. In other words, any of these capital budgeting techniques can be applied on a pre-tax or a post-tax basis.

Exercises and Problems:

19-1:

A) A project requires an initial cash outlay of $800, and returns $1,000 at the end of year 3 (nothing at the end of years 1 or 2). What is the approximately Net Present Value of this project, using a cost of capital of 10%?

B) A project requires an initial cash outlay of $5,000, and returns $1,000 at the end of each year from Year 1 through Year 10. What is the project's approximate Internal Rate of Return.

C) Refer to the project in part (B). What is the Payback Period of the Project? Also, what is the Accounting Rate of Return on the average net investment, assuming that the $5,000 purchase price is for a machine that is depreciated using straight-line depreciation over 10 years, with zero salvage value?

19-2: A machine costs $4,000 (paid out at the beginning of year 1), and generates year-end net cash inflows of $2,000 per year for five years (this is the useful life of the machine). The machine has zero salvage value. The company uses straight-line depreciation and a 10% cost of capital.

Required:

A) What is the payback period for this project?

B) What is the net present value of this project?

C) What is the accounting rate of return for this project?

19-3: A company purchases an asset for $40,000. The asset has a useful life of seven years. The salvage value is expected to be $10,000. For purposes of computing the accounting rate of return (i.e., the book rate of return), what is the average net investment in the asset, if the salvage value is used to reduce the depreciable basis of the asset?

19-4: What is the net present value of a project that requires an initial cash outlay of $1,000, and returns $7,000 at the end of seven years, using a discount rate of 12%?

19-5: An investment of $400 will yield a single, lump-sum payoff of $1,000 after 10 years. At a discount rate of 7%, what is the Net Present Value of this project?

19-6: A machine that costs $1,000 will save $200 in operating costs every year for the next seven years. What is the approximate Internal Rate of Return of this capital project?

19-7: A project requires an initial investment of $500, and will return $100 per year for 11 years. Using a discount rate of 9%, what is this project's Net Present Value?

19-8: A machine costs $50,000 (paid out at the beginning of year 1), and generates year-end net cash inflows of $8,834 per year for 12 years (this is the useful life of the machine). The machine has zero salvage value. The company uses straight-line depreciation.

Required:

A) What is the internal rate of return?

B) What is the net present value, using a discount rate of 10%?

C) What is the accounting rate of return?

19-9: Using an 11% discount rate, what is the net present value of a project that requires cash outlays of $10,000 at the beginning of years one, three and five, and provides cash inflows of $20,000 at the end of years one, three and five? You may assume that the present value of a cashflow at the end of year X is equivalent to the cashflow of an equivalent amount at the beginning of year X + 1 (e.g., December 31, 2005 is the same as January 1, 2006).

19-10: The Seven Flags over the Land of Enchantment amusement park plans to build a new roller coaster that will be faster, higher, scarier and more thrilling than its existing roller coasters. Seven Flags uses a 12% discount rate to evaluate capital expenditures. The cost to prepare the site and construct the new coaster is $550,000, and this expenditure will be incurred evenly throughout 2007 and 2008 (which is equivalent to a single cash outlay of $550,000 incurred on December 31, 2007). The new coaster will be finished at the beginning of 2009. The operating costs for the new coaster will be $30,000 per year beginning January 1, 2009 (assume that the annual operating cost is incurred at the beginning of each year). The additional revenue due to additional ticket sales are projected to be $200,000 per year for eight years (the projected life of the coaster) from the time the coaster opens at the beginning of 2009 through 2016 (assume, for simplicity, that the annual revenue is received at the end of each year). At the end of 2016, the amusement park will pay $150,000 to remove the coaster.

Required: Calculate the net present value of the new roller coaster, as of January 1, 2007.

19-11: Consider a capital project with a one-year life. The cash outlay for the equipment occurs at the beginning of year one, and a single cash in-flow occurs at the end of year one. The equipment has zero salvage value. Straight-line depreciation is used. Indicate which of the following statements are true.

Required:

A) If the payback period is less than one, the net present value will be greater than zero.

B) The internal rate of return is half of the accounting (book) rate of return.

C) The inverse of the payback period equals the internal rate of return plus one.

D) The payback period is the inverse of the internal rate of return.

E) If the internal rate of return is greater than the discount rate, the net present value will be greater than zero.

19-12: Consider the following two possible capital projects:

Project	Initial Cost (incurred at beginning of year 1)	Project Life	Salvage Value	Positive annual cash flow (received at the end of each year)
A	$200,000	16 years	$0	$28,000
B	$56,000	14 years	$0	$9,783

Using the above information, it can be shown that the Internal Rate of Return of Project B is higher than the Internal Rate of Return of project A.

Required:

A) Is the NPV for Project A higher than, equal to, or lower than, the NPV for Project B, assuming a 10% discount rate?

B) Is the Payback Period for Project A better than, equal to, or worse than, the Payback Period for Project B?

C) Is the Accounting Rate of Return for Project A higher than, equal to, or lower than, the Accounting Rate of Return for Project B, assuming straight-line depreciation?

D) If the discount rate is 11% instead of 10%, which project has the higher NPV?

E) If the discount rate is 10%, and both projects have a salvage value of $66,000 (i.e., the equipment for Project B actually *appreciates*), which project would have the higher NPV?

19-13: A machine with a useful life of five years and a salvage value of $4,000 is purchased for $20,000. The benefit of the machine is that it reduces normal cash operating expenses by $5,000 per year during the first two years of the machine's life, and by $4,000 for each of the following three years.

Required:
A) Calculate the accounting rate of return for the project, assuming that the full $20,000 purchase price is depreciated using the straight-line method, so that at the end of year five, the machine has a book value of zero, and the salvage value is treated as income in year five.

B) Calculate the accounting rate of return for the project, assuming that the net cost of the machine (purchase price less salvage value) is depreciated using the straight-line method.

19-14: Plain Vanilla Industries purchases a machine for $120,000. The machine has a six year life and a salvage value of zero. The company depreciates the machine using the sum-of-the-years-digits method, which results in depreciation expense in each year as follows:

Year 1	$34,286
Year 2	28,571
Year 3	22,857
Year 4	17,143
Year 5	11,429
Year 6	5,714
	$120,000

The machine increases cash inflows to the firm by $30,000 in year one, $35,000 in year two, $40,000 in year three, $35,000 in year four, and $25,000 in year five.

Required: Calculate the accounting rate of return from the investment in the machine.

19-15: A machine can be purchased for $120,000 that increases cash flows by $20,000 each year for the next six years. In addition, the machine has a salvage value of $20,000, which is used to reduce the depreciable basis of the asset. Assume the purchase price is paid at the beginning of the first year, and that all cash inflows are received at the end of each year. The company uses sum-of-the-years-digits depreciation, which results in the following depreciation schedule:

Year 1	$28,571
Year 2	23,810

Year 3	19,048
Year 4	14,286
Year 5	9,524
Year 6	4,761

Required: Compute the Accounting Rate of Return.

19-16: A company is considering purchasing a machine that will reduce its operating costs. The purchase requires a down payment of $5,000, and three equal annual payments of $3,000, due at the beginning of the second, third and fourth years of the life of the machine. The machine will reduce operating expenses in an amount equivalent to $2,000 received at the end of each year for eight years. The machine has a useful life of eight years, at the end of which it has a salvage value of $1,500. The company records the purchase of the machine at $14,000 (i.e., interest expense is not imputed), and treats the salvage value as a reduction in the depreciable basis of the asset. The asset is depreciated using straight-line depreciation. The discount rate is 8%.

Required: Calculate the payback period, the net present value, and the average accounting rate of return.

PRESENT VALUE TABLES:

Table 1: Present value of $1 received (or paid) ***n*** years from now

n	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	20%
1	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8333
2	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561	0.6944
3	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575	0.5787
4	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718	0.4823
5	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972	0.4019
6	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323	0.3349
7	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759	0.2791
8	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269	0.2326
9	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843	0.1938
10	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472	0.1615
11	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149	0.1346
12	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869	0.1122
13	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625	0.0935
14	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413	0.0779
15	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229	0.0649
16	0.3936	0.3387	0.2919	0.2519	0.2176	0.1883	0.1631	0.1415	0.1229	0.1069	0.0541
17	0.3714	0.3166	0.2703	0.2311	0.1978	0.1696	0.1456	0.1252	0.1078	0.0929	0.0451
18	0.3503	0.2959	0.2502	0.2120	0.1799	0.1528	0.1300	0.1108	0.0946	0.0808	0.0376
19	0.3305	0.2765	0.2317	0.1945	0.1635	0.1377	0.1161	0.0981	0.0829	0.0703	0.0313
20	0.3118	0.2584	0.2145	0.1784	0.1486	0.1240	0.1037	0.0868	0.0728	0.0611	0.0261

Table 2: Present value of an annuity of $1 received (or paid) each year for the next ***n*** years

n	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	20%
1	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696	0.8333
2	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257	1.5278
3	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832	2.1065
4	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550	2.5887
5	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522	2.9906
6	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845	3.3255
7	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604	3.6046
8	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873	3.8372
9	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716	4.0310
10	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188	4.1925
11	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337	4.3271
12	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206	4.4392
13	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831	4.5327
14	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245	4.6106
15	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474	4.6755
16	10.1059	9.4466	8.8514	8.3126	7.8237	7.3792	6.9740	6.6039	6.2651	5.9542	4.7296
17	10.4773	9.7632	9.1216	8.5436	8.0216	7.5488	7.1196	6.7291	6.3729	6.0472	4.7746
18	10.8276	10.0591	9.3719	8.7556	8.2014	7.7016	7.2497	6.8399	6.4674	6.1280	4.8122
19	11.1581	10.3356	9.6036	8.9501	8.3649	7.8393	7.3658	6.9380	6.5504	6.1982	4.8435
20	11.4699	10.5940	9.8181	9.1285	8.5136	7.9633	7.4694	7.0248	6.6231	6.2593	4.8696

CHAPTER 20: Operating Budgets

Chapter Contents:

Overview:

A budget is a quantitative plan for the future that assists the organization in coordinating activities. All large organizations budget. Many organizations prepare detailed budgets that look one year ahead, and budgets that look further into the future that contain relatively less detail and more general strategic direction.

The budget assists in the following activities:

- **Planning**. A budget helps identify the resources that are needed, and when they will be needed.

- **Control**. A budget helps control costs by setting spending guidelines.

- **Motivating Employees**. A budget can motivate employees and managers. Budgets are more effective motivational tools if employees and managers "buy into" the budget, which is more likely to occur if they participate in the preparation of the budget in a meaningful way.

- **Communication**. A budget can provide either one-way (top-down) or two-way communication within the organization.

A company's overall budget, which is sometimes called a **master budget**, consists of many supporting budgets. These supporting budgets include:

- Sales budget
- Pro forma income statement
- The production budget and supporting schedules
- Budgets for capital assets and for financing activities
- Budgets for individual balance sheet accounts and departmental expenses
- Cash budget, including cash disbursements and cash receipts budgets
- Pro forma balance sheet

There is a logical sequence for the preparation of these budgets. The first step in a corporate setting is almost always to forecast sales and to assemble a sales budget.

The Sales Budget:

The individuals who are best able to forecast sales are usually the sales force and product managers. Their ability to accurately forecast sales depends on the nature of the industry and on characteristics of the product. Demand is seasonal for many products, in which case each month's forecast usually incorporates information about sales for the same month last year. Accurately forecasting sales of new products and fashion products can be difficult. Demand for some products is sensitive to macroeconomic forces such as interest rates and foreign exchange rates. On the other hand, given the seemingly arbitrary way in which most of us decide where to eat lunch, restaurants can usually predict each day's lunch revenue with astounding accuracy.

Most companies face a downward-sloping demand curve for their products, which implies that forecasting sales revenue requires predicting sales volume at the planned sales price.

Pro Forma Income Statement:

With planned sales prices, forecasted sales volumes, and an understanding of the cost structure of the business, the company can assemble a pro forma income statement (an anticipated income statement for the upcoming period). This process is illustrated below, in a simple one-product setting, for the Guess Who Jeans Company. The planned sales price is $40 per unit. Assume that the sales manager's best guess of sales volume at this price is 20,000 units for October. Then anticipated revenue for October is $800,000. The company's cost structure is characterized by $30 of variable manufacturing costs per unit, and $150,000 in fixed manufacturing and S.G.&A. (selling, general and administrative) costs. This information is sufficient to complete the pro forma income statement that is shown below.

GUESS WHO JEANS
PRO FORMA CONTRIBUTION MARGIN
INCOME STATEMENT FOR OCTOBER

Income Statement Account	Budgeted amount Per unit	Sale of 20,000 units
Revenue	$40	$800,000
Variable manufacturing costs:		
Materials	15	300,000
Labor	10	200,000
Overhead	5	100,000
Total	30	600,000
Contribution margin	$10	200,000
Fixed costs:		
Manufacturing overhead		100,000
Selling, general & admin.		50,000
Total fixed costs		150,000
Operating income		$50,000

The Production Budget:

The next step in the budgeting process is more complicated for manufacturing firms than for merchandising firms, because manufacturing companies have three types of inventory accounts: raw materials, work-in-process and finished goods. However, regardless of the number of asset accounts involved, the goal is to determine the required additions to each account (purchases or transfers-in from an upstream account). The calculation to determine required additions is derived by expanding the ***Sources*** = ***Uses*** equality as follows:

⇒ Beginning balance + additions = transfers out + ending balance

This calculation sometimes uses physical quantities, and sometimes uses dollar values, depending on which makes the most sense under the circumstances.

The beginning balance equals the ending balance for the prior period, which is available either from actual results (the ending balance sheet), or from another budget if the start of the period being budgeted is in the future.

The ending balance is a target established by the company, and is usually based on anticipated activity for the following period (that is, the period following the one for which the current budget is being prepared).

Transfers-out equals the demand for the asset derived from a previous step in the budgeting process:

- If the asset account is finished goods inventory, the demand is based on cost of goods sold, as derived from the pro forma income statement.

- If the asset account is work-in-process inventory, the demand is based on the additions to the finished goods account, as calculated by applying the ***sources*** = ***uses*** equation shown above to the finished goods account.

- If the asset account is raw materials inventory, the demand is based on the additions to the work-in-process account for materials, as calculated by applying the ***sources*** = ***uses*** equation shown above to the work-in-process account.

The unknown in the ***sources*** = ***uses*** equation is ***additions***, which can be solved for, thus completing the production budget. The following table provides balance sheet information for Guess Who Jeans for September 30, which is the period just ended. (This is also the beginning balance for October 1, the period for which the budget is being prepared, because balance sheet amounts at the end of the day on September 30 are the same as the opening balances on the morning of October 1). We will use the information in this table to budget for October's production. Because Guess Who Jeans makes only one product, it is more convenient to use physical quantities in the sources = uses equations than dollars. We assume that the budget for October is being prepared on October 1st.

GUESS WHO JEANS
BALANCE SHEET
SEPTEMBER 30 (THE MONTH JUST ENDED)

Assets	Amount		Liabilities	Amount
Cash	$ 67,000		Accounts Payable	$ 295,000
Accounts Receivable	676,000		Line of Credit	345,000
Inventory:				
Raw Materials (1,800 yards)	13,500		Stockholders' Equity:	
Work in Process (1,500 units)	35,000		Common stock	100,000
Finished Goods (5,000 units)	150,000		Additional paid-in capital	72,500
Total inventory	198,500		Retained earnings	1,009,000
			Total S/H equity	1,181,500
Property, Plant & Equipment, net of accumulated depreciation	880,000			
Total	$1,821,500		Total	$1,821,500

Required additions to finished goods inventory: Guess Who Jeans expects to sell 20,000 units each month for the next two months (October and November). The company would like to have on hand, at the beginning of each month, 20% of next month's sales. The company did not achieve this operational goal for October, because 5,000 units are on hand on October 1, and expected sales are 20,000 units, but the company came close to its goal (25% versus 20%). At the end of October, the company would like to have 4,000 units on hand (20% of 20,000 units expected to be sold in November).

Beginning balance + additions = transfers out + ending balance

⇒ 5,000 units + additions

= 20,000 units in expected sales + 4,000 units for desired ending inventory

⇒ additions = 19,000

Hence, Guess Who Jeans should plan to transfer out 19,000 units from work-in-process to finished goods inventory during the month of October.

Required additions to work-in-process: Guess Who Jeans would like to have on hand, at any point in time, 1,200 units in work-in-process. The company has determined that this level of work-in-process provides optimal efficiency on the production line. (As shown above, the level of work-in-process is slightly higher than desired at the end of September.)

Beginning balance + additions = transfers out + ending balance

1,500 units + additions

= 19,000 units transferred to finished goods

+ 1,200 units for desired ending WIP

additions = 18,700

Hence, Guess Who Jeans should plan to start production of 18,700 units during the upcoming month of October.

Required additions to raw materials: On average, 2 yards of fabric are required for each unit of product. Guess Who Jeans would like to maintain 2,000 yards of fabric on hand at any point in time. (The company had less fabric on hand than desired at the end of September.)

Beginning balance + additions = transfers out + ending inventory

⇒ 1,800 yards + additions

= (2 yards per unit x 18,700 units)

+ 2,000 yards desired in ending inventory on October 31

⇒ 1,800 yards + additions = 37,400 yards + 2,000 yards

⇒ Additions = 37,600 yards of fabric

Hence, Guess Who Jeans should plan to purchase 37,600 yards of fabric during the month of October. Using the budgeted cost of $7.50 per yard, the expected expenditure for these fabric purchases is $282,000.

Accounts Receivable and Accounts Payable Budgets:

Accounts receivable: To budget for the ending balance of accounts receivable, the company incorporates information about the rate at which receivables are collected. Guess Who Jeans makes all sales on credit, and past experience indicates that the following collection schedule can be anticipated:

50% of sales are collected in the month of sale
30% of sales are collected in the month following the sale
20% of sales are collected two months following the sale

This collection schedule implies that on October 31, accounts receivable will consist of:

50% of October sales
20% of September sales
Nothing from sales that occurred prior to September
(E.g., August sales would be collected in August, September, and October)

Actual sales for September were 25,000 units.
Anticipated sales for October are 20,000 units.

Therefore, the budget for accounts receivable at the end of October can be calculated as follows:

50% of October sales	20,000 units x $40 per unit x 50% =	$400,000
20% of September sales	25,000 units x $40 per unit x 20% =	200,000
		$600,000

However, this calculation does not incorporate information available about September collections of September sales and September collections of prior month sales. Possibly, September collections of September sales differed from the 50% that is budgeted, or perhaps not all of August's sales were collected by the end of September. This additional information would normally be used to refine the budget of Accounts Receivable at the end of October.

Accounts payable: To budget for the ending balance of accounts payable, the company incorporates information about the extent to which the company makes purchases on credit. Guess Who Jeans pays cash for all types of purchases except for fabric purchases. The company pays for fabric 30 days after the fabric is purchased, on average.

This payment policy implies that at the end of October, accounts payable will consist of all October purchases of fabric, and nothing else. In the raw materials budget (see above), we determined that $282,000 would be incurred for fabric purchases in October. Hence, this amount is the anticipated the balance in Accounts Payable on October 31.

The cash budget:

One of the most important components of the budgeting process for most organizations is the cash budget. The cash budget indicates how much cash the company will have on hand at the end of each period, and also indicates when the company will need to borrow funds to cover temporary cash shortfalls, and when the company will have excess funds to invest in short-term financial instruments. Cash flow is so important that in some organizations, cash balances are projected for the end of each week, or even on a daily basis.

Often, the cash budget is assembled from supporting schedules. These schedules show, for the period being budgeted, anticipated cash disbursements and cash receipts that arise from (1) operating activities, (2) additions and disposals of fixed assets, and (3) financing activities.

Cash receipts: the company anticipates that the only cash receipts that will occur in October will come from collections of receivables. Cash receipts in October are based on anticipated collections of sales that were made in August and September, and anticipated sales for October, and are projected as follows:

Sales made in the month of:	Sales volume during the month	Unit sales price	percentage collected during October	Collections in October
August	22,000	$40	20%	$176,000
September	25,000	$40	30%	300,000
October	20,000	$40	50%	400,000
				$876,000

Cash disbursements are anticipated as follows:

Fabric purchases (for fabric acquired in September)	$295,000
Manufacturing labor	189,000
Manufacturing variable overhead	94,500
Fixed manufacturing overhead (excluding non-cash items)	50,000
Fixed selling, general and admin. overhead (excluding non-cash items)	35,000
Cash payments for capital acquisitions (from the capital budget)	110,000
Payments of short-term borrowings	60,000
Total disbursements for October	$833,500

This information about receipts and disbursements is used to project the ending cash balance for the month, as follows:

Beginning balance + cash receipts – cash disbursements = ending balance

$67,000 + $876,000 – $833,500 = $109,500

Pro Forma Balance Sheet:

The foregoing analysis can be used to assemble a pro forma balance sheet, projecting the balance sheet at the end of the October. The amounts in the pro forma balance sheet are derived as follows:

Cash: from the cash budget, shown above.

Accounts receivable: from the accounts receivable budget, shown above.

Raw materials inventory: from the projected ending inventory of 2,000 yards multiplied by the budgeted price of $7.50 per yard.

Work-in-process inventory:

Beginning balance	$ 35,000
+ Fabric additions (37,400 yards x $7.50 per yard)	280,500
+ Manufacturing labor (from the cash disbursements budget)	189,000
+ Manufacturing variable overhead (from the cash disbursements budget)	94,500
– Transfers out to finished goods inventory (19,000 units x $30 per unit)	570,000
Ending balance	$ 29,000

Finished goods inventory: from the projected ending inventory of 4,000 units, multiplied by the budgeted cost of $30 per unit. (Note: the company uses Variable Costing for internal reporting.)

Property, plant & equipment, net of accumulated depreciation:

Beginning balance	$880,000
+ Capital acquisitions (from the cash disbursements budget)	110,000
– Depreciation expense	65,000
Ending balance	$925,000

The $65,000 in depreciation expense reconciles to the non-cash portion of the $150,000 in fixed manufacturing and fixed selling, general and administrative costs shown on the pro forma income statement. The difference of $85,000 (i.e., the cash portion of these fixed costs) is shown on the cash disbursements budget as $50,000 for fixed manufacturing overhead and $35,000 for fixed selling, general and administrative overhead.

Accounts payable: from the accounts payable budget, shown above.

Short-term borrowings: beginning balance of $345,000 less the anticipated payment of $60,000 as per the cash disbursements budget.

Common stock and Additional paid-in capital: no change.

Retained earnings: beginning balance of $1,009,000 + October income of $50,000, as per the pro forma income statement.

GUESS WHO JEANS
PRO FORMA BALANCE SHEET
OCTOBER 31

Assets	Amount		Liabilities	Amount
Cash	$109,500		Accounts Payable	$282,000
Accounts Receivable	600,000		Line of Credit	285,000
Inventory:				
Raw Materials (2,000 yards)	15,000		Stockholders' Equity:	
Work in Process (1,200 units)	29,000		Common stock	100,000
Finished Goods (4,000 units)	120,000		Additional paid-in capital	72,500
Total inventory	164,000		Retained earnings	1,059,000
			Total S/H equity	1,231,500
Property, Plant & Equipment, net of accumulated depreciation	925,000			
Total	$1,798,500		Total	$1,798,500

It is interesting to note that whereas the pro forma income statement can be prepared early in the budgeting process (at least for the results of operating activities), the pro forma balance sheet is one of the last schedules to be prepared, because it depends on information obtained from numerous supporting budgets and schedules.

Exercises and Problems

20-1: ZFN anticipates sales of 20,000 units in March, 30,000 units in April, and 40,000 units in May. The company wants to have 20% of next month's sales on hand at the end of the previous month. In fact, at the beginning of March, the company has 4,000 units on hand. How many units should the company produce during April?

20-2: Yue Yeung Industries has sales of $10,000 in May, $20,000 in June, and $30,000 in July. The company collects 25% of sales in the month of sale, and the remaining 75% in the following month. Calculate Accounts Receivable at June 30.

20-3: A merchandising company expects to sell 300 units in April, 400 units in May, and 500 units in June. The company plans to have 30% of each month's sales, plus an additional 50 units, on hand in inventory at the beginning of each month. How many units should the company plan to purchase in May?

20-4: Quolala is a merchandising company. Quolala expects unit sales for the coming year as follows:

March	15,000
April	23,000
May	31,000
June	47,000
July	56,000

The average selling price is $23 per unit. The company's policy is to maintain month-end inventory levels at 30% of next month's anticipated sales. All sales are made on credit, and expected collections are as follows:

70% collected in the month of sale
20% collected in the month following the sale
10% collected in the second month following the sale.

Cost of goods sold equals 80% of the sales price. The company pays cash for all purchases of inventory, at the time of purchase.

Required:

A) How much inventory (how many units) will Quolala expect to purchase in June?

B) What will be the dollar amount of accounts receivable at the end of July?

C) How much should the company expect to pay (i.e., credits to cash, debits to inventory) for purchases of inventory in May?

D) What can the company expect to collect in receivables (i.e., debits to cash, credits to accounts receivable) in June?

20-5: The Gordon Candy Company is a wholesaler for peanut brittle and other candies. Gordon's sales of peanut brittle for the last four months of 2006 are projected as follows:

September	150 cases
October	170 cases
November	190 cases
December	230 cases

Bill Gordon, founder, Chairman, President, and Chief Executive Officer of the company, plans to sell each case for $150, which represents a 25% mark-up over cost (Note: an item purchased for $1 and sold for $1.60 would represent a 60% mark-up over cost).

Bill manages his inventory purchases so that he has 45% of each month's sales on hand at the beginning of the month. Bill makes all purchases on credit. Bill pays 60% of credit purchases in the month of purchase, and pays the remaining 40% in the month following the purchase.

On average, Bill's customers pay cash at the time of purchase for 50% of purchases, and buy the remaining 50% on credit. Credit purchases are paid to the Gordon Candy Company as follows:

40% in the month of purchase
35% in the month immediately following the purchase
20% in the second month following the purchase
5% bad debt expense (Bill never collects this amount).

Required: Calculate the cash inflows from sales of peanut brittle and the cash outflows from purchases of peanut brittle, for November.

20-6: California Concepts sells hair products. Sales of shampoo for the last half of 2005 are projected as follows:

September:	100 cases
October:	120 cases
November:	130 cases
December:	160 cases

California Concepts plans to sell each case for $25, which represents a $7 mark-up over cost. The company manages its inventory purchases so that it always has 70% of each month's unit sales on hand at the beginning of that month. The company buys inventory on credit. The company pays for these credit purchases in the month following the purchase.

On average, the company's customers pay cash at the time of purchase for 60% of their purchases, and buy the remaining 40% on credit. These credit purchases are paid to California Concepts as follows:

30% in the month of purchase
40% in the month immediately following the purchase
30% in the second month following the purchase

Required:

A) Calculate Accounts Receivable for sales of shampoo as of the end of November, and Accounts Payable for purchases of shampoo as of the end of November.

B) Calculate net cash flows from sales and purchases of shampoo that occur in November.

20-7: The Piombino Manufacturing Company anticipates sales as follows:

September	40,000 units
October	45,000 units
November	55,000 units
December	62,000 units

Piombino plans to have 35% of each month's sales on hand as finished goods inventory at the beginning of the month. The manufacturing process requires 30 days (one month) from start to finish. Each unit requires two pounds of aluminum, and the aluminum is put into the production process at the beginning of production (day one of the 30 day production cycle). Aluminum costs $15 per pound. The company wants to have 50,000 pounds of aluminum raw materials on hand at the beginning of each month. Purchases of aluminum are paid 50% in the first month after purchase and 50% in the second month after purchase.

Required: How much money will be disbursed in November for aluminum?

20-8: Mary River Distributors sells brandy and other alcoholic beverages. Sales of brandy for the last four months of 2005 are projected as follows:

September	1,700 cases
October	1,900 cases
November	2,300 cases
December	2,800 cases

The increase through the year arises due to the increasing popularity of brandy as the weather turns cold, and particularly the high consumption around the holiday season.

Mary River plans to sell each case for $250, which represents a 35% mark-up over cost (Note: an item purchased for $1 and sold for $1.60 would represent a 60% mark-up).

Mary River manages its inventory purchases so that it always has 40% of each month's sales on hand at the beginning of the month. The company buys all brandy on credit. The company pays 60% of credit purchases in the month of purchase, and pays the remaining 40% in the month following the purchase.

On average, Mary River's customers pay cash at the time of purchase for 20% of their purchases, and buy the remaining 80% on credit. These credit purchases are paid to Mary River as follows:

50% in the month of purchase
25% in the month immediately following the purchase
20% in the second month following the purchase
5% bad debt expense (Mary River never collects this amount).

Required: Because "cash is king," Mary River asks you to calculate the net cash inflows (receipts less disbursements) from sales and purchases of brandy, in November.

20-9: Muravera, Inc., budgets sales as follows:

April	$520,000
May	600,000
June	580,000
July	450,000
August	420,000
September	470,000
October	500,000

Sales are 30% cash sales and 70% credit sales. Credit sales are collected, on average, according to the following schedule:

In the month of purchase	25%
In the first month after purchase	30%
In the second month after purchase	20%
In the third month after purchase	15%
In the fourth month after purchase	10%
	100%

Required: If all goes according to the budget, what will be the balance in Accounts Receivable at September 30?

20-10: The Dorsely Manufacturing Company anticipates sales of 62,000 units in April, 55,000 units in May, 45,000 units in June, 38,000 units in July, and 29,000 units in August. Dorsely plans to have 40% of each month's sales on hand as finished goods inventory at the beginning of the month. The manufacturing process requires 60 days (two months) from start to finish. Each unit requires three feet of wire, and the wire is put into the production process half-way through production (day 30 of the 60-day production cycle). Wire costs $7 per foot. The company wants to have 110% of each month's wire raw materials requirements on hand at the beginning of the month. Purchases of wire are paid 50% in the month of purchase and 50% in the first month after purchase.

Required: What will be the balance for Accounts Payable for wire at May 31?

20-11: Edwin's Clothing Store expects revenues of $27,000 in March, $32,000 in April, $33,000 in May, and $36,000 in June. Eighty percent of these revenues are cash sales, and the remaining 20% are credit sales. Bad debt expense is accrued monthly such that the allowance for uncollectible accounts (the contra-asset balance sheet account) is 10% of the gross receivables at the end of any given month. Credit sales are collected as follows: 10% in the month of sale, 35% in the month following the sale, 25% in the second month following the sale, and 20% in the third month following the sale. Ten percent is never collected, and uncollected accounts receivable are written off at the end of the third month following the sale.

Required: Calculate net accounts receivable (net of the allowance for uncollectible accounts) as of June 30 (after the closing entries for the month have been made).

20-12: The Trinidad Community Hospital expects patient revenues of $240,000 in March, $250,000 in April, $270,000 in May, and $260,000 in June. Anticipated collections are as follows: 40% of patient revenues are from Medicare patients, and Medicare reimburses the hospital in the month after the services are provided (i.e. payment is received the month after the revenue has been recognized). 10% of the revenues are from Medicaid patients, and Medicaid reimburses the hospital two months after the services are provided. 30% of the revenues are from patients covered by private insurance, and the insurance companies reimburse the hospital 50% in the month of service, and 50% in the month following service. 20% of the patients are not covered by insurance at all. Among these patients, there is a bad debt rate of 30%. Bad debt expense is accrued in the month the revenue is earned. The revenue that is collected from these patients is received as follows: 10% in the month of service, 30% in the month following service, 40% in the second month following service, and 20% in the third month following service.

Required: Calculate patient receivables at June 30, net of the allowance for uncollectible accounts.

CHAPTER 21: Budgetary Incentive Schemes

Chapter Contents:

- Introduction
- Example of a budgetary incentive scheme
- Exercises and problems

As discussed in Chapter 20, most budgets are built on sales forecasts, and hence, budgets are only as accurate as those forecasts. The sales force has the most accurate and complete information about future sales prospects. Therefore, sales personnel are the best source for the sales forecast, and one would expect the budgeting process to begin with input from the sales force.

Furthermore, the success of most companies depends in large part on the ability of the sales force to generate sales. In order to motivate sales personnel to work hard, many companies include sales commissions as an important component of sales personnel' compensation packages: the more they sell, the more they earn.

For many companies, and in many industries, a straight commission is not viewed as equitable. Some sales representatives have "easier" sales territories or product lines. A fixed percentage commission applied to all members of the sales force seems unfair to sales representatives who are assigned more difficult product lines or territories. Many companies solve this problem by paying sales representatives a bonus based on actual sales relative to budgeted sales. The budget can be tailored for each sales representative, so that the difficulty of meeting and exceeding budget is comparable for all sales personnel. Such a bonus scheme rewards sales representatives for *incremental* effort and sales volume, relative to some baseline.

Taken together, the preceding three paragraphs create an obvious dilemma. The company relies on the sales force to accurately forecast sales for budgeting purposes, yet sales representatives, when asked for their forecasts, will budget conservatively. In so doing, they give themselves easy targets that help ensure that they will maximize their bonuses.

One possible solution to this dilemma is to not pay bonuses based on actual performance relative to budget. An alternative solution is to not ask the sales representatives for their forecasts, but simply to assign targeted sales goals. Neither solution is optimal, because the first solution limits the company's ability to motivate the sales force using a bonus scheme that is generally perceived as effective and fair, and the second solution ignores information that would materially assist in the budgeting process.

One might wonder whether a better solution is possible. In fact, budgetary incentive schemes that simultaneously address these two apparently conflicting objectives have been used for at least 25 years. The example described in the rest of this chapter is adapted from a bonus scheme that was used by IBM in Brazil, as described in an article by Joshua Gonek that appeared in the *Harvard Business Review* in the 1970s. However, the following example is set in the context of students in an accounting class, not sales representatives working for a company.

Example of a Budgetary Incentive Scheme:

Instructors want students to work hard and to study diligently for exams. If an instructor also wants students to predict their performance on an upcoming exam, then the instructor faces the same dilemma as described above: how does one encourage students to provide accurate forecasts of future performance, and also provide incentives for students to exert maximum effort after the forecasts have been delivered. (In the absence of an incentive mechanism to encourage accurate forecasts, students are notoriously optimistic.)

Consider an exam with ten multiple choice questions, where credit on each question is “all or nothing” (no partial credit). Each question is worth five points, for a total of fifty points. Now consider the following extra credit opportunity related to that exam. One week before the exam, students are asked to forecast how many of the ten questions they will answer correctly. After the exam, they receive extra credit based on the number of points indicated in the box at the intersection of their forecast (the column headings in the table) and their actual score (the number in the far left-hand column of each row in the table). For example, if a student forecasts that she will answer six questions correctly, and actually answers seven questions correctly, she receives 13 extra credit points (the intersection of row 7 and column 6) in addition to her score of 35 (7 questions x 5 points per question), for a total of 48 points.

EXTRA CREDIT GRID FOR EXAM

		Forecast Exam Score										
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Actual Exam Score	**0**	--	--	--	--	--	--	--	--	--	--	--
	1	1	2	1	--	--	--	--	--	--	--	--
	2	2	3	4	3	2	1	--	--	--	--	--
	3	3	4	5	6	5	4	3	2	1	--	--
	4	4	5	6	7	8	7	6	5	4	3	2
	5	5	6	7	8	9	10	9	8	7	6	5
	6	6	7	8	9	10	11	12	11	10	9	8
	7	7	8	9	10	11	12	13	14	13	12	11
	8	8	9	10	11	12	13	14	15	16	15	14
	9	9	10	11	12	13	14	15	16	17	18	17
	10	10	11	12	13	14	15	16	17	18	19	20

This scheme encourages students to forecast accurately, and once the students have made their forecasts, to study hard for the exam. To see that the extra credit scheme achieves both objectives, note the following:

When the student makes her forecast, she is choosing the column that will be used to determine her extra credit. Within each column, the numbers become larger as one moves down the table. Therefore, once the forecast has been delivered, students want to score as high as possible to maximize both the extra credit score and the total exam score.

Now consider the question of whether students have incentives to forecast accurately. At the time that the student makes her forecast, she has an idea of what her actual score will be. Hence, she has a best-guess of the row that will be used to determine her extra credit. In any given row, the maximum bonus occurs in the column for which the row heading equals the column heading. For example, if the student thinks she will answer five questions correctly, then her maximum extra credit from row "5" is ten, which occurs in the column labeled "5." Therefore, if she thinks she will score five, she cannot expect to do better than to forecast five, the same as her expected performance. If she intentionally forecasts low (choosing a column to the left of column 5) or forecasts high (choosing a column to the right of column 5), she can anticipate earning less than ten extra credit points if she actually answers five questions correctly, as she predicts.

This extra credit scheme is an example of a budgetary incentive scheme that encourages individuals to both forecast accurately, and to exert maximum effort after the forecast has been delivered. Implicit in this scheme, and all such schemes, is a "baseline" performance level. For example, in the extra credit scheme, if the instructor anticipates that the median on the exam will be six, then it is important that students have approximately the same expectation. If the exam turns out to be more difficult or easier than anticipated, then students' forecasts will be "high" or "low" on average, and the amount of extra credit earned will be less than otherwise would have been the case. The extra credit scheme would still encourage accurate forecasts and maximum effort, but it probably would not be perceived as "fair" after the scores are in. Hence, this specific scheme and all such schemes rely on some level of accuracy in management's (or the instructor's) information, but then uses that information to obtain still more accurate information from the individuals who are best informed (sales representatives or students, as the case may be).

Exercises and Problems

21-1: The table below represents a bonus scheme, in which the sales representative is given a quota (called the objective), is asked to provide a forecast for her sales volume for the upcoming year, and then is given a bonus (expressed as a percentage of a baseline bonus) based on a combination of her forecast and actual results. The numbers in the grid represent the percentage of the baseline bonus that the sales representative will receive. For example, if the sales representative is given a quota of 300 units and she forecasts that she can sell 600 units, F/O = 2.0, and she will be working from the column with 2.0 in the heading. Then, if she sells 450 units, her bonus will be calculated from the number at the intersection of the column labeled 2.0 and the row labeled 1.5 (A/O = 450/300 = 1.5). The number in that box is 120, so she will receive 120% of the baseline bonus.

		F/O = forecast ÷ objective										
		0	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**
A/O = Actual ÷ Objective	**0**	--	--	--	--	--	--	--	--	--	--	--
	0.5	60	30	--	--	--	--	--	--	--	--	--
	1.0	90	120	90	60	30	--	--	--	--	--	--
	1.5	120	150	180	150	120	90	60	30	--	--	--
	2.0	150	180	210	240	210	180	150	120	90	60	30
	2.5	180	210	240	270	300	270	240	210	180	150	120
	3.0	210	240	270	300	330	360	330	300	270	240	210
	3.5	240	270	300	330	360	390	420	390	360	330	300
	4.0	270	300	330	360	390	420	450	480	450	420	390
	4.5	300	330	360	390	420	450	480	510	540	510	480
	5.0	330	360	390	420	450	480	510	540	570	600	570

Required: Evaluate this bonus scheme, and discuss in two or three sentences how effective the incentives imbedded in this bonus scheme are likely to be, in terms of motivating the sales representative to provide her best forecast of her sales volume for the upcoming year, and to work hard to achieve and even exceed her forecasted sales volume, once her forecast has been made.

21-2: The table below represents a bonus scheme, in which the sales representative is given a quota (called the objective), is asked to provide a forecast for her sales volume for the upcoming year, and then is given a bonus (expressed as a percentage of a baseline bonus) based on a combination of her forecast and actual results. The numbers in the grid represent the percentage of the baseline bonus that the sales representative will receive. For example, if the sales representative is given a quota of 300 units and she forecasts that she can sell 600 units, F/O = 2.0, and she will be working from the column with 2.0 in the heading. Then, if she sells 450 units, her bonus will be calculated from the number at the intersection of the column labeled 2.0 and the row labeled 1.5 (A/O = 450/300 = 1.5). The number in that box is 180, so she will receive 180% of the baseline bonus.

		F/O = forecast ÷ objective										
		0	**0.5**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**
A/O = Actual ÷ Objective	**0**	--	--	--	--	--	--	--	--	--	--	--
	0.5	--	30	60	30	--	--	--	--	--	--	--
	1.0	30	60	90	120	90	60	30	--	--	--	--
	1.5	60	90	120	150	180	150	120	90	60	30	--
	2.0	90	120	150	180	210	240	210	180	150	120	90
	2.5	120	150	180	210	240	270	300	270	240	210	180
	3.0	150	180	210	240	270	300	330	360	330	300	270
	3.5	180	210	240	270	300	330	360	390	420	390	360
	4.0	210	240	270	300	330	360	390	420	450	480	450
	4.5	240	270	300	330	360	390	420	450	480	510	540
	5.0	270	300	330	360	390	420	450	480	510	540	570

Required: Evaluate this bonus scheme, and discuss in two to four sentences how effective the incentives imbedded in this bonus scheme are likely to be, in terms of motivating the sales representative to provide her best forecast of her sales volume for the upcoming year, and to work hard to achieve and even exceed her forecasted sales volume, once her forecast has been made.

CHAPTER 22: Divisional Performance Measures

Chapter Contents:

- Divisional income
- Return on investment
- Residual income
- Exercises and problems

This chapter discusses three performance measures used to evaluate divisions and divisional managers. The term "division" in this chapter is shorthand for any responsibility center that is treated as a profit center or as an investment center. Investors and stock analysts use analogous measures to evaluate company-wide performance.

Divisional Income:

Divisional income is a measure of divisional performance that is analogous to corporate net income for evaluating overall company performance. Similar to related-party transactions in the context of financial accounting, the calculation of divisional income must consider transactions that occur between divisions, and between the division and corporate headquarters. One type of intra-company transaction is the transfer of goods between divisions. These transfers, which represent revenue to the selling division and a cost of inventory to the buying division, are discussed in Chapter 23. Another type of transaction is the receipt of services from corporate headquarters or from other responsibility centers within the company. Examples of such services are human resources, legal, risk management, and computer support. In many companies, these services are "charged out" to the divisions that utilize them. These service department cost allocations were discussed in Chapter 12.

Because divisional income fails to account for the size of the division, it is ill-suited for comparing performance across divisions of different sizes. Divisional income is most meaningful as a performance measure when compared to the same division in prior periods, or to budgeted income for the division.

Return on Investment:

Return on investment (**ROI**) is calculated as:

$$\text{Return on Investment} = \frac{\text{Divisional Income}}{\text{Divisional Investment}}$$

The same issues arise in determining the numerator in ROI as arise in the previous subsection with respect to deriving divisional income. As regards the denominator, senior management must decide whether and how to allocate shared assets among divisions, such as service departments at the corporate level, or shared manufacturing facilities. Also, management must decide how to value the capital assets that comprise the division's investment. These assets can be valued at their gross book value (the acquisition cost), their net book value (usually the acquisition cost minus depreciation expense), or less often, some other valuation technique such as replacement cost, net realizable value or fair market value. The calculation of the numerator should be consistent with the choice of valuation technique in the denominator. For example, if divisional investment is calculated using gross book value, then divisional income in the numerator should not be reduced by depreciation expense.

One advantage of using gross book value instead of net book value in the ROI calculation is that net book value can discourage divisional managers from replacing old equipment, even if new equipment would be more efficient and would increase the economic profits of the division. This dysfunctional managerial incentive occurs because if the existing equipment is fully depreciated, but is still functional, its replacement can reduce the division's ROI by lowering the numerator (due to increased depreciation expense) and increasing the denominator (because fully depreciated assets have a net book value of zero).

ROI can be broken down into the following two components:

$$\textbf{ROI} = \frac{\text{Divisional Income}}{\text{Divisional Investment}} = \frac{\text{Divisional Income}}{\text{Divisional Revenue}} \textbf{ X } \frac{\text{Divisional Revenues}}{\text{Divisional Investment}}$$

The first term on the right-hand side is called the **return on sale**s (**ROS**). It is also called the **operating profit percentage**. This ratio measures the amount of each dollar of revenue that "makes its way" to the bottom line. ROS is often an important measure of the efficiency of the division, and the divisional manager's ability to contain operating expenses.

The second term on the right-hand side is called the **asset turnover ratio** or the **investment turnover ratio**. This ratio measures how effectively management uses the division's assets to generate revenues. Interestingly, this ratio seems to hover around one for many companies in a wide range of industries, particularly in the manufacturing sector of the economy.

Breaking ROI into these two components often provides more useful information than looking at ROI alone, and it is an example of the type of financial ratio analysis that stock analysts conduct in evaluating company-wide performance. In this context, two common specifications for the denominator in the ROI calculation are assets and equity. The resulting ratios are called **return on assets** (**ROA**) and **return on equity** (**ROE**).

At the divisional level, ROI controls for the size of the division, and hence, it is well-suited for comparing divisions of different sizes. On the other hand, similar to the Internal Rate of Return for evaluating capital projects, ROI can discourage managers from making some investments that shareholders would favor. For example, if a divisional manager is evaluated on ROI, and if the division is currently earning an ROI in excess of the company's cost of capital, then the manager would prefer to reject an additional investment opportunity that would earn a return above the cost of capital but below the division's current ROI. The new investment opportunity would lower the division's ROI, which is not in the manager's best interests. However, because the investment opportunity provides a return above the cost of capital, shareholders would favor it.

Residual Income:

One way in which financial accounting practice fails to follow corporate finance theory is that the cost of debt is treated as an expense in arriving at net income, but the cost of equity is not. Specifically, interest expense appears as a deduction to income on the income statement, but dividends are shown on the statement of changes in shareholders' equity. Hence, net income is affected by the company's financing strategy as well as by its operating profitability, which can obscure the economic performance of the firm.

A simple solution to this problem is to add back interest expense (net of the tax effect) to net income, to arrive at operating income after taxes. The performance measure called **residual income** makes this adjustment, and then goes one step further, by deducting a charge for capital based on the organization's total asset base:

$$\text{Residual Income} = \text{Operating Income} - (\text{Investment Base x Required Rate of Return})$$

The company's cost of capital is often appropriate for the required rate of return.

Residual income is probably the closest proxy that accounting provides for the concept of economic profits; hence, residual income probably comes close to measuring what shareholders really care about (to the extent that shareholders only care about maximizing wealth). Residual income can be calculated both at the corporate level and at the divisional level. Many companies that use residual income at the divisional level do so because management believes that residual income aligns incentives of divisional managers with incentives of senior management and shareholders.

One type of residual income calculation is called Economic Value Added. EVA was developed by the consulting firm of Stern Stewart & Co., and is a registered trademark of that firm. The calculation of EVA includes a deduction for the cost of capital, and also adjusts accounting income to more accurately reflect the economic effect of transactions and the economic value of assets and liabilities. In general, these adjustments move the income calculation further from the reliability-end of the relevance-versus-reliability continuum, and closer to the relevance-end of that continuum.

Since the 1990s, EVA has helped revive the popularity of residual income. However, it should be emphasized that although Stern Stewart has obtained trademark protection on the term "EVA," the concept of residual income precedes EVA by almost half a century, and it is in the public domain. Anyone can use residual income for any purpose whatsoever without violating trademark, copyright or patent law, and this includes making obvious adjustments to net income to more accurately reflect the underlying economic reality of the firm.

Exercises and Problems:

22-1: The Purini Dog Food Company has two divisions, the Puppy Chow Division and the Canine Elder Division. Operating results for the two divisions are as follows:

	Puppy Chow Division	Canine Elder Division
Net Operating Income	$10,000	$ 6,000
Average Operating Assets	$50,000	$42,000

The required rate of return, which is equal to the cost of capital, is 10%.

Required: A project with a return of $20,000 on an investment of $130,000 exists. If the divisions are evaluated based on return on investment, which division(s) would like to accept the project? If the divisions are evaluated based on residual income, which division(s) would like to accept the project?

22-2: Nummi Motors operates two divisions: the truck division and the car division. Nummi's hurdle rate (i.e., the cost of capital) is 10%. Following is information about the two divisions:

	Truck Division	Car Division
Divisional Income	$ 1 million	$ 2 million
Divisional Operating Assets	$12 million	$10 million

Required:

A) Calculate the truck division's residual income

B) Calculate the car division's return on investment

22-3: A company has two divisions: the Eastern division and the Western division. The cost of capital is 15%. Following is information about the two divisions:

	Eastern Division	**Western Division**
Divisional profits	$ 100,000	$ 200,000
Divisional investment	1,000,000	1,000,000

Required:

A) Calculate each division's residual income, and residual income for the company as a whole

B) Calculate each division's return on investment, and return on investment for the company as a whole.

22-4: In 1980, the truck division of Motown Motors had return on sales of 15% and an asset turnover ratio of 50%. Sales were $100 million. Calculate the division's return on investment.

22-5: Recall that Residual Income is calculated by subtracting from NOPAT (Net operating profit after taxes) a charge for the cost of capital. If a company has interest expense and income tax expense, but no other income or expense line-items between operating income and net income, then NOPAT simply adds back to net income the after-tax effect of interest expense.

Arbatax has after-tax net income in 2007 of $34,000,000. The company has a marginal tax rate of 35%. The company incurred interest expense in 2007 of $6,000,000 (and the company earned no interest income). Arbatax had total assets in 2007 of $400,000,000. The company's cost of capital is 8%.

Required: Determine the company's Residual Income for 2007.

22-6: Following is selected information from the 2005 Annual Report of General Motors (some small miscellaneous line-items have been excluded, so that net income calculated from these numbers differs slightly from net income as per the annual report):

	2005	**2004**
Automotive and Other Operations		
Revenue	$158,221,000,000	$161,545,000,000
COGS, SG&A and other	175,395,000,000	162,087,000,000
Financing and Insurance Business		
Revenue	34,383,000,000	31,972,000,000
Expenses	18,372,000,000	18,264,000,000
Interest expense	15,768,000,000	11,980,000,000
Net income tax benefit (increases income)	5,878,000,000	916,000,000
Total assets	480,530,000,000	482,347,000,000
Shareholders equity	14,597,000,000	27,360,000,000

Required: Calculate GM's pre-tax income, after-tax income, return on investment, and residual income for both 2005 and 2004. Combine both segments of the company for this exercise (automotive and financing). For return on investment, use post-tax income in the numerator and total assets in the denominator. For residual income, use a 7% cost of capital, and a marginal tax rate of 30% to adjust for the tax effect of interest expense.

22-7: Following is selected information from the 2005 or 2006 financial statements of four airlines. All amounts are in 000's.

	Southwest Airlines	Alaska Airlines	Frontier Airlines	Midwest Express
Revenue	$7,584,000	$2,416,100	$994,273	$522,989
Operating income	820,000	−10,800	−7,897	−65,168
Net interest expense	75,000	18,700	12,392	−142
Pre-tax income	874,000	124,200	−20,469	−65,026
After-tax income	548,000	−2,300	−13,971	−64,886
Total assets	14,218,000	3,511,900	970,432	351,344
Shareholders equity	6,675,000	626,900	228,776	17,256

Required: Calculate ROI for each airline using net income and total assets. Break out each airline's ROI into return on sales and the asset turnover ratio.

22-8: Following is selected financial information for four companies for 2005 (all amounts are in millions):

	Apple Computer	Pepsi	Chevron	The GAP
Revenue	$13,931	$32,562	$198,200	$16,023
Total assets	11,551	31,727	125,833	8,821
Shareholder equity	7,466	14,320	62,676	5,425
Operating income	1,650	6,382	25,197	1,745
Net income	1,335	4,078	14,099	1,113

Required: Calculate each firm's return on investment (net income on total assets), return on sales, asset turnover ratio, and residual income using an 8% cost of capital. None of these firms incurred significant interest expense during the year.

22-9: Following is selected segment information for 2005 from the Annual Report for Starbucks.

	United States (000's)	International (000's)	Unallocated Corporate (000's)	Total (000's)
Revenue	$5,334,460	$1,034,840	$ 0	$6,369,300
Pre-tax earnings	945,926	86,421	– 235,903	796,444
Identifiable assets	1,633,721	605,750	1,274,594	3,514,065

The total column agrees to the company's 2005 income statement. In answering the following questions, because Starbucks has virtually no debt, interest expense can be ignored. Also, assume a 33% effective tax rate and a 7% cost of capital.

Required:

A) Calculate post-tax return on investment and post-tax residual income for the United States segment, the International segment, and for the company as a whole.

B) Explain why corporate-level residual income is less than the sum of the residual income of the two segments. Speculate as to the types of assets and expenses that are included as unallocated corporate. Identify the advantages and disadvantages of failing to allocate to the operating divisions significant corporate-level assets and expenses.

CHAPTER 23: Transfer Pricing

Ferrari
Shall we draw up the papers, or is our handshake good enough?

Rick
It's certainly not good enough. But since I'm in a hurry, it'll have to do.

Ferrari
Ah, to get out of Casablanca and go to America! You're a lucky man.

Rick
Oh, by the way, my agreement with Sam's always been that he gets 25% of the profits. That still goes.

Ferrari
Hmmm. I happen to know that he gets 10%. But he's worth 25%.

Rick
Don't forget, you owe Rick's a hundred cartons of American cigarettes.

Ferrari
I shall remember to pay it… to myself.

From *Casablanca*, 1942

Chapter Contents:

- Definition and overview
- Transfer pricing options
- Market-based transfer prices
- Cost-based transfer prices
- Negotiated transfer prices
- Survey of practice
- External reporting
- Dual transfer pricing
- Transfer pricing and multinational income taxes
- Other regulatory issues
- Exercises and problems

Definition and Overview:

A transfer price is what one part of a company charges another part of the same company for goods or services. In the excerpt from *Casablanca*, Rick apparently loaned Ferrari 100 cartons of cigarettes for which he was never repaid. Now that Ferrari owns both the Blue Parrot and Rick's Café, he jokes about the fact that what was previously a debt that he owed to Rick, is now a "debt" from one nightclub that he owns to another nightclub that he owns. If Ferrari continues to transfer cartons of cigarettes between the two clubs, he might wish to establish a "transfer price" for cigarettes, but knowing Ferrari, he won't bother.

We will restrict attention to transfers that involve a tangible product, and we will refer to the two corporate entities engaged in the transfer as divisions. Hence, the transfer price is the price that the "selling" division charges the "buying" division for the product. Because objects that float usually flow downstream, the selling division is called the **upstream division** and the buying division is called the **downstream division**.

Transferred product can be classified along two criteria. The first criterion is whether there is a readily-available external market price for the product. The second criterion is whether the downstream division will sell the product "as is," or whether the transferred product becomes an input in the downstream division's own production process. When the transferred product becomes an input in the downstream division's production process, it is referred to as an **intermediate product**. The following table provides examples.

	An external market price is available	**No external market price is available**
The downstream division will sell "as is"	The West Coast Division of a supermarket chain transfers oranges to the Northwest Division, for retail sale.	A pharmaceutical company transfers a drug that is under patent protection, from its manufacturing division to its marketing division.
The downstream division will use the transferred product in its own production process	An oil company transfers crude oil from the drilling division to the refinery, to be used in the production of gasoline.	The Parts Division of an appliance manufacturer transfers mechanical components to one of its assembly divisions.

Transfer pricing serves the following purposes.

1. When product is transferred between profit centers or investment centers within a decentralized firm, transfer prices are necessary to calculate divisional profits, which then affect divisional performance evaluation.

2. When divisional managers have the authority to decide whether to buy or sell internally or on the external market, the transfer price can determine whether managers' incentives align with the incentives of the overall company and its owners. The objective is to achieve **goal congruence**, in which divisional managers will want to transfer product when doing so maximizes consolidated corporate profits, and at least one manager will refuse the transfer when transferring product is not the profit-maximizing strategy for the company.

3. When multinational firms transfer product across international borders, transfer prices are relevant in the calculation of income taxes, and are sometimes relevant in connection with other international trade and regulatory issues.

The transfer generates journal entries on the books of both divisions, but usually no money changes hands. The transfer price becomes an expense for the downstream division and revenue for the upstream division. Following is a representative example of journal entries to record the transfer of product:

Upstream Division:

(1)	Intercompany Accounts Receivable	$9,000	
	Revenue from Intercompany Sale		$9,000
(2)	Cost of Goods Sold – Intercompany Sales	$8,000	
	Finished Goods Inventory		$8,000

(To record the transfer of 500 cases of *Clear Mountain Spring Water*, at $18 per case, to the Florida marketing division, and to remove the 500 cases from finished goods inventory at the production cost of $16 per case.)

Downstream Division:

(1)	Finished Goods Inventory	$9,000	
	Intercompany Accounts Payable		$9,000

(To record the receipt of 500 cases of *Clear Mountain Spring Water*, at $18 per case, from the bottling division in Nebraska)

Transfer Pricing Options:

There are three general methods for establishing transfer prices.

1. **Market-based transfer price:** In the presence of competitive and stable external markets for the transferred product, many firms use the external market price as the transfer price.

2. **Cost-based transfer price:** The transfer price is based on the production cost of the upstream division. A cost-based transfer price requires that the following criteria be specified:

    a. Actual cost or budgeted (standard) cost.
    b. Full cost or variable cost.
    c. The amount of markup, if any, to allow the upstream division to earn a profit on the transferred product.

3. **Negotiated transfer price:** Senior management does not specify the transfer price. Rather, divisional managers negotiate a mutually-agreeable price.

Each of these three transfer pricing methods has advantages and disadvantages.

Market-based Transfer Prices:

Microeconomic theory shows that when divisional managers strive to maximize divisional profits, a market-based transfer price aligns their incentives with owners' incentives of maximizing overall corporate profits. The transfer will occur when it is in the best interests of shareholders, and the transfer will be refused by at least one divisional manager when shareholders would prefer for the transfer not to occur. The upstream division is generally indifferent between receiving the market price from an external customer and receiving the same price from an internal customer. Consequently, the determining factor is whether the downstream division is willing to pay the market price. If the downstream division is willing to do so, the implication is that the downstream division can generate incremental profits for the company by purchasing the product from the upstream division and either reselling it or using the product in its own production process. On the other hand, if the downstream division is unwilling to pay the market price, the implication is that corporate profits are maximized when the upstream division sells the product on the external market, even if this leaves the downstream division idle. Sometimes, there are cost savings on internal transfers compared with external sales. These savings might arise, for example, because the upstream division can avoid a customer credit check and collection efforts, and the downstream division might avoid inspection procedures in the receiving department. Market-based transfer pricing continues to align managerial incentives with corporate goals, even in the presence of these cost savings, if appropriate adjustments are made to the transfer price (i.e., the market-based transfer price should be reduced by these cost savings).

However, many intermediate products do not have readily-available market prices. Examples are shown in the table: a pharmaceutical company with a drug under patent protection (an effective monopoly); and an appliance company that makes component parts in the Parts Division and transfers those parts to its assembly divisions. Obviously, if there is no market price, a market-based transfer price cannot be used.

A disadvantage of a market-based transfer price is that the prices for some commodities can fluctuate widely and quickly. Companies sometimes attempt to protect divisional managers from these large unpredictable price changes.

Cost-based Transfer Prices:

Cost-based transfer prices can also align managerial incentives with corporate goals, if various factors are properly considered, including the outside market opportunities for both divisions, and possible capacity constraints of the upstream division.

First consider the case in which the upstream division sells the intermediate product to external customers as well as to the downstream division. In this situation, capacity constraints are crucial. If the upstream division has excess capacity, a cost-based transfer price using the variable cost of production will align incentives, because the upstream division is indifferent about the transfer, and the downstream division will fully incorporate the company's incremental cost of making the intermediate product in its production and marketing decisions. However, senior management might want to allow the upstream division to mark up the transfer price a little above variable cost, to provide that division positive incentives to engage in the transfer.

If the upstream division has a capacity constraint, transfers to the downstream division displace external sales. In this case, in order to align incentives, the opportunity cost of these lost sales must be passed on to the downstream division, which is accomplished by setting the transfer price equal to the upstream division's external market sales price.

Next consider the case in which there is no external market for the upstream division. If the upstream division is to be treated as a profit center, it must be allowed the opportunity to recover its full cost of production plus a reasonable profit. If the downstream division is charged the full cost of production, incentives are aligned because the downstream division will refuse the transfer under only two circumstances:

> First, if the downstream division can source the intermediate product for a lower cost elsewhere; or
>
> Second, if the downstream division cannot generate a reasonable profit on the sale of the final product when it pays the upstream division's full cost of production for the intermediate product.

If the downstream division can source the intermediate product for a lower cost elsewhere, to the extent the upstream division's full cost of production reflects its future long-run average cost, the company should consider eliminating the upstream division. If the downstream division cannot generate a reasonable profit on the sale of the final product when it pays the upstream division's full cost of production for the intermediate product, the optimal corporate decision might be to close the upstream division and stop production and sale of the final product. However, if either the upstream division or the downstream division manufactures and markets multiple products, the analysis becomes more complex. Also, if the downstream division can source the intermediate product from an external supplier for a price greater than the upstream division's full cost, but less than full cost plus a reasonable profit margin for the upstream division, suboptimal decisions could result.

Negotiated Transfer Prices:

Negotiated transfer pricing has the advantage of emulating a free market in which divisional managers buy and sell from each other in a manner that simulates arm's-length transactions. However, there is no reason to assume that the outcome of these transfer price negotiations will serve the best interests of the company or shareholders. The transfer price could depend on which divisional manager is the better poker player, rather than whether the transfer results in profit-maximizing production and sourcing decisions. Also, if divisional managers fail to reach an agreement on price, even though the transfer is in the best interests of the company, senior management might decide to impose a transfer price. However, senior management's imposition of a transfer price defeats the motivation for using a negotiated transfer price in the first place.

Survey of Practice:

Roger Tang (*Management Accounting*, February 1992) reports 1990 survey data on transfer pricing practices obtained from approximately 150 industrial companies in the *Fortune* 500. Most of these companies operate foreign subsidiaries and also use transfer pricing for domestic interdivisional transfers. For domestic transfers, approximately 46% of these companies use cost-based transfer pricing, 37% use market-based transfer pricing, and 17% use negotiated transfer pricing. For international transfers, approximately 46% use market-based transfer pricing, 41% use cost-based transfer pricing, and 13% use negotiated transfer pricing. Hence, market-based transfer pricing is more common for international transfers than for domestic transfers. Also, comparison to an earlier survey indicates that market-based transfer pricing is slightly more common in 1990 than it was in 1977.

Tang also finds that among companies that use cost-based transfer pricing for domestic and/or international transfers, approximately 90% use some measure of full cost, and only about 5% or 10% use some measure of variable cost.

External Reporting:

For external reporting under Generally Accepted Accounting Principles, no matter what transfer price is used for calculating divisional profits, the effect should be reversed and intercompany profits eliminated when the financial results of the divisions are consolidated. Obviously, intercompany transfers are not arm's-length transactions, and a company cannot generate profits or increase the reported cost of its inventory by transferring product from one division to another.

Dual Transfer Pricing:

Under a dual transfer pricing scheme, the selling price received by the upstream division differs from the purchase price paid by the downstream division. Usually, the motivation for using dual transfer pricing is to allow the selling price to exceed the purchase price, resulting in a corporate-level subsidy that encourages the divisions to participate in the transfer. Although dual transfer pricing is rare in practice, a thorough understanding of dual transfer pricing illustrates some of the key bookkeeping and financial reporting implications of all transfer pricing schemes.

In the following example, the Clear Mountain Spring Water Company changes from a negotiated transfer price of $18 per case (see the above example) to a dual transfer price in which the upstream division receives the local market price of $19 per case, and the downstream division pays $17 per case.

Upstream Division:

(1)	Intercompany Receivable/Payable	$9,500	
	Revenue from Intercompany Sale		$9,500
(2)	Cost of Goods Sold – Intercompany Sales	$8,000	
	Finished Goods Inventory		$8,000

(To record the transfer of 500 cases of *Clear Mountain Spring Water*, at $19 per case, to the Florida marketing division, and to remove the 500 cases from finished goods inventory at the production cost of $16 per case.)

Downstream Division:

(1)	Finished Goods Inventory	$8,500	
	Intercompany Receivable/Payable		$8,500

(To record the receipt of 500 cases of *Clear Mountain Spring Water* at $17 per case, from the bottling division in Nebraska)

Corporate Headquarters:

(1)	Interco. Receivable/Payable – Florida	$8,500	
	Corporate Subsidy for Dual Transfer Price	1,000	
	Interco. Receivable/Payable – Nebraska		$9,500

(To record the transfer of 500 cases of *Clear Mountain Spring Water* from Nebraska to Florida, at a dual transfer price of $19/$17 per case.)

Corporate Subsidy for Dual Transfer Price is an expense account at the corporate level. This account and the revenue account that records the intercompany sale affect the calculation of divisional profits for internal reporting and performance evaluation, but these accounts—as well as the intercompany receivable/payable accounts—are eliminated upon consolidation for external financial reporting. To the extent that the Florida Division has ending inventory, the cost of that inventory for external financial reporting will be the company's cost of production of $16 per case. In other words, the transfer price has no effect on the cost of finished goods inventory.

Transfer Pricing and Multinational Income Taxes:

When divisions transfer product across tax jurisdictions, transfer prices play a role in the calculation of the company's income tax liability. In this situation, the company's transfer pricing policy can become a tax planning tool. The United States has agreements with most other nations that determine how multinational companies are taxed. These agreements, which are called **bilateral tax treaties**, establish rules for apportioning multinational corporate income among the nations in which the companies conduct business. These rules attempt to tax all multinational corporate income once and only once (excluding the double-taxation that occurs at the Federal and state levels). In other words, the tax treaties attempt to avoid the double-taxation that would occur if two nations taxed the same income. Since transfer prices represent revenue to the upstream division and an expense to the downstream division, the transfer price affects the calculation of divisional profits that represent taxable income in the nations where the divisions are based.

For example, if a U.S.-based pharmaceutical company manufactures a drug in a factory that it operates in Ireland and transfers the drug to the U.S. for sale, a high transfer price increases divisional income to the Irish division of the company, and hence, increases the company's tax liability in Ireland. At the same time, the high transfer price increases the cost of product to the U.S. marketing division, lowers U.S. income, and lowers U.S. taxes. The company's incentives with regard to the transfer price depend on whether the marginal tax rate is higher in the U.S. or in Ireland. If the marginal tax rate is higher in the U.S., the company prefers a high transfer price, whereas if the marginal tax rate is higher in Ireland, the company prefers a low transfer price. The situation reverses if the drug is manufactured in the U.S. and sold in Ireland. The general rule is that the company wants to shift income from the high tax jurisdiction to the low tax jurisdiction.

There are limits to the extent to which companies can shift income in this manner. When a market price is available for the goods transferred, the taxing authorities will usually impose the market-based transfer price. When a market-based transfer price is not feasible, U.S. tax law specifies detailed and complicated rules that limit the extent to which companies can shift income out of the United States.

Other Regulatory Issues:

Transfer pricing sometimes becomes relevant in the context of other regulatory issues, including international trade disputes. For example, when tariffs are based on the value of goods imported, the transfer price of goods shipped from a manufacturing division in one country to a marketing division in another country can form the basis for the tariff. As another example, in order to increase investment in their economies, developing nations sometimes restrict the extent to which multinational companies can repatriate profits. However, when product is transferred from manufacturing divisions located elsewhere into the developing nation for sale, the local marketing division can export funds to "pay" for the merchandise received. As a final example, when nations accuse foreign companies of "dumping" product onto their markets, transfer pricing is often involved. Dumping refers to selling product below cost, and it generally violates international trade laws. Foreign companies frequently transfer product from manufacturing divisions in their home countries to marketing affiliates elsewhere, so that the determination of whether the company has dumped product depends on comparing the transfer price charged to the marketing affiliate with the upstream division's cost of production.

Exercises and Problems

23-1: The McNabb Company's Eastern Division has capacity to produce 200,000 widgets annually. The normal selling price is \$19 per widget. Fixed costs are \$800,000, and variable costs are \$7 per widget. Another division of McNabb Company would like to buy some widgets from the Eastern Division.

Required:

A) Assume the Eastern Division is operating at 100% of capacity (demand from current customers exceeds the Eastern Division's production capacity). The Western Division would like to purchase 10,000 widgets from the Eastern Division, and \$2 of the variable costs incurred by the Eastern Division could be avoided on each widget transferred. What is the lowest transfer price the Eastern Division should accept?

B) Assume that the Eastern Division is operating at 80% of capacity. The Western Division would like to purchase 20,000 widgets. No variable cost would be avoided on the sale. What is the lowest transfer price the Eastern Division should accept?

C) Assume the Eastern Division is operating at 95% of capacity. The Western Division would like to buy 40,000 widgets in an all-or-nothing deal (it is 40,000 or zero). There would be no variable cost savings. What is the lowest transfer price the Eastern Division could accept to maintain its current profitability?

23-2: The Upstream Division of CDC makes an intermediate product at a variable cost of \$40 per unit, but the cost is \$12 less per unit on internal sales, due to reduced packaging requirements. The Division can sell everything it can produce to the outside market for \$60 per unit (\$60 is the market price for the intermediate product). The Downstream Division can use the intermediate product in its own manufacturing process. Excluding the cost to the Downstream Division of obtaining this intermediate product, its variable production cost is \$55 per unit, and it sells its final product for \$108 per unit. The Downstream Division can buy the intermediate product from an independent supplier for the market price of \$60 per unit. What is the range of transfer prices at which the managers of both divisions would be willing to transfer product?

23-3: The Engineering Department of Electronics Mega-Corporation transferred one of the widgets that it manufactured to the Eastern Division of the company. This transfer occurred using a transfer price of the Engineering Department's budgeted variable cost of production. The market price of the widget was \$105.

The Eastern Division didn't do any work on the widget, but rather transferred the widget to the Western Division. This transfer occurred using a transfer price of the Engineering Department's budgeted full cost of production.

The Western Division didn't do any work on the widget either, but transferred the widget to the Central Division. This transfer occurred using a transfer price of the Engineering Department's actual full cost of production.

The Central Division didn't do any work on the widget either, but transferred the widget to the Southern Division. This transfer occurred using a transfer price of the Engineering Department's actual full cost of production plus a 10% mark-up.

The Southern Division didn't do any work on the widget, but transferred the widget to the European Division. This transfer occurred using a dual transfer price. The Southern Division received its cost, and the European Division paid the market price.

Following is cost information for the widget and for the Engineering Department.

	Budget	**Actual**
Direct materials per unit	$10	$12
Direct labor hours per unit	1	1
Direct labor wage rate per hour	$50	$50
Variable overhead per unit	$5	$6

Fixed and variable overhead are allocated based on direct labor hours. Annual fixed costs for the department were budgeted for $1,000,000, but actual fixed costs were $1,200,000. Total direct labor hours for the department for the year were budgeted for 100,000, but actual labor hours were 80,000.

Required:

A) What is the transfer price from Engineering to the Eastern Division?

B) What is the transfer price from the Eastern Division to the Western Division?

C) What is the transfer price from the Western Division to the Central Division?

D) What is the transfer price from the Central Division to the Southern Division

E) What is the transfer price paid by the European Division for the widget?

23-4: The Olala Juice Company makes and sells apple juice. Olala operates as two divisions: the New York Division under the name “Yo, Juice!”; and the California Division under the name “Wow, Juice?” Each division has a sales department and a production department. Each production department makes the same product: organic, wholesome, pasteurized apple juice. Usually, each division sells the juice that it makes. However, sometimes the New York sales force sells juice to a customer on the West Coast, in which case the most sensible thing to do is to ship the juice out of the California division's plant, and for purposes of calculating divisional income, transfer the product on paper from the California Division to the New York Division. Similarly, sometimes the California Division sells juice to an East Coast customer. Following is cost and volume information for each division for 2004. No marketing costs are incurred on internal sales.

	New York Division (The “Yo, Juice!” Co.)	**California Division** (The “Wow, Juice?” Co.)
External sales	900 cases at $25 per case	1,300 cases at $25 per case
Manufacturing Costs:		
Variable costs	$15 per case	$12 per case
Fixed costs	$5,000	$13,200
Marketing Costs:		
Variable Costs	$1.00 per case	$0.50 per case
Fixed Costs	$500	$1,000
Production	1,000 cases	1,200 cases
Transfers		
to the other division	200 cases	100 cases
from the other division	100 cases	200 cases

Required:

A) If transfers are made at variable manufacturing cost of the division that produced and transfers the product, calculate the divisional income of each division, using Variable Costing.

B) If transfers are made at full manufacturing cost of the division that produced and transfers the product, calculate the divisional income of each division, using Absorption Costing.

23-5 (Continuation of 23-4): Which of the following will maximize the sum of divisional operating income for the two divisions?

(A) A dual transfer price in which the selling division receives the full (variable plus fixed) manufacturing cost and the buying division pays the market price.

(B) A dual transfer price in which the selling division receives the market price and the buying division pays the full (variable plus fixed) manufacturing cost.

(C) A transfer price calculated as the variable manufacturing cost of the selling division.

(D) Every transfer price will result in the same total for the sum of the two division’s operating income. The transfer price only affects how this total is allocated between the two divisions.

23-6 (Continuation of 23-4): Assume each division is producing at capacity, and that each division can sell as much product as it produces to external customers at the market price (unlimited demand). Each manager is allowed to decide whether to transfer product to the other division. Which transfer price ensures that each manager is willing to transfer product to the other division?

(A) A dual transfer price in which the selling division receives the full (variable plus fixed) manufacturing cost and the buying division pays the market price.

(B) A dual transfer price in which the selling division receives the market price and the buying division pays the full (variable plus fixed) manufacturing cost.

(C) A transfer price calculated as the variable manufacturing cost of the selling division.

(D) None of the above.

23-7 (Continuation of 23-4): Assume all of the juice transferred from N.Y. to California is sold before year-end. However, some of the juice transferred from California to N.Y. has not been sold, and is in ending inventory. Which transfer pricing scheme will result in the lowest value for ending inventory for financial reporting of the consolidated company under GAAP?

(A) Variable manufacturing cost plus a 20% mark-up

(B) Full (variable plus fixed) manufacturing cost with no mark-up

(C) Market transfer price

(D) Each of the above transfer prices results in the same value for ending inventory

23-8: Robinson Farms has two divisions, the Orchard Division, and the Kitchen Division. The Orchard Division grows apples for a variable cost of $6 per bushel. Its 2005 sales were 150,000 bushels to outsiders at $10 per bushel and 40,000 bushels to the Kitchen Division at 140% of variable costs. Under a dual transfer pricing system, The Kitchen Division pays only the variable cost per bushel. The fixed manufacturing costs of the Orchard Division were $250,000 per year.

The Kitchen Division bakes pies with the apples, and sells the pies to outside customers for $2.00 per pie. It takes one bushel of apples to make a dozen pies. The Kitchen Division has variable manufacturing costs of $0.40 per pie in addition to the costs from the Orchard Division. The annual fixed manufacturing costs of the Kitchen Division were $170,000. There were no beginning inventories or ending inventories during the year.

Required:

A) What is the operating income of the Orchard Division?

B) What is the operating income of the Kitchen Division?

C) What is the operating income of Robinson Farms as a whole?

D) Explain why the company operating income is less than the sum of the two divisions' total income.

E) Now assume that there is no beginning or ending inventory of apples, but that out of the 480,000 pies manufactured, Sunnybrook Kitchen has 60,000 pies unsold at the end of 2005. Ignoring the issue of spoilage (the pies can be frozen), how would this ending inventory be valued for financial reporting purposes (i.e., for G.A.A.P.)? That is, what is the dollar value of this inventory on Robinson's consolidated financial statements?

23-9: The Upstream Division of Consolidated Inc. makes a widget that is transferred to the Downstream Division for further processing and eventual sale to outside customers. In May, the Upstream Division started with zero inventory, made 1,000 widgets, and transferred 800 widgets to the Downstream Division. The total cost to produce these 1,000 widgets was $50,000 in variable manufacturing costs and $100,000 in fixed manufacturing costs. Since the Upstream Division is strictly a manufacturing division, there were no non-manufacturing costs. Although the Upstream Division did not sell any widgets on the open market in May, there is a market for these widgets, and the market price in May was $180 per widget. The Downstream Division processed 750 of the 800 widgets received in May, at a total cost of $120,000 ($80,000 in variable manufacturing costs, and $40,000 in fixed manufacturing costs), and sold 665 of these widgets in May for $400 each. The Downstream Division incurred variable non-manufacturing costs of $10 per unit sold, and fixed non-manufacturing costs of $30,000.

Required:

A) What is the market-based transfer price? Calculate divisional income for the Upstream Division using Absorption Costing and the market-based transfer price.

B) What is the transfer price if product is transferred at variable cost of production? Calculate divisional income for the Upstream Division using Variable Costing and a variable cost-based transfer price.

C) What is the transfer price if the company transfers product at the full (variable plus fixed) cost of production? Calculate divisional income for the Upstream Division using Absorption Costing and a full cost-based transfer price.

D) Calculate divisional income for the Downstream Division using Absorption Costing and a market-based transfer price.

E) Calculate divisional income for the Downstream Division using Absorption Costing and a full cost-based transfer price.

23-10: The Ohio Division of the Chocolate Company makes chocolate, sells some chocolate to candy manufacturers, and transfers the rest of the chocolate to the Ice Cream Division of the Chocolate Company. In January the Ohio Division made 10,000 pounds of chocolate, incurred variable manufacturing costs of $15,000, and fixed manufacturing costs of $10,000. For internal reporting purposes, the company uses a full cost transfer price (i.e., variable plus fixed manufacturing costs) for transfers of product from one division to another. Of the 10,000 pounds of chocolate made in January, 8,000 pounds were sold to other companies at an average sales price of $5 per pound, and 2,000 pounds were transferred to the Ice Cream Division. The Ice Cream division used 1,000 pounds of chocolate to make 10,000 gallons of chocolate ice cream. Additional costs incurred to make the ice cream were $11,000 in variable manufacturing costs and $20,000 in fixed manufacturing costs. All of the ice cream was sold by the end of the month for $5 per gallon, but 1,000 pounds of the chocolate received from the Ohio Division was still on hand at the end of January.

Required:

A) What is the transfer price for January? Calculate divisional Gross Margin using Absorption Costing for the Ohio Division for January.

B) Calculate divisional Gross Margin using Absorption Costing for the Ice Cream Division for January.

C) Now assume the same facts as above, except that instead of using a full cost transfer price, the company uses a market-based transfer price. What is the market-based transfer price? Calculate divisional Gross Margins for both the Ohio Division and the Ice Cream Division using Absorption Costing and the market-based transfer price.

D) Assume the company uses a market-based transfer price for internal reporting purposes. What would the company show for external financial reporting purposes (GAAP) at the end of January for the cost of ending inventory for the chocolate held by the Ice Cream Division?

23-11: The Transylvania Salad Dressing Company operates in two countries: Rumania and Bulgaria. The Rumanian Division has a processing facility that produces olive oil, and also a factory that mixes and bottles salad dressing for the local market. The Bulgarian Division has a processing facility that produces wine vinegar, and also a factory, similar to the Rumanian factory, that mixes and bottles dressing for the local market. Historically, the oil and vinegar processing plants have produced enough oil and vinegar to meet the demand for both the Rumanian and Bulgarian bottling plants, and each processing facility has sold excess product (oil or vinegar) in its local market.

Following are relevant data for 2005. All amounts have been translated into U.S. currency.

	Rumanian bottling plant	Rumanian oil processing facility	Bulgarian bottling plant	Bulgarian vinegar processing facility
Production (in gallons):	250,000	400,000	150,000	100,000
Outside sales (in gallons):	250,000	60,000	120,000	20,000
Ending inventory (gallons):				
Dressing	0	0	30,000	0
Oil	0	0	20,000	0
Vinegar	0	0	0	0
Variable mfg. costs:	$0.36/gal	$1.00/gal	$0.22/gal	$0.80/gal
Fixed mfg costs:	$100,000	$300,000	$ 30,000	$ 50,000

Variable costs of the bottling plants shown above do not include the costs of the vinegar and oil, and are stated as per gallon of finished product (i.e., dressing). All outside sales are made at the prevailing market prices in that country, as shown below.

Market Prices, per gallon:

	In Bulgaria	In Rumania
salad dressing:	$3.00	$3.00
vinegar:	$1.20	$1.40
Oil:	$2.30	$2.00

Additional information: It takes 0.2 gallons vinegar and 0.8 gallons oil to make 1 gallon of salad dressing. The company is based in Bulgaria. The company pays Rumanian taxes on Rumanian income and Bulgarian taxes on consolidated income in excess of Rumanian income. Rumanian income is equivalent to income of the Rumanian division (bottling plant and oil processing plant). The tax rate for the company in Rumania is 50%, and the tax rate for the company in Bulgaria is 40%.

Required:

A) What is the transfer price of oil using variable cost? What is the transfer price of oil using full cost? What is the transfer price of oil using the selling division's market price?

B) What is the transfer price of vinegar using variable cost? What is the transfer price of vinegar using full cost? What is the transfer price of vinegar using the selling division's market price?

C) Assume each division buys and sells intermediate product (oil and vinegar) from the other division. What transfer pricing policy (variable cost, full cost, or market price of the selling division) maximizes the company's after tax profits for the year? The same type of transfer price (variable cost, full cost, or market price) must be used for both vinegar and oil. You may assume that under any transfer pricing method, taxable income in both countries will be positive.

D) Assume the company uses a market-based transfer price for calculating its tax expense. Compute the company's ending inventory for financial reporting purposes under U.S. Generally Accepted Accounting Principles.

23-12: The dairy in Las Placitas, New Mexico, sells milk, and makes various products from the milk, such as cheese, powdered mild, and Milk Duds. The dairy operates as two divisions: the Cow & Milk Division, and the Advanced Products (A.P.) Division. The manager of the Cow & Milk Division, Beatta Bovine, can choose either to package and sell milk directly to independent customers, or she can sell milk to the manager of the A.P. Division. The manager of the A.P. Division can either buy milk from the Cow & Milk Division, or buy milk on the open market, for use in the production of cheese, butter, etc. Currently, the dairy uses a market-based transfer price for internal sales of milk from one division to the other. Each manager is evaluated based on meeting (or exceeding) divisional profit targets for his or her division.

The manager of the A.P. Division, Hank Holstein, suggests changing to a full cost transfer price with a mark-up. The mark-up would be computed such that if all sales of the Cow & Milk Division were at this price, the Division would just meet its targeted profit amount. Furthermore, Hank suggests allowing his division to buy milk on the open market, but requiring the Cow & Milk Division to sell internally whenever the A.P. Division wants to buy internally. Hank argues that under this new transfer pricing scheme, his division will be no worse off than before (since if the transfer price is above market, he can buy milk on the open market instead of internally), and that the Cow & Milk Division should be satisfied with this transfer price, since internal sales will not pull that Division's profits below what would be necessary for the Division to meet its targeted profits objective.

Required: Under Hank's scheme, indicate whether each of the following statements is true or false.

A) If the market demand for milk exceeds the capacity of the Cow & Milk Division, Beatta will never prefer to sell milk to Hank (instead of selling to the open market) when Hank prefers to buy milk from Beatta (instead of buying on the open market).

B) If the Cow & Milk Division has excess capacity relative to market demand, Beatta will always want to supply milk to the Advanced Products Division.

C) This new transfer pricing scheme will ensure that the two divisions will only transfer product when the transfer is in the best interests of the Dairy as a whole.

D) If the Cow & Milk Division can sell all of its production to the Advanced Products division, the new transfer pricing scheme may induce Beatta to relax cost control pertaining to certain divisional costs.

CHAPTER 24: Corporate Social Responsibility

> *"But you were always a good man of business, Jacob,"* faltered Scrooge….
>
> *"Business!"* cried the Ghost, wringing its hands again. *"Mankind was my business. The common welfare was my business; charity, mercy, forbearance, and benevolence, were, all, my business. The dealings of my trade were but a drop of water in the comprehensive ocean of my business!"*
>
> \- Charles Dickens, *A Christmas Carol*

Chapter Contents:

Introduction:

Most of us balance multiple objectives. Probably, you are attempting to balance your efforts across two or more classes this term, in order to earn good grades in all of them. You are probably also balancing your accomplishments in school with other obligations and goals related to work, hobbies, your involvement with charities, and your relationships with friends and family. There is no "summary measure" or "overall grade" of your success in balancing these multiple objectives and goals, all of which compete for your time and effort.

Similarly, most government programs and organizations balance multiple objectives. City governments allocate scarce resources across diverse activities such as public safety, street maintenance, and public libraries. How does the citizenry choose between two more police officers or a new children's wing for the library? How does one develop a single measure to evaluate the city's overall success in meeting its goals?

Public schools have a goal not to leave any student behind. Schools also have goals to provide challenging opportunities for the very brightest students, and to provide extracurricular activities for all students. Schools must allocate limited resources across these sometimes-competing objectives.

The National Forest Service attempts to balance the economic needs of local communities and timber-dependent industries with the goal of conservation and with the goal of providing outdoor-enthusiasts recreational opportunities on public lands. These goals are so disparate that almost nobody thinks the Forest Service does a good job. The National Park Service has a comparatively easier time: it only balances the two competing objectives of conservation and recreational opportunities. Even so, the Park Service faces controversial decisions such as closing roads to private vehicles in some of the most popular and congested parks, and balancing different types of recreational activities.

The Objectives of Business Organizations:

Given that all individuals, and most not-for-profit and governmental organizations must balance competing objectives, it is interesting to observe that both in practice and in theory, businesses have often focused on a single objective. That objective is to maximize economic returns to owners.

For example, a popular microeconomics textbook tells students:

> *… When we model the behavior of firms, we will want to describe the objective as profit maximization and the constraints as technological constraints and market constraints.*
>
> \- *Hal Varian,*
> Microeconomic Analysis *(1984)*

And a widely-used textbook in corporate finance states:

> *Success is usually judged by value: Shareholders are made better off by any decision which increases the value of their stake in the firm."*
>
> \- *Brealey and Myers,*
> Principles of Corporate Finance *(1988)*

Examples from practice can be drawn from corporate mission statements available on company websites. For example, the athletic footwear company Nike has established the following mission:

> *Nike's corporate responsibility (CR) mission is simple and straightforward. It is clear acknowledgement that CR work should not be separate from the business – but should instead be fully integrated into it. Our CR mission:*
>
> - *We must help the company achieve profitable and sustainable growth.*
> - *We must protect and enhance the brand and company.*
>
> \- *Nike (2005)*

Although generously-worded, and sprinkled with friendly words like "corporate responsibility" and "sustainable growth," there is really nothing in this mission statement that implies the company has any other objective than to maximize long-run profits to shareholders.

The mission statement for pharmaceutical company Pfizer states:

> *We will become the world's most valued company to patients, customers, colleagues, investors, business partners, and the communities where we work and live.*
>
> *- Pfizer (2005)*

Does Pfizer have a business philosophy that would ever place the interests of the community above the interests of investors? If the CEO is meeting with local community leaders, he or she can point to this mission statement and imply so, but if the CEO is meeting with stock analysts and investment bankers, there is no need to interpret this mission statement that way.

If you work forty or more hours a week for an organization that does not have, as one of its ultimate goals, the objective of providing its employees with a challenging, rewarding, safe, and fair work environment, but only attempts to satisfy these objectives as an intermediate step in its efforts to maximize shareholder wealth (while complying with labor laws and maintaining acceptably-low levels of employee turnover), then your own ability to achieve your personal goals will be all that more difficult. Perhaps this fact helps explain the popularity of small, entrepreneurial forms of business; a proprietor or partner in a small company can strive to achieve non-economic goals as well as economic goals within the framework of his or her business.

Similarly, if companies do not have, as a goal, the objective of minimizing pollution, but only minimize pollution to the extent necessary to comply with environmental laws and maintain a favorable public image, then a society committed to achieving and preserving a clean environment will find attaining that objective more difficult. For example, it is possible that the costs incurred by society from major oil spills—the cleanup costs and the costs of long-term damage to the environment—are greater, in total, than the costs of additional steps to prevent oil spills in the first place. Even if double-hull oil tankers are not cost-effective from the oil company's perspective, they may be cost-effective from a societal point of view.

Given that we as a society, and all of us as individuals, have non-economic objectives as well as economic objectives, and given the enormous volume of activity that occurs within for-profit businesses—the human capital, energy, creativity, and material resources invested in business—one might ask whether businesses should focus only on the goal of maximizing shareholder wealth. Are we as a society better off operating in an economy in which the sole objective of corporate America is to maximize the economic resources of owners, and owners then use those resources to achieve their economic and non-economic goals; or would we be better off in an economy in which companies, as well as governments, not-for-profit organizations, and individuals, contribute directly and deliberately to the non-economic objectives of our society? To choose the second scenario is to ask companies to assume multiple objectives, and to ask management to balance resources across those objectives in a manner, and to an extent, that goes beyond the traditional role that owners have assigned to corporate managers.

The question of whether companies have a single objective to maximize economic returns to shareholders, or multiple economic and non-economic objectives, significantly affects the standards of corporate social responsibility by which managers should be judged. At a minimum, if managers are ultimately responsible only for maximizing shareholder wealth, society nevertheless requires managers to comply with laws and regulations, and to meet standards of business ethics related to honesty, integrity, and fair-play. On the other hand, if companies have, as ultimate goals, social and environmental goals, then standards of corporate social responsibility might include the conduct of managers towards achieving these goals.

Sustainability:

There is increasing concern by government leaders, policymakers and the public over the accelerated rate at which natural resources are being depleted, and the associated environmental degradation. As a result, many businesses and business leaders have recognized “sustainability” as a worthwhile goal: companies should strive to conduct business in a sustainable manner. However, there is no widely-accepted definition of sustainability. In 1987, the World Commission on Environment and Development (commonly called the Brundtland Commission) defined sustainability as follows:

> *Sustainable development “meets the needs of the present without compromising the ability of future generations to meet their own needs.”*

This definition has been adopted by many organizations, but does not provide guidance on how to make these intergenerational trade-offs. A slightly different view was recently expressed by former Soviet leader Mikhail Gorbachev:

> *We desperately need to … adopt a new paradigm for development, based on the costs and benefits to all people, and bound by the limits of nature herself rather than the limits of technology and consumerism.*

Can we expect the profit motive to induce companies to adopt sustainable business practices? Does economic theory, and do observed business practices, suggest that the goal of maximizing long-run profits is consistent with the goal of sustainability? If timber companies harvest all of the forests under their control, without replanting, their subsequent profits from timber sales presumably will be zero, so the companies would appear to have economic incentives to harvest forests responsibly, and to replant. Companies, unlike individuals, have indefinite lives, so they might be more motivated than individuals to make long-term investments in the environment, if those investments also offer long-term economic returns.

Unfortunately, neither observed business practices nor theory provide strong support for this line of reasoning. Many industries in both renewable and nonrenewable resources, such as oil and timber, are depleting these resources at alarming rates.

Finance theory postulates that companies should maximize the present value of future free cash flows. With appropriate assumptions, free cash flows over the life of the company equal the sum of earnings over the life of the company, so that accounting theory postulates that companies should maximize current and future profits. Does this theory predict that companies will use resources in a sustainable manner?

Consider an oil company with oil reserves that can last 100 years at a given level of production. Assume a discount rate of 8% (see Chapter 19 for an explanation of discount rates). Assume, for simplicity, that the company anticipates zero inflation and a constant sales price for oil. How important are the resources available to the company during the last 50 years of this 100-year period, to the value (and the stock price) of the company today? The answer is: not very important. Consider an even more extreme question. How important are the resources available to the company during the last 80 years of this 100-year period? The answer is that because of the 8% discount rate, approximately 80% of the value of the company today derives from oil sales over the first twenty years. Only 20% of the value of the company derives from the last 80 years. Can we expect wise stewardship of the resources controlled by this company, when the company's actions to ensure the availability of these resources more than twenty years into the future have such a minimal impact on the company's stock price today?

Corporate Social Responsibility and Negative Externalities:

Another reason that market mechanisms are unable to consistently induce companies to engage in sustainable business practices arises from what economists call negative externalities. When the actions of a company impose costs on third parties, the economic terminology is that a **negative externality** exists. For example, if a company discharges pollution into a river, then there is a negative externality that constitutes a cost to people who live downstream. If the company can pollute the river without violating environmental laws or incurring negative publicity that ultimately affects sales, then this negative externality can be difficult to remedy.

Despite numerous laws and regulations designed to limit the costs imposed by negative externalities, they are pervasive. Examples today include cruise ships that dump sewage into coastal waters, and the economically-motivated introduction of invasive foreign plants and animals that then displace or destroy native species, harming the people and industries that appreciated or depended on them.

One type of externality is called the tragedy of the commons. The term literally refers to overgrazing of common lands that can occur in an agricultural community, because each family realizes that if they limit the opportunity for their animals to graze on the commons—which would be the socially-responsible behavior—they would make themselves worse off in the short-run without improving their situation in the long-run, because acting alone, one family does not materially affect the health of the pasture. Similarly, companies in many industries today take advantage of public goods that are subject to the tragedy of the commons. The most poignant examples relate to resources that cannot be owned by one company or country, such as the oceans and atmosphere. For example, ocean fish populations for some species no longer support commercial fishing: depletion of these fish populations constitute both an environmental tragedy and an economic tragedy for small fishing communities.

Limited attempts have been made to use the efficiency of the marketplace to limit the costs imposed by negative externalities. For example, governments have experimented with pollution credits for certain types of emissions. Because companies can buy and sell these credits, they have incentives to reduce emissions without being subject to blanket emission-caps that might not make sense for a particular company and community. Such attempts do not represent a move away from the single-objective, profit-maximizing framework of our economy, but rather constitute efforts to use regulation to induce for-profit companies to internalize part of the cost of negative externalities.

Social Responsibility as a Means to an End:

Some argue that when companies fail to operate in a sustainable manner, when they impose negative externalities on society, and when they otherwise fail to act in socially-responsible ways, the resulting negative publicity will eventually translate into decreased sales and profits. Hence, the profit motive is all that is needed to align corporate objectives with society's non-economic goals. Historically, there are a few instances in which this chain of events has perhaps occurred. Arguably, the divestiture by some pension funds and other investors in the stock of companies that conducted business in South Africa helped end apartheid. Most people agree that the grape boycott led by Cesar Chavez led to long-term improvements in the lives of Hispanic and Mexican migrant workers.

However, such examples are rare and usually involve particularly emotional issues and charismatic leaders. According to Harvard Business School management professor Lynn Sharp Paine:

> *It strains credulity to suggest that Nike would have benefited financially from requiring its suppliers to meet higher standards at the inception of its then-novel overseas manufacturing program in the 1960s. Insistence on adult workers (no children), safe working conditions, and reasonable hours and pay would have cost Nike real dollars and cents. Prior to the 1990's, when workers and consumers in industrialized countries awakened to the conditions of workers overseas, it would have been difficult to cite even minimal reputational benefits from such a stance.*

Neither an overview of business history, nor current events, seems to support the idea that the free-market mechanism is a general remedy for all of the ills that the conduct of business, in its pursuit of profits, imposes on society, even if we could agree on what those ills are. Most of us would like to see locally-owned, “Main Street” businesses thrive, yet we shop at the mall and at Wal-Mart for price and selection. When we travel, we eat at McDonalds’ instead of the local diner, because we know what to expect from the fast-food chain restaurants in terms of quality and cleanliness. Many of us would prefer to buy eggs laid by free-range chickens, if we gave the matter any thought, but we won’t pay an extra fifty cents a dozen. Most of us oppose child-labor, and no doubt, we all oppose child slave labor, but many of us won’t pay an extra dollar for a candy bar made with fair-trade chocolate, which is the only way today to ensure that the chocolate was not harvested by children under forced-labor conditions.

On the other hand, there are alternative views, and in any case, the future might not resemble the past. For example, Oekom, a German company that grades companies based on environmental and social performance, conducted a joint study with the investment banking firm of Morgan Stanley. The study found a positive correlation between financial performance and sustainable business practices. According to Markus Knisel, director of Morgan Stanley Private Wealth Management, “The positive correlation between sustainability and financial performance will provide an enormous boost to the sustainable investment sector.” Hence, it is possible that market mechanisms do encourage sustainable business practices, and will be more effective in doing so in the future.

Social Responsibility as an End in Itself:

Some argue that a more effective and efficient framework for our economy and society would be for corporate management to internalize the non-economic objectives that the owners themselves share. Finding the common denominator of values and non-economic objectives across hundreds or even tens-of-thousands of owners is difficult. However, it is not impossible, as demonstrated by the success over the past two decades of such diverse products as mutual funds, credit cards, and long-distance telephone companies that target financial support for particular social or environmental goals.

Such a philosophy of business involves the expectation by shareholders that corporate managers will consider environmental and social factors in their decisions, as well as economic factors, and will consider these factors above and beyond what is required by law or would result in negative publicity that ultimately hurts profits. In fact, shareholders might accept lower economic returns in exchange for corporate behavior that aligns with their personal values. How much lower? Probably not much; but if it is any amount at all, then management must abandon the appealing simplicity of a single-minded focus on economic profits, and address multiple objectives in a meaningful way.

Non-Economic Goals and Management Accounting:

Regardless of whether one believes that companies should adopt non-economic goals as well as profit maximization as ultimate goals, or whether one believes that the profit motive is sufficient to encourage companies to act in socially and environmentally responsible ways, there is an important role for management accounting. Specifically, shareholders, potential shareholders, and customers must have access to the information that enables them to make investment and purchase decisions consistent with their values.

Traditional accounting and financial reporting systems were not designed to collect and report information about social and environmental performance, in part because many of these measures are non-monetary, and accounting systems traditionally relied on the monetary-unit as the common denominator in which to measure economic activities and transactions. Two relatively recent innovations in management accounting and corporate reporting that provide a framework for companies to formally incorporate nonfinancial objectives into management decision-making and corporate reporting are the **balanced scorecard** and the **triple-bottom-line**.

The Balanced Scorecard:

The balanced scorecard is a performance measurement tool and a performance management system created in the early 1990s by Robert Kaplan and David Norton. The balanced scorecard emphasizes traditional financial measures, but also adds nonfinancial measures. An important motivation for adding these nonfinancial measures is the observation that many financial measures are backward-looking, while many important forward-looking measures of performance are nonfinancial. In part, the balanced scorecard seems to have been a response to what was perceived as an inordinate preoccupation by analysts and shareholders on quarterly earnings announcements, which reflect very short-term past performance, and are not necessarily a strong predictor of long-term future performance.

The four original components of the balanced scorecard were

1. The learning and growth perspective
2. The internal business process perspective
3. The customer perspective
4. The financial perspective

Sometimes, sustainability is added as an additional perspective. Each of these perspectives has performance measures associated with it, and these performance measures are tailored for the specific circumstances of the company implementing the scorecard. An important advantage of the balanced scorecard is that it explicitly acknowledges the fact that companies have multiple stakeholders: investors, creditors, customers, and employees.

The popularity of the balanced scorecard is illustrated by the results of a recent survey of 100 large U.S. companies. The survey found that 60% of these companies use some variation of the balanced scorecard. Among companies using the balanced scorecard, 80% of the companies are either using the scorecard or planning to use it for incentive compensation purposes.

The use of the balanced scorecard does not imply that the company is compromising its focus on economic profits, or that the company has identified multiple objectives as ultimate goals. In fact, the survey referenced above found that among companies using the balanced scorecard, on average, financial measures are given 55% of the total weight in the scorecard, and the remaining 45% is shared by all of the other elements of the scorecard combined. Hence, financial measures still predominate. Many companies adopt the balanced scorecard because management believes that superior performance along the nonfinancial components of the scorecard will improve long-run financial performance.

The Triple-Bottom-Line:

The balanced scorecard is a management tool. By contrast, the triple-bottom-line is an external reporting tool designed for shareholders and other financial statement users. The triple-bottom-line reports periodic (quarterly or annual) information about the company's performance along environmental and social dimensions, as well as the usual information about the company's economic performance. Reporting under the triple-bottom-line is divided into three components:

1. **Economic performance** reports traditional measures of financial performance, and possibly additional statistics related to economic performance such as product market share or information about new product development.

2. **Social performance** reports measures of performance related to employee welfare, such as employee injury rates, training programs, and hiring and retention statistics. This category also reports other social performance measures such as charitable contributions, and the company's activities in shaping local, national and international public policy.

3. **Environmental performance** reports the impact of the company's products, services and processes on the environment. This component of the triple-bottom-line might report on the release of pollutants into the air and public waters, the utilization of renewable and nonrenewable natural resources, and the company's stewardship of natural resources on company-owned or company-controlled lands.

There are no "Generally Accepted Accounting Principles" for reporting under the triple-bottom-line. However, the Global Reporting Initiative (GRI), sponsored by the United Nations Environment Program, has emerged as a prominent source of guidance for triple-bottom-line reporting. According to GRI, over 500 organizations worldwide follow its reporting guidelines. An alternative framework that is widely used for reporting on environmental performance is ISO 14000, established by the Organization de Standards International. This organization is a management practice standard-setting body founded in Amsterdam in 1947. ISO establishes standards for a variety of products and production processes, and compliance with ISO is a contractual requirement by some corporate customers.

The triple-bottom-line is gaining momentum in some other nations more quickly than in the United States.

Conclusion:

Reporting on sustainability is no more synonymous with engaging in activities that promote sustainability than reporting on economic profitability is synonymous with being profitable. However, in the current U.S. regulatory environment, companies are required to report on economic performance in accordance with Generally Accepted Accounting Principles, whether they have good news to tell or bad. By contrast, reporting to shareholders and to the public on environmental and social performance is generally voluntary in the U.S. and in most other nations. Hence, we would expect that company managers that choose to report this information believe it will be viewed favorably by financial statement users. Companies that engage in activities that promote environmental and social performance goals are the companies most likely to report these activities using the triple-bottom-line or some similar reporting framework. Companies that do not engage in these activities, or engage in them minimally, probably will not report under the triple-bottom-line.

Consequently, investors and consumers that wish to make investment and purchase decisions based, in part, on companies' environmental and social performance are hampered by the lack of universal reporting (not all public companies report this information) and by the lack of uniform reporting (among companies that report this information, they do not report the information using the same criteria in the same way). Another component in the reporting framework that is present for financial data, but generally absent for environmental and social reporting, is third-party attestation. Financial statements are audited by public accountants, and financial statement users can place more reliance on the accuracy of that information because of the independent auditor's third-party verification role. No such audit requirement exists for information that U.S. companies report voluntarily about environmental and social performance.

Hence, whether one believes that the profit-motive and reputational effects are sufficient to induce companies to engage in responsible environmental and social behavior, or one believes that companies should include environmental and social goals as ultimate objectives along with traditional economic objectives, it would seem that the following elements are essential—but currently absent—for either mechanism to work effectively: First, the regulatory reporting regime should require that environmental and social performance information be reported to investors and consumers using commonly-accepted criteria. Second, the information should be audited, to enhance the credibility of this information with financial statement users.

Discussion questions:

24-1: Do you agree with the Brundtland Commission definition of sustainability? Can you offer an alternative definition that you prefer?

24-2: Is the goal of achieving sustainable business practices compatible with the goal of maximizing long-run financial performance?

24-3: Can corporate strategies accommodate multiple long-run objectives? Can you cite examples of companies that seem to have established multiple objectives?

24-4: If you believe that companies can only effectively accommodate one long-run objective, do you think that shareholders have the same goals for the company as creditors? If not, how should the company balance the objectives of creditors with the objectives of shareholders? Similarly, do you think that current shareholders have the same objectives for corporate financial reporting as potential shareholders?

24-5: Does the balanced scorecard accommodate multiple long-run objectives, or only multiple objectives in the short run?

24-6: What is the relationship between reporting on environmental and social performance, and investing in environmental and social goals?

Five-Page Summary of Key Concepts:

Cost Classifications:

Cost object: something we want to know the cost of.
All costs can be classified along each of the following three dimensions.
– **direct costs** versus **overhead costs** (also called **indirect costs**)
– **variable costs** versus **fixed costs** (many costs are **mixed**; also called **semi-variable**)
– **manufacturing costs** versus **non-manufacturing costs**

Steps in Cost Allocation:

Step 1: Identify the **cost object** (usually a product or service of the organization).
Step 2: Identify the **direct costs**. These costs can be **traced** directly to the cost object.
Step 3: Identify the **overhead cost pools** associated with the cost object.
Step 4: Select the **cost allocation base** for assigning each overhead pool to the cost object.
Step 5: Develop the **overhead rate per unit of the allocation base**:

$$\text{Overhead Rate} = \frac{\text{Total Costs in the Overhead Cost Pool}}{\text{Total Quantity of the Cost Allocation Base}}$$

This rate is used to allocate overhead to the cost object based on the quantity of the allocation base incurred by the cost object. For example, to allocate utility expense at a factory using direct labor hours as the allocation base, the ratio in Step 5 is total utility expense incurred by the factory during the period divided by total hours of direct labor incurred for all products made at the factory. Utility expense is then allocated to each product using this ratio multiplied by the total direct labor hours incurred in the production of each product.

If overhead is allocated using budgeted rates (as in **Normal Costing** and **Standard Costing**), Step 5 becomes:

Step 5a: For the budget period, estimate the total quantity of the cost allocation base that will be incurred.
Step 5b: For the budget period, estimate the cost of items identified in Step 3 above.
Step 5c: Compute the budgeted overhead rate as: Step 5b ÷ Step 5a

Activity-Based Costing (ABC): A costing system characterized by the use of **multiple overhead pools**, each with its own allocation base, and characterized by the choice of **cost drivers** for the allocation bases.

Misapplied Overhead (O/H)

When overhead is allocated using budgeted rates, a difference can arise between actual overhead incurred, and overhead allocated to product. This difference is called **Underapplied or Overapplied Overhead**.

Misapplied overhead = actual overhead incurred – overhead applied
If actual overhead incurred is greater than overhead applied, overhead is underapplied.
If actual overhead incurred is less than overhead applied, overhead is overapplied

Cost-Volume-Profit Analysis:

P = (SP – VC) x Q – FC

Where: **P** = profits,
SP = sales price per unit,
VC = variable cost per unit (manufacturing and non-manufacturing),
Q = number of units made and sold
FC = total fixed costs (manufacturing and non-manufacturing).

SP – VC is the **unit contribution margin** (**UCM**)
Q x (SP – VC) is the **total contribution margin**. (**TCM**)
TCM ÷ sales is the **contribution margin ratio.** (**CMR**)
Breakeven Point: in units **= FC ÷ UCM**; in sales dollars **= FC ÷ CMR**

Flexible Budgeting:

Static budget variance = actual results – static budget (i.e., the original budget)

Flexible budget for costs =
(static budget **VC** x actual units produced or sold) + static budget **FC**.

Flexible budget for revenues = static budget **SP** x actual units sold.

Flexible budget variance = actual results – flexible budget

Variable Cost Variances:

The materials price (or labor rate) variance

= **(AP - SP) x AQ = (AQ x AP) – (AQ x SP)**

The materials quantity or usage (or labor efficiency) variance

= **(AQ - SQ) x SP = (AQ x SP) – (SQ x SP)**

Where **AP** = actual price per unit of input, **SP** = budgeted (i.e., standard) price per unit of input, **AQ** = actual quantity of inputs used (or purchased), and **SQ** = quantity of inputs that should have been used for the ***actual*** output achieved (actual units produced x standard quantity allowed per unit; a flexible budget concept)

Fixed Manufacturing Overhead (FMOH) Cost Variances

There are important issues related to how the denominator in the overhead rate (step 5) is calculated for the purpose of allocating fixed overhead. Two choices are:

1. **Practical Capacity**: The level of the allocation base that would be incurred if fixed assets run full-time, but allowing for routine maintenance and unavoidable interruptions.

2. **Budgeted Utilization**: The level of the allocation base that would be expected for budgeted production.

Budget variance (also called the fixed overhead **spending variance)**
= actual total FMOH – budgeted total FMOH

Volume variance = budgeted total FMOH – FMOH allocated to output using a standard costing system (i.e., budgeted FMOH per unit x actual units produced).

Budgeted FMOH per unit = FMOH ÷ the denominator concept in step 5 above.
The volume variance is favorable if actual production exceeds the denominator in the FMOH rate.

Absorption Costing and Variable Costing:

Under **Absorption Costing** (also called **Full Costing**), **product costs** (also called **inventoriable costs**) include all manufacturing costs: labor, materials, and manufacturing overhead (fixed and variable). Absorption Costing is required for external reporting under GAAP.

Variable Costing (also called **Direct Costing**) is an alternative method that treats direct manufacturing costs and variable manufacturing overhead as product costs, but treats fixed manufacturing overhead as a period expense (appears on the income statement when incurred). Variable costing assumes fixed costs are unrelated to production, since these costs are incurred in the short-run even if nothing is produced.

Absorption Costing and Variable Costing treat direct labor, direct materials, and variable manufacturing overhead in the same way (and they both honor the matching principle for these costs). Both methods also treat non-manufacturing costs in the same way (as a period expense). ***Only fixed manufacturing overhead is treated differently***.

Each method is associated with its own income statement format:

Gross Margin Income Statement under Absorption Costing

Sales
– COGS (cost of goods sold)
= ***Gross margin***
– Fixed and variable non-manufacturing costs
= Income

Where COGS = (manufacturing VC + FMOH per unit) x units sold; and FMOH per unit = FMOH ÷ units produced (or other denominator-level concept).

Contribution Margin Income Statement under Variable Costing

Sales
– Variable manufacturing costs
– Variable non-manufacturing costs
= ***Contribution margin***
– Fixed manufacturing costs
– Fixed non-manufacturing costs
= Income

Where variable manufacturing costs = manufacturing VC x units sold (honoring the matching principle); and variable non-manufacturing costs = all variable non-manufacturing costs incurred during the period (not honoring the ***matching principle***).

Calculation of Ending Inventory:

Absorption Costing: (manufacturing VC + FMOH per unit) x units in ending inventory

Variable Costing: manufacturing VC x units in ending inventory

Operational Budgeting:

Production budget (in units)

Beginning units + units produced = units sold + ending units

Cash budget (in dollars)

Beginning cash + receipts = ending cash + disbursements

Capital Budgeting:

Net Present Value (NPV) = the present value of current and future cash inflows minus the present value of current and future cash outflows.

Internal Rate of Return (IRR) = the interest rate computed such that the **NPV** of the project is zero.

Payback Period = net investment ÷ average annual cash flow

Accounting Rate of Return (**ARR**), also called the **Book Rate of Return**:

$$\textbf{ARR} = \frac{\text{Average annual income}}{\text{average book investment}}$$

Where, for example, average annual income equals cash flow less depreciation expense, and average book investment is net of accumulated depreciation.

Divisional Performance Evaluation Tools:

Return on Investment (ROI) = divisional operating profit ÷ divisional investment.
Also, ROI = investment turnover x profit margin
Where: profit margin = operating profits ÷ revenues
And: investment turnover = revenues ÷ investment.

Residual Income = operating profit – (hurdle rate x divisional investment) where operating profit does not reflect a deduction for interest expense.

Transfer pricing:

Transfer prices are used to value goods or services exchanged between divisions of a decentralized firm. The transfer price is the price one division charges another division for an intermediate product. The selling division is the **upstream division** and the buying division is the **downstream division**. Three methods for setting transfer prices are a **market-based** transfer price; a **negotiated** transfer price; and a **cost-based** transfer price.

Three Common Costing Systems:

	Actual Costing System	**Normal Costing System**	**Standard Costing System**
Direct Costs:	(**Actual** prices or rates x **actual** quantity of inputs per output) x **actual** outputs	(**Actual** prices or rates x **actual** quantity of inputs per output) x **actual** outputs	(**Budgeted** prices or rates x **standard inputs allowed** for each output) x **actual** outputs
Overhead Costs:	**Actual** overhead rates x **actual** quantity of the allocation base incurred.	**Budgeted** overhead rates x **actual** quantity of the allocation base incurred.	**Budgeted** overhead rates x (**standard inputs allowed** for actual outputs achieved)

Glossary:

Absorption costing: A calculation of product costs that includes all manufacturing costs: labor, materials, variable overhead and fixed overhead. Absorption costing is required under GAAP. Alternatives are variable costing and throughput costing.

Accounting rate of return (ARR): A capital budgeting performance measure that divides the average income from the project by the average book investment in the project, where these averages are over the life of the project.

Activity-based costing (ABC): A costing system characterized by the use of multiple overhead pools, each with its own allocation base, and by the choice of cost drivers for the allocation bases.

Actual costing system: A costing system that determines costs by using actual prices and quantities of inputs. The term is used to distinguish actual costing from costing systems that rely on budgeted numbers, such as a normal costing system or a standard costing system. The implicit assumption throughout financial accounting is that the accounting information reported is not materially different from what would be reported under an actual costing system.

Asset turnover ratio: A divisional or company-wide performance measure. At the divisional level, it is calculated as divisional revenues divided by divisional investment.

Balanced scorecard: A performance measurement tool and performance management system that includes nonfinancial measures as well as traditional financial measures.

Basic profit equation: The statement that:

$$\text{profits} = (\text{sales price} - \text{variable cost}) \text{ x units sold} - \text{fixed costs}.$$

This equation forms the basis for cost-volume-profit analysis. The term (but not the formula) is specific to this book.

Batch-level costs: Costs for which the number of batches run is a key cost driver. These costs change in a more-or-less linear fashion with the number of batches run. Batch-level costs are a typical part of the cost hierarchy in a batch manufacturing environment.

Bilateral tax treaties: An agreement between two nations that determines how each nation will tax multinational companies that conduct business in both countries.

Book rate of return: Synonymous with accounting rate of return.

Breakeven analysis: Cost-volume-profit analysis under the assumption of zero profits. Usually, it is the determination of the volume of unit sales required to earn zero profits

Budget: A plan for the future, expressed in quantitative terms.

Committed costs: Costs that will occur in the future, and that cannot be avoided.

Common costs: Cost of resources that benefit multiple parts of the organization. The term also refers to costs incurred up to the split-off point, in a joint product manufacturing process.

Contribution margin: Sales minus variable costs. The contribution margin can be calculated either for an individual unit (in which case it is sometimes called the unit contribution margin) or for all sales activity for a given period. See also the following entry.

Contribution margin income statement: An income statement that subtracts variable costs (variable cost-of-goods-sold plus variable period costs) to derive contribution margin, and then subtracts fixed costs to derive operating income. An alternative income statement format is a gross margin income statement.

Conversion costs: All manufacturing costs other than direct materials.

Cost: Resources sacrificed to achieve a specific objective.

Cost accounting: This term is sometimes used synonymously with management accounting, and sometimes used to refer to the accounting system and methods used to determine and track the cost of inventory in manufacturing and merchandising firms.

Cost allocation: The assignment of overhead costs to the cost object. The term also refers to the assignment of common costs to joint products, and the assignment of service department costs to user departments.

Cost allocation base: A quantitative characteristic shared by multiple cost objects that is used to allocate overhead costs among the cost objects. A cost allocation base can be a financial measure or a nonfinancial measure. Common cost allocation bases in a manufacturing setting are direct labor hours, machine hours, and direct labor dollars.

Cost center: A responsibility center of the organization that is held responsible for the costs that it incurs, but not for revenues or capital investments. A factory is a likely cost center, as is the human resources department.

Cost driver: A cost driver is an economic concept. It is something that increases costs: if the organization incurs more of the driver, the organization incurs more costs. Most cost objects have multiple cost drivers. Typical cost drivers for the production of blue jeans include the price of fabric, sewing operator time, and electric rates.

Cost hierarchy: A grouping of costs according to functional or operational levels within the organization that serve as key cost drivers. In a manufacturing environment, the hierarchy often consists of the overall facility, then products made in that facility, then batches of product, and then individual units.

Cost object: Anything that management of the organization wants to know the cost of. For manufacturing firms, typical cost objects are products and facilities. For service sector companies, typical cost objects are the delivery of services to specific clients.

Cost pool: A grouping of overhead cost items for the purpose of allocating those costs to cost objects. Often, an attempt is made to ensure that the costs in each cost pool are homogenous.

Cost-plus contract: A sales contract in which the sales price is a function of the cost of making the product or providing the customer the service.

Depreciation tax shield: The reduction in tax expense in any given year due to the reduction in income that arises from the recognition of depreciation expense on capital assets.

Differential costs: Synonymous with relevant costs.

Direct cost: Costs that can be traced to the cost object in an economically feasible way. Direct costs are distinguished from overhead costs.

Direct costing: Synonymous with variable costing. The term is seldom used anymore.

Direct method: A method of allocating service department costs to user departments that, for simplicity, ignores services provided by service departments to other service departments.

Discount rate: A finance term that represents a measure of the time value of money.

Downstream division: The buying division in a transfer pricing scenario.

Downward demand spiral: The decline in sales that occurs when sales prices are raised to cover the higher fixed-cost-per-unit that occurs from either an increase in fixed overhead or an earlier decline in sales. The process repeats itself, as the subsequent decline in sales may prompt another price increase.

Efficiency variance: The difference between actual costs and budgeted costs that is due solely to the difference between the quantity of inputs actually used for the output achieved, and the quantity of inputs that should have been used for the output achieved.

Equivalent units: A concept used to facilitate the valuation of work-in-process by costing partially finished units as a percentage of the cost of finished units, where the percentage is determined by the stage of completion of the units in WIP. An equivalent unit represents the resources necessary to complete one unit, even though those resources might have been incurred to bring two units halfway to completion, or four units one-quarter of the way to completion, etc.

Expenses: Costs charged against revenue in a particular accounting period.

Facility-level costs: Costs that are fixed with respect to the facility, and are not associated with a particular product or production line in the facility. Facility-level costs are typically identified as part of the cost hierarchy.

FIFO (First-in, First-out): An inventory flow assumption that the first units made are the first units sold (i.e., the oldest units in inventory are the units sold). Alternative inventory flow assumptions are LIFO and the weighted average method.

Financial accounting: Accounting information and financial reports prepared for users external to the organization, such as investors, creditors, regulators and stock analysts. Financial accounting is distinguished from management accounting.

Fixed cost: A cost that is not expected to change, in total, due to changes in the level of activity (e.g., production or sales) within the relevant range.

Flexible budget: A "budget" prepared *after the end of the period* that multiplies the originally-budgeted cost (or revenue) per unit by the actual units made (or sold). A flexible budget answers the question: what would I have budgeted, if I had known how many units I would have made or sold.

Flexible budget variance: A performance measurement tool that compares actual costs (revenues or profits) to the costs (revenues or profits) in the flexible budget.

Full costing: In this textbook, full costing is synonymous with absorption costing. More generally, full costing can also refer to the inclusion of nonmanufacturing as well as manufacturing costs in the determination of product costs.

Generally Accepted Accounting Principles (GAAP): Financial accounting and reporting standards promulgated by a regulatory or self-regulatory body that are mandatory for external reporting purposes for companies that meet certain criteria. GAAP for U.S. public companies is promulgated by the Financial Accounting Standards Board, with oversight from the SEC.

Goal congruence: The alignment of the incentives of managers with the incentives of shareholders. More generally, the term refers to aligning incentives of any two parties in a principal-agent relationship, which includes any setting in which authority and responsibility have been delegated.

Gross margin income statement: An income statement that subtracts cost-of-goods-sold from revenue to derive gross margin, and then subtracts period costs to derive operating income. Virtually all income statements prepared for financial accounting purposes are gross margin income statements. An alternative income statement format is a contribution margin income statement.

Hurdle rate: A targeted rate of return set by senior management to communicate to managers in the company the criterion by which to accept or reject a capital project proposal.

Idle capacity variance: A term used synonymously with the volume variance when capacity is the denominator-level concept in the fixed overhead rate.

Indirect costs: Synonymous with overhead costs.

Institute of Management Accountants (IMA): The most important professional association of management accountants in the United States. The IMA is headquartered in Montvale, NJ, and has local chapters throughout the U.S.

Intermediate product: A product made by one part of a company and used by another part of the same company in its production process. Transfer prices are often used to "price" internal sales of intermediate products.

Internal rate of return (IRR): A capital budgeting performance measure that represents the discount rate required to achieve a net present value of zero for the project.

Inventoriable costs: Costs that are debited to inventory for either external or internal reporting purposes. For manufacturing firms, inventoriable costs are either the complete set, or a subset of manufacturing costs.

Investment center: A responsibility center of the organization that is held responsible for revenues, costs and capital investments. Investment centers are highly-autonomous units of the organization, with substantial decision-making authority. A division is a likely investment center.

Investment turnover ratio: Synonymous with asset turnover ratio.

Joint costs: Synonymous with common costs in the context of joint products.

Just-in-time (JIT): A manufacturing practice characterized by maintaining inventories at their lowest possible levels.

Lean: ***Lean production*** and ***lean manufacturing*** are umbrella terms that describe a company's comprehensive effort to improve productivity, efficiency and customer satisfaction, and reduce waste and production lead times, through techniques such as **just-in-time** and **total quality management**. More recently, the term "lean" has been applied to similar initiatives that occur outside of the manufacturing setting (e.g., in the support functions of manufacturing companies or in service-sector companies). The term

lean accounting describes an accounting system designed to support an organization's lean initiative, or to describe an accounting system that itself is "lean."

LIFO (Last-in, First-out): An inventory flow assumption that the last units made are the first units sold. Alternative inventory flow assumptions are FIFO and the weighted average method.

Management accounting: Accounting information prepared for individuals in the organization, particularly managers, to assist them in planning, performance evaluation, and control. Management accounting is distinguished from financial accounting.

Managerial accounting: See management accounting.

Master budget: A comprehensive set of budgets for a given period that usually consists of a pro forma income statement and balance sheet and supporting schedules such as a cash budget and production budget.

Misapplied overhead: The difference between actual overhead incurred in a given period and overhead applied to cost objects during that period.

Mixed cost: A cost that is neither variable (in a linear fashion) nor fixed within the relevant range. Often, mixed costs are comprised of a variable component and a fixed component.

National Association of Accountants (NAA): The former name of the Institute of Management Accountants (IMA).

Negative externality: Costs imposed by companies on the public or specific third parties that do not arise from a contractual relationship. A classic example of a negative externality is pollution generated by a factory.

Net present value: A capital budgeting performance measure that discounts all future cash inflows and outflows associated with the capital project to the present, and then sums the present values of all inflows and outflows associated with the project.

Normal capacity: the level of facility activity that satisfies average customer demand over an intermediate period of time. It frequently averages over seasonal or cyclical fluctuations in demand.

Normal costing system: A costing system that tracks costs by using actual direct costs of the cost object, and applying overhead using a budgeted overhead rate and actual quantities of the allocation base incurred. The only difference between an actual costing system and a normal costing system is the use of budgeted overhead rates.

Operating profit percentage: Synonymous with return on sales (ROS).

Opportunity cost: The profit foregone by selecting one alternative over another.

Overhead costs: Costs that are associated with the cost object, but cannot be traced to the cost object in an economically feasible way. Overhead costs are distinguished from direct costs.

Overhead rate: The ratio of overhead costs to the total quantity of the cost allocation base. This ratio is used to allocate overhead costs to cost objects.

Payback period: A capital budgeting performance measure that estimates the period of time required to recoup the initial investment in the asset.

Period costs: Costs that are expensed when incurred (subject to the principles of accrual accounting), because they cannot be associated with the manufacture of products.

Practical capacity: A measure of factory capacity (or other types of facility output) that allows for anticipated unavoidable operating interruptions and maintenance.

Price variance: In the context of variable costs, the price variance is the difference between actual costs and budgeted costs that is due solely to the difference between the actual price per unit of input and the budgeted price per unit of input. In the context of fixed overhead, the price variance is synonymous with the spending variance.

Prime costs: Synonymous with direct costs.

Product costs: Any cost that is associated with units of product for a particular purpose.

Production volume variance: See volume variance.

Product-level costs: Costs that are direct and fixed with respect to a particular product. Product-level costs are a typical part of the cost hierarchy.

Profit center: A responsibility center of the organization that is held responsible for the revenues and costs that it incurs, but not for capital investments. A product line is a likely profit center.

Pro forma financial statements: Financial statements projected for a future period based on budgeted or hypothetical levels of activity.

Quantity variance: The efficiency variance for direct materials. This variance is also called the usage variance.

Reciprocal method: A method of allocating service department costs to user departments that solves a set of simultaneous equations in order to fully account for services provided by service departments to other service departments.

Relevant costs: Costs that are relevant with respect to a particular decision. A relevant cost for a particular decision is one that changes if an alternative course of action is taken.

Relevant range: The range of activity (e.g., production or sales) over which fixed costs are fixed and variable costs are variable. In other words, a fixed cost is called fixed if it behaves as a fixed cost within the relevant range, even if it behaves as a semi-variable cost over a wider range of activity than specified by the relevant range. Similarly, a variable cost is called variable if it is linear in output over the relevant range, even if linearity no longer holds outside of the relevant range.

Residual income: A divisional or company-wide performance measure that subtracts a charge for the cost of capital from after-tax operating income. Residual income represents an attempt to use accounting information to approximate economic profits.

Responsibility center: A department, division, or any area of activity that is tracked separately by the accounting system, and that is under the control of a manager who is responsible for the performance of the center.

Return of investment (ROI): A divisional or company-wide performance measure. At the divisional level, it is calculated as divisional income divided by divisional investment.

Return on assets (ROA): A company-wide performance measure that is calculated as income divided by total assets. When applied to a division within a company, the same calculation is sometimes called return on investment (ROI).

Return on equity (ROE): A company-wide performance measure that is calculated as income divided by equity.

Return on sales (ROS): A divisional or company-wide performance measure. It is calculated as income divided by revenue.

Semi-variable costs: Synonymous with mixed costs.

Separable costs: Costs incurred by joint products after the split-off point.

Sequential method: Synonymous with the step-down method.

Spending variance: With respect to variable overhead, the spending variance is analogous to the price variance for variable direct costs. With respect to fixed overhead, the spending variance is the difference between actual fixed costs and budgeted fixed costs.

Split-off point: The point in a joint manufacturing process at which joint products take on separate identities. Costs incurred prior to this point are common costs. Costs incurred on joint products after the split-off point are separable costs.

Standard cost: A budgeted cost, usually stated on a per-unit basis, and usually based on a rigorous determination of the quantities of inputs required to produce the output, and the prices of those inputs.

Standard costing system: A costing system that tracks product costs using standard costs during the period, and makes appropriate adjustments for the differences between actual costs and standard costs at the end of the period. Most manufacturing firms use standard costing systems.

Standard quantity: Budgeted inputs to produce one unit of output. Alternatively, the budgeted inputs to produce any specified level of output, particularly the level of output actually achieved during the period.

Static budget: A budget that is based on projected levels of activity, prior to the start of the period. It is the “original” budget for the period, not updated as information about the period becomes known.

Static budget variance: The difference between actual revenues or costs for a period, and revenues or costs as originally budgeted for the period and as reported in the static budget.

Step-down method: A method of allocating service department costs to user departments that accounts for some of the services provided by service departments to other service departments. Service department costs are allocated one at a time, and each service department’s costs are allocated to user departments and to any service departments the costs of which have not yet been allocated.

Sunk cost: Costs that were incurred in the past.

Super-variable costing: Synonymous with throughput costing.

Target costing: The determination of the per-unit variable cost necessary to achieve desired profits, followed by efforts by those responsible for product design and manufacturing to achieve the desired per-unit cost.

Theoretical capacity: A measure of factory capacity (or other types of facility output) that assumes 100% efficiency all of the time. It is a performance benchmark, but generally not an attainable standard.

Theory of constraints: A relatively new operations management tool that increases production throughput and decreases inventory levels by identifying bottleneck operations and increasing throughput at those operations.

Throughput costing: A calculation of product costs that includes only direct materials. All conversion costs are treated as period expenses. More traditional alternatives are absorption costing and variable costing.

Throughout margin: An income statement subtotal that arises when throughput costing is used (see previous entry). The subtotal is revenues minus cost-of-goods-sold, where cost-of-goods-sold consists of only direct materials associated with units sold.

Total quality management (TQM): The practice of eliminating defects in raw materials and the production process. More generally, the practice of eliminating defects in all aspects of the organization's value chain. TQM is synonymous with zero defect programs.

Transfer price: The amount that one part of a company charges another part of the same company for goods or services. Often, the term is used in connection with intermediate products that are manufactured by one division, and used by another division in its manufacturing process.

Triple-bottom-line: An external reporting method and format that reports the firm's performance separately along each of three dimensions: financial, environmental and social.

Unit contribution margin: The per-unit sales price minus per-unit variable costs.

Unit-level costs: Costs for which the number of units produced is a key cost driver. These costs change in a more-or-less linear fashion with the number of units produced. Unit-level costs are a typical part of the cost hierarchy in a manufacturing environment.

Upstream division: The selling division in a transfer pricing scenario.

Usage variance: The efficiency variance for direct materials. This variance is also called the quantity variance.

Value chain: The sequence of activities that creates value in an organization.

Variable cost: A cost that varies in a linear fashion with the level of activity (e.g., production or sales) within the relevant range.

Variable costing: A calculation of product costs that includes all direct manufacturing costs and variable manufacturing overhead, but not fixed manufacturing overhead. Under variable costing, fixed manufacturing overhead is treated as a period cost. Alternatives are absorption costing and throughput costing.

Volume variance: In this book, this term refers only to the fixed overhead volume variance. This variance is the difference between budgeted fixed overhead and the amount of fixed overhead allocated to production using a standard costing system. As such, it is a function of actual production volume relative to the denominator used in the fixed overhead rate. Beyond this book, the term volume variance sometimes refers to the sales volume variance, which is the difference between budgeted revenue and actual revenue that is due solely to sales volume differing from budgeted volume.

Wage rate variance: The price variance in the context of direct labor costs. It is the difference between actual costs and budgeted costs that is due solely to the difference between the actual average wage rate and the budgeted average wage rate.