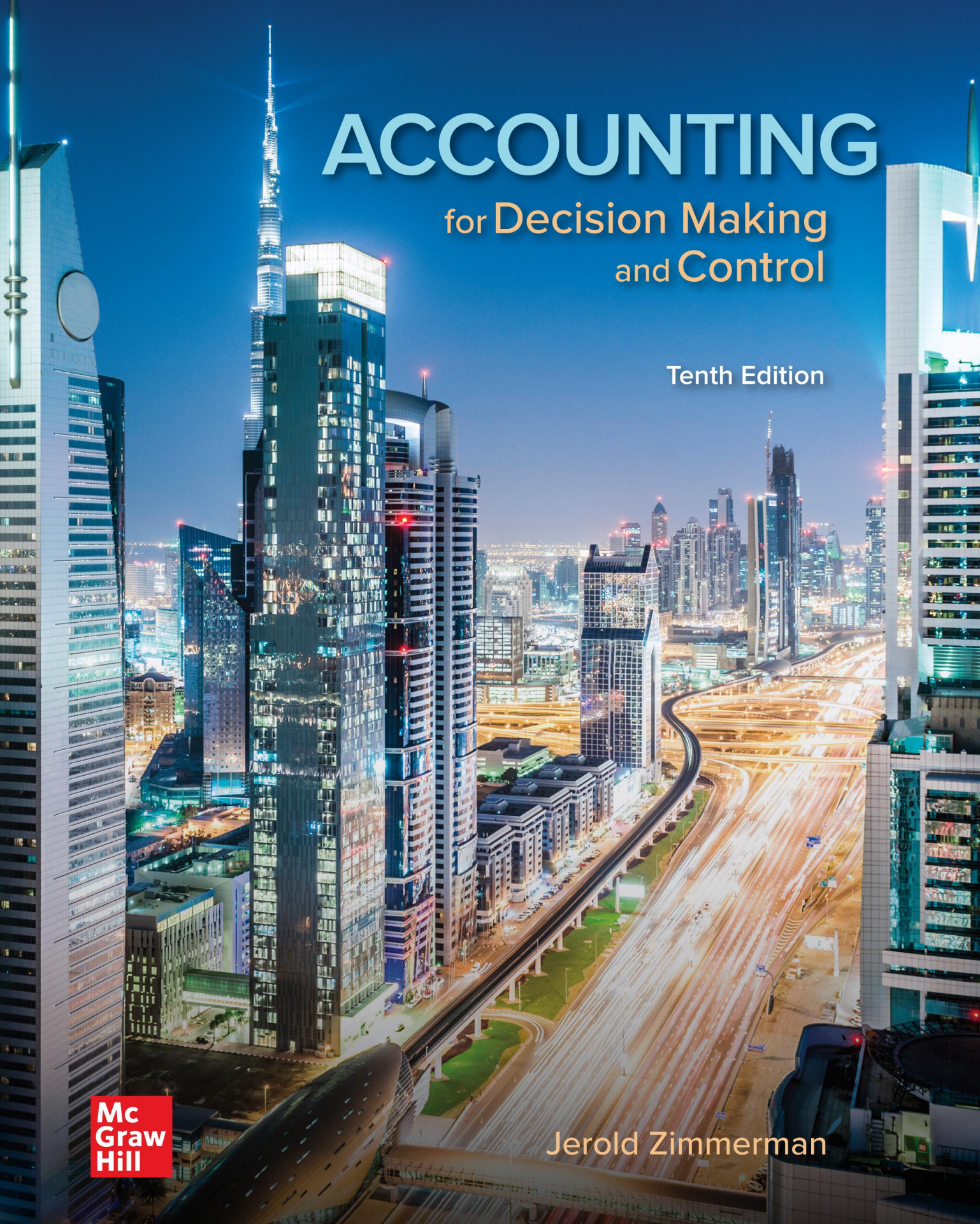
ACCOUNTING
for Decision Making
and Control
Tenth Edition
Jerold Zimmerman
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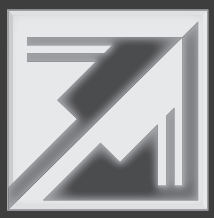
Tenth Edition



Accounting for Decision Making and Control

Jerold L. Zimmerman
University of Rochester

Mc Graw Hill Education

ACCOUNTING FOR DECISION MAKING AND CONTROL, TENTH EDITION

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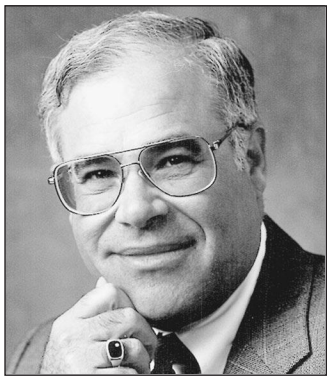
About the Author



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Jerold L. Zimmerman

Jerold Zimmerman is Professor Emeritus at the Simon Business School, University of Rochester. He holds an undergraduate degree from the University of Colorado, Boulder, and a doctorate from the University of California, Berkeley.

While at Rochester, Dr. Zimmerman taught a variety of courses spanning accounting, finance, and economics. Accounting courses include nonprofit accounting, intermediate accounting, accounting theory, and managerial accounting. A deeper appreciation of the challenges of managing complex organizations was acquired while serving as the Simon School's Deputy Dean and on the board of directors of several public corporations.

Professor Zimmerman publishes widely in accounting on topics as diverse as cost allocations, corporate governance, disclosure, financial accounting theory, capital markets, and executive compensation. His paper "The Costs and Benefits of Cost Allocations" won the American Accounting Association's Competitive Manuscript Contest. He is recognized for developing Positive Accounting Theory. This work, co-authored with colleague Ross Watts at the Massachusetts Institute of Technology, received the American Institute of Certified Public Accountants' Notable Contribution to the Accounting Literature Award for "Towards a Positive Theory of the Determination of Accounting Standards" and "The Demand for and Supply of Accounting Theories: The Market for Excuses." Both papers appeared in the *Accounting Review*. Professors Watts and Zimmerman are also co-authors of the highly cited textbook *Positive Accounting Theory* (Prentice Hall, 1986). Professors Watts and Zimmerman received the 2004 American Accounting Association Seminal Contribution to the Literature award. Professor Zimmerman's textbooks also include *Managerial Economics and Organizational Architecture* with Clifford Smith and James Brickley, 6th ed. (McGraw-Hill, 2016) and *Management Accounting in a Dynamic Environment* with Cheryl McWatters (Routledge UK, 2016). He is a founding editor of the *Journal of Accounting and Economics,* published by Elsevier. This scientific journal is one of the most highly referenced accounting publications. In 2016, Professor Zimmerman received the American Accounting Association Outstanding Accounting Educator Award, in part for this this textbook's contribution to accounting education.

He and his wife Dodie have two daughters, Daneille and Amy. Jerry has been known to occasionally engage friends and colleagues in an amicable diversion on the links.

Preface

During their professional careers, managers in all organizations, profit and nonprofit, rely on their accounting systems. Sometimes managers use the accounting system to acquire information for decision making. At other times, the accounting system measures their performance and thereby influences the managers' behavior. The accounting system is both a source of information for decision making and part of the organization's control mechanisms—thus, the title of the book, *Accounting for Decision Making and Control.*

The purpose of this book is to provide students and managers with an understanding and appreciation of the strengths and limitations of an organization's accounting system, thereby allowing them to be more intelligent users of these systems. This book provides a framework for understanding accounting systems and a basis for analyzing proposed changes to these systems. The text demonstrates that managerial accounting is an integral part of the firm's organizational architecture, not just an isolated set of computational topics.

Changes in the Tenth Edition

Feedback from reviewers and instructors using the prior editions and my own teaching experience provided the basis for the revision. In particular, the following changes have been made:

- Each chapter in the tenth edition was heavily edited with an eye to make it more concise, remove redundancy, and enhance readability while presenting the same fundamental concepts, learning objectives, and challenging critical thinking end-of-chapter materials as in prior editions.
- References to actual company practices have been updated.
- Users were uniform in their praise of the problem material. They found it challenged their students to critically analyze multidimensional issues while still requiring numerical problem-solving skills.
- The end-of-chapter problem material was revised by updating problems with the new tax rates stated in the 2018 U.S. Tax Cuts and Jobs Act.
- Each chapter and all end-of-chapter problems were revised in light of the 2018 tax reform (Tax Cuts and Jobs Act).
- Outdated and obsolete problems were deleted.
- Discussions of how data analytics and Big Data are changing managerial accounting were added.

Overview of Content

Chapter 1 describes the book's conceptual framework and illustrates the framework using a simple decision context regarding accepting an incremental order from a current customer. The chapter describes why firms use a single accounting system and the concept of economic Darwinism, among other important topics. This chapter is an integral part of the text.

Chapters 2, 4, and 5 present the underlying conceptual framework. The importance of opportunity costs in decision making, cost–volume–profit analysis, and the difference between accounting costs and opportunity costs are discussed in Chapter 2. Chapter 4 employs the economic theory of organizations as the conceptual foundation to understand the role of the accounting system as part of the organization's control mechanism. Chapter 5 describes the crucial role of accounting as part of the firm's organizational architecture. Chapter 3 on capital budgeting extends opportunity costs to a multiperiod setting. This chapter can be skipped without affecting the flow of later material. Alternatively, Chapter 3 can be assigned at the end of the course.

Using budgeting, Chapter 6 applies the conceptual framework and illustrates the trade-off managers face between decision making and control. Budgets are a decision-making tool to coordinate activities within the firm and a device to control behavior. This chapter provides an in-depth illustration of how budgets are an important part of an organization's decision-making and control apparatus.

Chapter 7 presents a general analysis of why managers allocate certain costs and the behavioral implications of these allocations. Cost allocations affect both decision making and incentives. Again, managers face a trade-off between decision making and control. Chapter 8 continues the cost allocation discussion by describing the "death spiral" that can occur when significant fixed costs exist and excess capacity arises. This leads to an analysis of how to treat capacity costs—a trade-off between underutilization and overinvestment. Finally, the chapter describes several specific cost allocation methods such as service department costs and joint costs.

Chapter 9 applies the general analysis of overhead allocation described in Chapters 7 and 8 to the specific case of absorption costing in a manufacturing setting. Chapters 10 and 11describe the managerial implications of traditional absorption costing. Chapter 10 analyzes variable costing, and activity-based costing is the topic of Chapter 11. Variable costing is an interesting example of economic Darwinism. Proponents of variable costing argue that it does not distort decision making and therefore should be adopted. Nonetheless, variable costing is not widely practiced, probably because of tax, financial reporting, and control considerations.

Chapter 12 discusses the decision-making and control implications of standard labor and material costs. Chapter 13 extends the discussion to overhead and marketing variances. Chapters 12 and 13 can be omitted without interrupting the flow of later material. Finally, Chapter 14 synthesizes the course by reviewing the conceptual framework and applying it to various organizational innovations, such as six sigma/total quality management, lean production/just in time, and the balanced scorecard. These innovations provide an opportunity to apply the analytic framework underlying the text.

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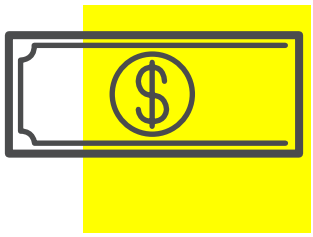

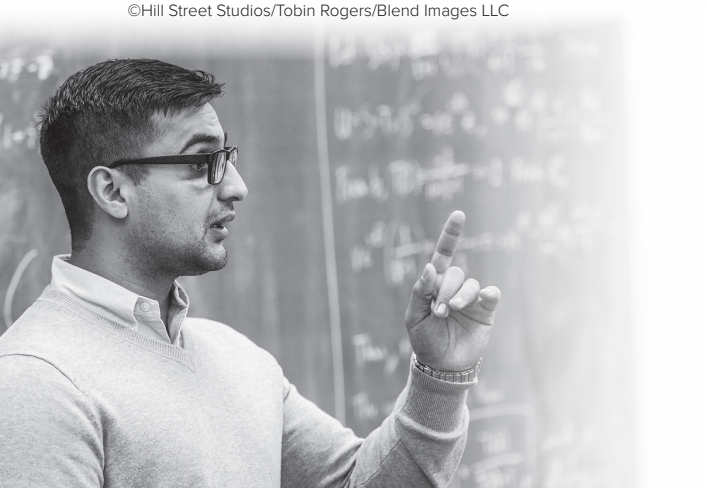

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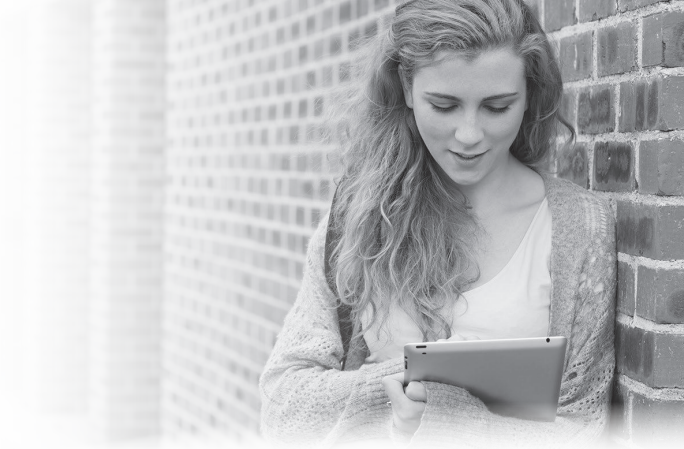

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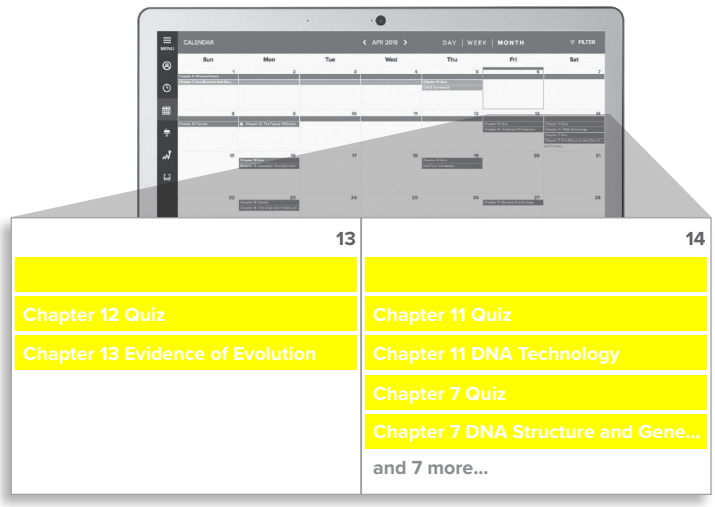

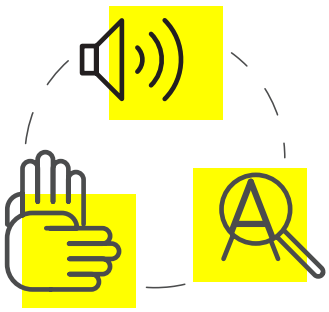

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To the numerous students who endured the development process, I owe an enormous debt of gratitude. I hope they learned as much from the material as I learned teaching them. Some were even kind enough to provide critiques and suggestions—in particular, Jan Dick Eijkelboom. Others supplied, either directly or indirectly, the problem material in the text. The able research assistance of P. K. Madappa, Eamon Molloy, Jodi Parker, Steve Sanders, Richard Sloan, and especially Gary Hurst contributed amply to the manuscript and problem material. Janice Willett and Barbara Schnathorst did a superb job of editing the manuscript and problem material.

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To my wife, Dodie, and daughters, Daneille and Amy, thank you for setting the right priorities and for giving me the encouragement and environment to be productive. Finally, I wish to thank my parents for all their support.

Jerold L. Zimmerman
University of Rochester

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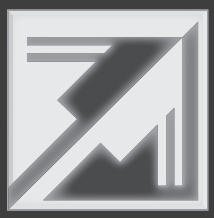

Introduction

Chapter Outline

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A. Managerial Accounting: Decision Making and Control

Managers at Hyundai must decide which car models to produce, the quantity of each model to produce given the selling prices for the models, and how to manufacture the automobiles. They must decide which car parts, such as headlight assemblies, Hyundai should manufacture internally and which parts should be outsourced. They must decide not only on advertising, distribution, and product positioning to sell the cars, but also the quantity and quality of the various inputs. For example, they must determine which models will have leather seats and the quality of the leather to be used. Similarly, in deciding which investment projects to accept, capital budgeting analysts require data on future cash flows. How are these numbers derived? How does one coordinate the activities of hundreds or thousands of employees in the firm so that these employees accept senior management's leadership? At Hyundai, and at other organizations small and large, managers must have good information to make all these decisions.

Information about firms' future costs and revenues must be estimated by managers. Organizations' internal information systems provide some of the knowledge for these pricing, production, capital budgeting, and marketing decisions. These systems range from the informal and the rudimentary to very sophisticated, electronic management information systems. The term **information system** should not be interpreted to mean a single, integrated system. Most information systems consist not only of formal, organized, tangible records such as payroll and purchasing documents, but also informal, intangible bits of data such as memos, special studies, and managers' impressions and opinions. The firm's information system also contains nonfinancial information such as customer and employee satisfaction surveys. As firms grow from single proprietorships to large global corporations with tens of thousands of employees, managers lose the knowledge of enterprise affairs gained from personal, face-to-face contact in daily operations. Higher-level managers of larger firms come to rely more and more on formal operating reports.

The **internal accounting system**, an important component of a firm's information system, includes budgets, data on the costs of each product and current inventory, and periodic financial reports. In many cases, especially in small companies, these accounting reports are the only formalized part of the information system providing the knowledge for decision making. Many larger companies have other formalized, nonaccounting–based information systems, such as production planning systems. This book focuses on how internal accounting systems provide knowledge for decision making.

After making decisions, managers must implement them in organizations in which the interests of the employees and the owners do not necessarily coincide. Just because senior managers announce a decision does not ensure that the decision will be implemented.

Organizations do not have objectives; people do. One common objective of owners of the organization is to maximize profits, or the difference between revenues and expenses. Maximizing firm value is equivalent to maximizing the stream of profits over the organization's life. Employees, suppliers, and customers also have their own objectives—usually maximizing their self-interest.

Not all owners care only about monetary flows. An owner of a professional sports team might care more about winning (subject to covering costs) than maximizing profits. Nonprofits do not have owners with the legal rights to the organization's profits. Moreover, nonprofits seek to maximize their value by serving some social goal such as education or health care.

No matter what the firm's objective, the organization will survive only if its inflow of resources (such as revenue) is at least as large as the outflow. Accounting information is useful to help manage the inflow and outflow of resources and to help align the owners' and employees' interests, no matter what objectives the owners wish to pursue.

Throughout this book, we assume that individuals maximize their self-interest. The owners of the firm usually want to maximize profits, but managers and employees will do so only if it is in their interest. Hence, a conflict of interest exists between owners—who, in general, want higher profits—and employees—who want easier jobs, higher wages, and more fringe benefits. To control this conflict, senior managers and owners design systems to monitor employees' behavior and incentive schemes that reward employees for generating more profits. Not-for-profit organizations face similar conflicts. Those people responsible for the nonprofit organization (boards of trustees and government officials) must design incentive schemes to motivate their employees to operate the organization efficiently.

All successful firms must devise mechanisms that help align employee interests with maximizing the organization's value. All of these mechanisms constitute the firm's **control system**; they include performance measures and incentive compensation systems, promotions, demotions and terminations, security guards and video surveillance, internal auditors, and the firm's internal accounting system.

As part of the firm's control system, the internal accounting system helps align the interests of managers and shareholders to cause employees to maximize firm value. It sounds like a relatively easy task to design systems to ensure that employees maximize firm value. But a significant portion of this book demonstrates the exceedingly complex nature of aligning employee interests with those of the owners.

Internal accounting systems serve two purposes: (1) to provide some of the knowledge necessary for planning and making decisions (*decision making*) and (2) to help motivate and monitor people in organizations (*control*). Preventing fraud and embezzlement is the most basic control use of accounting. Maintaining inventory records helps reduce employee theft. Accounting budgets, discussed more fully in Chapter 6, provide an example of both decision making and control. Asking each salesperson in the firm to forecast his or her sales for the upcoming year generates useful information for planning next year's production (decision making). However, if the salesperson's sales forecast is used to benchmark performance for compensation purposes (control), he or she has incentives to underestimate those forecasts.

Using internal accounting systems for both decision making and control gives rise to the fundamental trade-off in these systems: A system cannot be designed to perform two tasks as well as a system that must perform only one task. Some ability to deliver knowledge for decision making is sacrificed to provide better motivation (control). The trade-off between providing knowledge for decision making and motivation/control arises continually throughout this text.

This book is applications oriented: It describes how the accounting system assembles knowledge necessary for implementing decisions using the theories from microeconomics, finance, operations management, and marketing. It also shows how the accounting system helps motivate employees to implement these decisions. Moreover, it stresses the continual trade-offs that must be made between the decision making and control functions of accounting.

Chief financial officers (CFOs), responsible for their company's accounting system, identify "managing costs and profitability" as their most important goal. Other top priorities include setting budgets and measuring performance. These findings indicate that firms use their internal accounting system both for decision making (managing costs and profitability) and for controlling behavior (setting budgets and measuring performance).[1]

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[1]S. White, "How CFOs Can Support the Transformation to a Digital Business Model," *Financial Management,* November 4, 2015, https://www.fm-magazine.com/news/2015/nov/how-cfos-can-support-digital-business-model-201513323.html.

The firm's accounting system provides much of the fabric that helps hold the organization together. It contains knowledge for decision making, and it provides information for evaluating and motivating the behavior of individuals within the firm. Being such an integral part of the organization, the accounting system cannot be studied in isolation from the other mechanisms used for decision making or for aligning incentives. A firm's internal accounting system should be examined from a broad perspective, as part of the larger organization design question facing managers.

This book uses an economic perspective to study how accounting can motivate and control behavior in organizations. Besides economics, a variety of other paradigms also are used to investigate organizations: scientific management (Taylor), the bureaucratic school (Weber), the human relations approach (Mayo), human resource theory (Maslow, Rickert, Argyris), the decision-making school (Simon), and the political science school (Selznick). Behavior is a complex topic. No single theory or approach is likely to capture all the elements. However, understanding managerial accounting requires addressing the behavioral and organizational issues. Economics offers one useful and widely adopted framework.

B. Design and Use of Cost Systems

Managers make decisions and monitor subordinates who make decisions. Both managers and accountants must acquire sufficient familiarity with cost systems to perform their jobs. Accountants (often called *controllers*) are charged with designing, improving, and operating the firm's accounting system—an integral part of both the decision-making and performance evaluation systems. Both managers and accountants must understand the strengths and weaknesses of current accounting systems. Internal accounting systems, like all systems within the firm, are constantly being refined and modified. Accountants' responsibilities include making these changes.

Internal accounting systems:

1. Provide information to assess the profitability of products or services and to optimally price and market these products or services.
2. Provide information to detect production inefficiencies to ensure that the proposed products and volumes are produced at minimum cost.
3. When combined with the performance evaluation and reward systems, create incentives for managers to maximize firm value.
4. Support the financial accounting and tax accounting reporting functions.
5. Contribute more to firm value than it costs.

Figure 1–1 portrays the functions of the accounting system. In it, the accounting system supports both external and internal reporting systems. Examine the top half of Figure 1–1. The accounting procedures chosen for external reports to shareholders and taxing authorities are dictated in part by regulators. In the United States, the **Securities and Exchange Commission (SEC)** and the **Financial Accounting Standards Board (FASB)** regulate the financial statements issued to shareholders. The **Internal Revenue Service (IRS)** administers the accounting procedures used in calculating corporate income taxes. If the firm is involved in international trade, foreign tax authorities prescribe the accounting rules applied in calculating foreign taxes. Regulatory agencies constrain public utilities' and financial institutions' accounting procedures.

Management compensation plans and debt contracts often rely on external reports. Senior managers' bonuses are often based on accounting net income. Likewise, if the firm issues long-term bonds, it agrees in the debt covenants not to violate specified

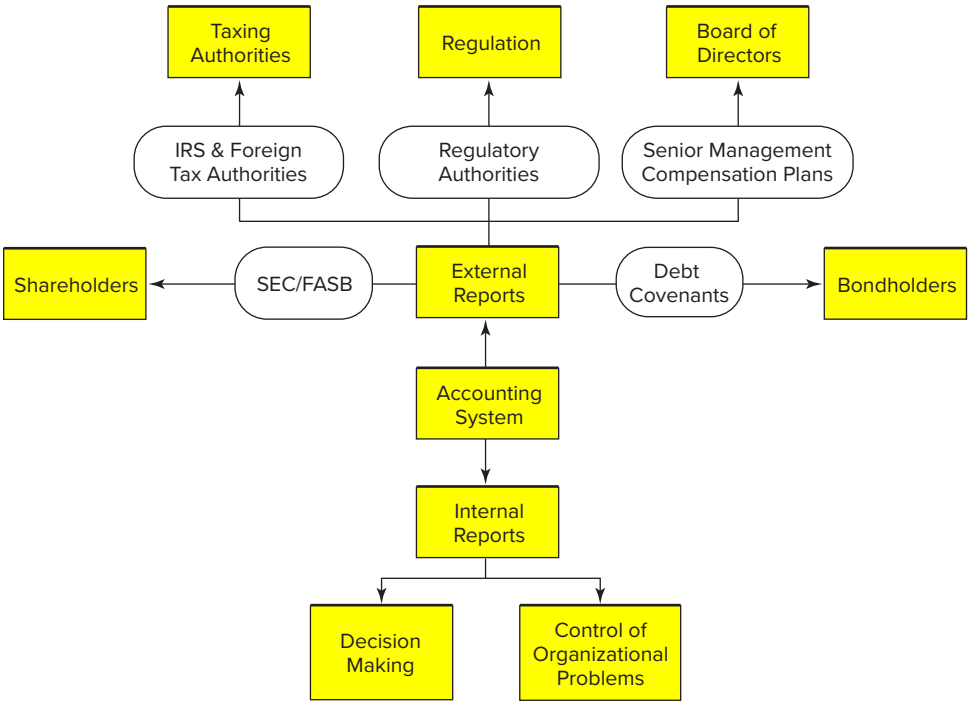


FIGURE 1–1
The multiple role of accounting systems

accounting-based constraints. For example, the bond contract might specify that the debt-to-equity ratio will not exceed some limit. Like taxes and regulation, compensation plans and debt covenants create incentives for managers to choose particular accounting procedures.[2]

As companies expand into international markets, external users of the firm's financial statements become global. No longer are the firm's shareholders, tax authorities, and regulators domestic. Rather, the firm's internal and external reports are used internationally in a variety of ways.

The bottom of Figure 1–1 illustrates that internal reports are used for decision making as well as control of organizational problems. As discussed earlier, managers use a variety of sources of data for making decisions. The internal accounting system provides one important source. These internal reports affect the behavior of managers in the firm. The internal accounting system reports on managers' performance and therefore provides incentives for them. Any changes to the internal accounting system can affect all the various uses of the resulting accounting numbers.

The internal and external accounting reports are closely linked. The internal accounting system affords a more disaggregated view of the company. These internal reports are generated more frequently, usually monthly or even weekly or daily, whereas the external reports are provided quarterly for publicly traded U.S. companies. The internal reports offer costs and profits by specific products, customers, lines of business, and divisions of the company. For example, the internal accounting system computes the unit cost of individual products produced. These unit costs are then used to value the work-in-process and finished goods inventory, and to compute cost of goods sold. Chapter 9 describes the details of product costing.

---

[2]For further discussion of the incentives of managers to choose accounting methods, see R. Watts and J. Zimmerman, *Positive Accounting Theory* (Englewood Cliffs, NJ: Prentice Hall, 1986).

Managerial Application: Spaceship Lost Because Two Measures Used

Multiple accounting systems are confusing and can lead to errors. An extreme example of this occurred in 1999 when NASA lost its $125 million Mars spacecraft. Engineers at Lockheed Martin built the spacecraft and specified the spacecraft's thrust in English pounds. But NASA scientists, navigating the craft, assumed the information was in metric newtons. As a result, the spacecraft was off course by 60 miles as it approached Mars and crashed. Multiple systems for the same underlying construct often produce confusion and decision making errors.

SOURCE: A. Pollack, "Two Teams, Two Measures Equaled One Lost Spacecraft," *The New York Times*. October 1, 1999, p. 1.

Because internal accounting systems serve multiple users and have several purposes, the firm employs either multiple systems (one for each function) or one basic system that serves all three functions (decision making, performance evaluation, and external reporting). Firms can either maintain a single set of books and use the same accounting methods for both internal and external reports, or they can keep multiple sets of books. The decision depends on the costs of writing and maintaining contracts based on accounting numbers, the costs from the dysfunctional internal decisions made using a single system, the additional bookkeeping costs arising from the extra system, and the confusion of having to reconcile the different numbers arising from multiple accounting systems.

Inexpensive accounting software packages and falling costs of information technology reduce some of the costs of maintaining multiple accounting systems. However, confusion arises when the systems report different numbers for the same concept. For example, when one system reports the manufacturing cost of a product as $12.56 and another system reports it at $17.19, managers wonder which system is producing the "right" number. Some managers may be using the $12.56 figure while others are using $17.19, causing inconsistency and uncertainty. Whenever two numbers for the same concept are produced, the natural tendency is to explain (i.e., reconcile) the differences. Managers involved in this reconciliation could have used their time more productively. Also, using the same accounting system for multiple purposes increases the credibility of the financial reports for each purpose. With only one accounting system, the external auditor monitors the internal reporting system at little or no additional cost.

A survey of large U.S. firms found that managers typically use the same accounting procedures for both external and internal reporting. More than 80 percent of chief financial officers (CFOs) report using the same accounting methods and report the same earnings internally and externally. In other words, most firms use "one number" for both external and internal communications. One CFO stated, "We make sure that everything that we have underneath—in terms of the detailed reporting—also rolls up basically to the same

Historical Application: Different Costs for Different Purposes

". . . cost accounting has a number of functions, calling for different, if not inconsistent, information. As a result, if cost accounting sets out, determined to discover what the cost of everything is and convinced in advance that there is one figure which can be found and which will furnish exactly the information which is desired for every possible purpose, it will necessarily fail, because there is no such figure. If it finds a figure which is right for some purposes it must necessarily be wrong for others."

SOURCE: J. Clark, *Studies in the Economics of Overhead Cost* (Chicago: University of Chicago Press, 1923), p. 234.

story that we've told externally."[3] Nothing prevents firms from using separate accounting systems for internal decision making and internal performance evaluation except the confusion generated and the extra data processing costs.

Probably the most important reason firms use a single accounting system is it allows reclassification of the data. An accounting system does not present a single, bottom-line number, such as the "cost of publishing this textbook." Rather, the system reports the components of the total cost of this textbook: the costs of proofreading, typesetting, paper, binding, cover, and so on. Managers in the firm then reclassify the information on the basis of different attributes and derive different cost numbers for different decisions. For example, if the publisher is considering translating this book into Chinese, not all the components used in calculating the U.S. costs are relevant. The Chinese edition might be printed on different paper stock with a different cover. The point is, a single accounting system usually offers enough flexibility for managers to reclassify, recombine, and reorganize the data for multiple purposes.

A single internal accounting system requires the firm to make trade-offs. A system that is best for performance measurement and control is unlikely to be the best for decision making. It's like configuring a motorcycle for both off-road and on-road racing: Riders on bikes designed for both racing conditions probably lose to riders on bikes designed for just one racing surface. Wherever a single accounting system exists, additional analyses arise. Managers making decisions find the accounting system less useful and devise other systems to augment the accounting numbers for decision-making purposes.

Concept Questions

- What causes the conflict between using internal accounting systems for decision making and control?
- Describe the different kinds of information provided by the internal accounting system.
- Give three examples of the uses of an accounting system.
- List the characteristics of an internal accounting system.
- Do firms have multiple accounting systems? Why or why not?

C. Marmots and Grizzly Bears

Managers often criticize accounting's usefulness for making pricing or outsourcing decisions. Accounting data are based on historical costs rather than current values, and hence contain stale information. Why then do managers persist in using (presumably inferior) accounting information?

Before addressing this question, consider the parable of the marmots and the grizzly bears.[4] Marmots are small groundhogs that are a principal food source for certain bears. Zoologists studying the ecology of marmots and bears observed bears digging and moving rocks in the autumn in search of marmots. They estimated that the calories expended searching for marmots exceeded the calories obtained from their consumption. A zoologist

[3]SOURCE: I. D. Dichev, J. R. Graham, H. Campbell, and S. Rajgopal, S., "Earnings Quality: Evidence from the Field," *Journal of Accounting and Economics* 56, no. 2–3 (2013), pp. 1–33.

[4]This example is suggested by J. McGee, "Predatory Pricing Revisited," *Journal of Law & Economics* XXIII (October 1980), pp. 289–330.

relying on Darwin's theory of natural selection might conclude that searching for marmots is an inefficient use of the bear's limited resources and thus these bears should become extinct. But fossils of marmot bones near bear remains suggest that bears have been searching for marmots for tens of thousands of years.

Because the bears survive, the benefits of consuming marmots must exceed the costs. Bears' claws might be sharpened as a by-product of the digging involved in hunting for marmots. Sharp claws help bears searching for food under the ice after winter's hibernation. Therefore, the benefit of sharpened claws and the calories derived from the marmots offset the calories consumed gathering the marmots.

What does the marmot-and-bear parable say about why managers persist in using apparently inferior accounting data in their decision making? As it turns out, the marmot-and-bear parable is an extremely important proposition in the social sciences known as *economic Darwinism.* In a competitive world, if surviving organizations use some operating procedure (such as historical cost accounting) over long periods of time, then this procedure likely yields benefits in excess of its costs. Firms survive in competition by selling goods or services at lower prices than their competitors while still covering costs. Companies cannot survive by making more mistakes than their competitors.

Economic Darwinism suggests that successful (surviving) firms should not change internal processes unless they are clearly broken. Currently, considerable attention is being directed at revising and updating firms' internal accounting systems because many managers believe their current accounting systems are "broken" and require major overhaul. Alternative internal accounting systems are being proposed, among them **activity-based costing (ABC)**, **balanced scorecards**, **economic value added (EVA)**, and **lean accounting systems**. These systems are discussed and analyzed later in terms of their ability to help managers make better decisions, as well as to help provide better measures of performance for managers in organizations, thereby aligning managers' and owners' interests.

Although internal accounting systems often appear inconsistent with some particular theory, these systems (like the bears searching for marmots) have survived the test of time and therefore are likely yielding unobserved benefits (like claw sharpening). This book discusses these additional benefits. Two caveats exist concerning too strict an application of economic Darwinism:

1. Some surviving operating procedures can be neutral mutations. Just because a system survives does not mean that its benefits exceed its costs. Benefits less costs might be close to zero.
2. Just because a given system survives does not mean it is optimal. A better system might exist but has not yet been discovered.

Terminology: Benchmarking and Economic Darwinism

Benchmarking is a technique where a company compares its performance against the best firms, determines how those firms achieved their superior performance, and uses the knowledge to improve its own performance.

Economic Darwinism predicts that managers copy the practices of highly successful companies through benchmarking studies. The practice of benchmarking dates back to 607, when Japan sent teams to China to learn the best practices in business, government, and education. Today, most large enterprises routinely conduct benchmarking studies to discover the best business practices and then implement them in their firms.

SOURCE: American Society for Quality http://asq.org/learn-about-quality/benchmarking/overview/overview.html.

Historical Application: Sixteenth-Century Cost Records

The well-known Italian Medici family had extensive banking interests and owned textile plants in the fifteenth and sixteenth centuries. They used sophisticated cost records to maintain control of their cloth production. These cost reports contained detailed data on the costs of purchasing, washing, beating, spinning, and weaving the wool, of supplies, and of overhead (tools, rent, and administrative expenses). Modern costing methodologies closely resemble these fifteenth-century cost systems, suggesting they yield benefits in excess of their costs.

SOURCE: P. Garner, *Evolution of Cost Accounting to 192* (Montgomery, AL: University of Alabama Press, 1954), pp. 12–13. Original source: R. de Roover, "A Florentine Firm of Cloth Manufacturers," *Speculu. XVI* (January 1941), pp. 3–33.

The fact that most managers use their accounting system as the primary formal information system suggests that these accounting systems yield total benefits that exceed their total costs. These benefits include financial and tax reporting, providing information for decision making, and creating internal incentives. The proposition that surviving firms have efficient accounting systems does not imply that better systems do not exist, only that they have not yet been discovered. What is, is not necessarily the "best." Economic Darwinism helps identify the costs and benefits of alternative internal accounting systems and is applied repeatedly throughout the book.

D. Management Accountant's Role in the Organization

Describing how firms organize their accounting functions provides further understanding of internal accounting systems. No single organizational structure applies to all firms. Figure 1–2 presents one common organization chart. The design and operation of the internal and external accounting systems are the responsibility of the firm's chief financial officer. The firm's line-of-business or functional areas, such as marketing, manufacturing, and research and development, are combined and shown under a single organization, "operating divisions." The remaining staff and administrative functions include human resources, chief financial officer, legal, and other. In Figure 1–2, the CFO oversees all the financial and accounting functions in the firm and reports directly to the president. The CFO's three major functions include controllership, treasury, and internal audit. Controllership involves tax administration, the internal and external accounting reports (including statutory filings with the Securities and Exchange Commission if the firm is publicly traded), and the planning and control systems (including budgeting). Treasury involves short- and long-term financing, banking, credit and collections, investments, insurance, and capital budgeting. Depending on their size and structure, firms organize these functions differently. Figure 1–2 shows the internal audit group reporting directly to the CFO. In other firms, internal audit reports to the controller, the chief executive officer (CEO), or the board of directors.

The controller, the firm's chief management accountant, has responsibility for data collection and reporting. The controller compiles the data to prepare the firm's balance sheet, income statement, and tax returns. In addition, this person prepares the internal reports for the various divisions and departments within the firm and helps other managers by providing them with the data to make decisions—as well as the data to evaluate these managers' performance.

Usually, each operating division or department has its own controller. For example, if a firm has several divisions, each division has its own division controller, who reports to both the division manager and the corporate controller. In Figure 1–2, the operating

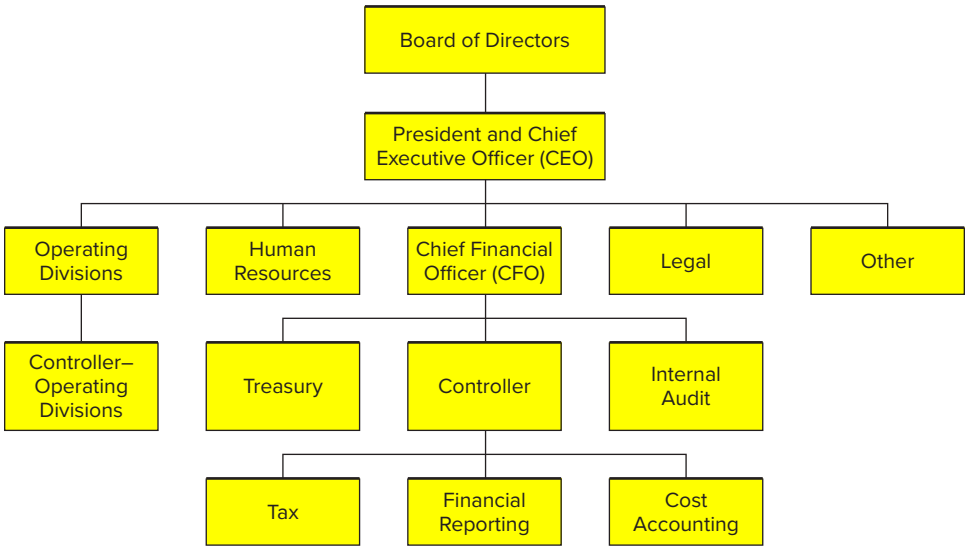


FIGURE 1-2
Organization chart for a typical corporation

divisions have their own controllers. The division controller provides the corporate controller with periodic reports on the division's operations. The division controller oversees the division's budgets, payroll, inventory, and product costing system (which reports the cost of the division's products and services). While most firms have division-level controllers, some firms centralize these functions to reduce staff so that all the division-level controller functions are performed centrally out of corporate headquarters.

The controllership function at the corporate, division, and plant levels involves assisting decision making and control. The controller must balance providing information to

Historical Application: The Rise of the CFO

In a 1960 study of 400 of the largest U.S. corporations, none of the firms had a position entitled "Chief Financial Officer." By 2000, 80 percent had a person holding the title "CFO." Prior to 1960, most large firms called their top accounting manager "Chief Accountant," who typically was not part of the senior executive team. Several factors caused the elevation of "Chief Accountant" to "CFO," who also became an integral member of the firm's senior executives. First, between 1960 and 2000, large U.S. firms became global, with operations in numerous countries requiring more complex financial transactions involving foreign currency hedging and multinational banking relations. Large firms also started new lines of business. These firms became more complex, which necessitated more sophisticated reporting and control systems such as budgeting and monthly reports. To enter new markets, large firms acquired other companies. The CFO played an integral role in valuing and financing acquisitions. In addition, accounting rules became significantly more complicated, requiring sophisticated compliance capabilities. Thus, today's CFOs have a much broader skill set and manage a larger portfolio of activities than their predecessors, and as such, their role and title in their firms has been elevated.

SOURCES: L. Sjoblom and N. Michels-Kim, "Leading Nestlé's House of Finance," *Strategic Finance,* September 2011, pp. 29–33; and D. Zorn, "Here a Chief, There a Chief: The Rise of the CFO in the American Firm," *American Sociological Review,* June 2004, pp. 345–364.

other managers for decision making against providing monitoring information to top executives for use in controlling the behavior of lower-level managers.

Besides overseeing the controllership and treasury functions in the firm, the chief financial officer usually has responsibility for the internal audit function. The internal audit group seeks to eliminate internal fraud and to provide internal consulting and risk management. Since 2002 federal regulation increased the CFO's role by requiring companies to continuously test the effectiveness of the internal controls over their financial statements. The internal audit group now works closely with the audit committee of the board of directors to help ensure the integrity of the firm's financial statements by testing whether the firm's accounting procedures are free of internal control deficiencies.

Federal law also requires companies with publicly traded stock or bonds to have corporate codes of conduct (ethics codes). While many firms had ethics codes prior to this act, these codes define honest and ethical conduct, including conflicts of interest between personal and professional relationships, compliance with applicable governmental laws, rules and regulations, and prompt internal reporting of code violations to the appropriate person in the company. The audit committee of the board of directors is responsible for overseeing compliance with the company's code of conduct.

The importance of the internal control system cannot be stressed enough. Throughout this book, we use the term *control* to mean aligning the interests of employees with maximizing the value of the firm. The most basic conflict of interest between employees and owners is employee theft. In fact, one study reports that the typical firm loses 5 percent of its revenues to fraud.[5] To reduce the likelihood of embezzlement, firms install internal control systems, which are an integral part of their control system. Internal and external auditors' first responsibility is to test the integrity of the firm's internal controls. Fraud and theft are prevented not just by having security guards and door locks but also through a variety of procedures such as requiring checks above a certain amount to be authorized by two people. Internal control systems include internal procedures, codes of conduct, and policies that prohibit corruption, bribery, and kickbacks. Finally, internal control systems should prevent intentional and accidental financial misrepresentation by managers.

Concept Questions

Define *economic Darwinism.*

Describe the major functions of the chief financial officer.

E. Evolution of Management Accounting: A Framework for Change

Management accounting evolved as their organizations changed. Prior to 1800, most businesses were small, family-operated organizations. Management accounting was less important for these small firms. It was not critical for planning decisions and control reasons because the owner could directly observe the organization's entire environment. The owner, who made all of the decisions, delegated little decision-making authority and had no need to devise elaborate formal systems to motivate employees. The owner observing slacking employees simply replaced them. As organizations grew larger with remote operations, management accounting became ever more important.

[5]Association of Fraud Examiners, "Report to the Nations: 2018 Global Studies on Occupational Fraud and Abuse," http://www.acfe.com/report-to-the-nations/2018/.

Most of today's modern management accounting techniques developed between 1825 to 1925 with the growth of large organizations.[6] Textile mills in the early nineteenth century grew by combining the multiple processes (spinning the thread, dying, weaving, etc.) of making cloth. These large firms developed systems to measure the cost per yard or per pound for the separate manufacturing processes. The cost data allowed managers to compare the cost of conducting a process inside the firm versus purchasing the process from external vendors. Similarly, the railroads of the 1850s to 1870s developed cost systems that reported cost per ton-mile and operating expenses per dollar of revenue. These measures allowed managers to increase their operating efficiencies. In the early 1900s, Andrew Carnegie (at what was to become U.S. Steel) devised a cost system that reported detailed unit cost figures for material and labor on a daily and weekly basis. This system allowed senior managers to maintain very tight controls on operations and gave them accurate and timely information on costs for pricing decisions. Merchandising firms such as Marshall Field's and Sears, Roebuck developed gross margin (revenues less cost of goods sold) and stock-turn ratios (sales divided by inventory) to measure and evaluate performance. Manufacturing companies such as Du Pont Powder Company and General Motors developed performance measures to control their growing organizations.

In the period from 1925 to 1975, management accounting was heavily influenced by external considerations. Income taxes and financial accounting requirements (e.g., those of the Financial Accounting Standards Board) were major factors affecting management accounting.

Since 1975, two major environmental forces have changed organizations and caused managers to question the appropriateness of traditional management accounting procedures. These environmental forces are (1) factory automation and computer/information technology and (2) global competition. These environmental changes force managers to reconsider their organizational structure and their management accounting procedures.

Information technology advances such as the Internet, intranets, wireless communications, and faster microprocessors have had a big impact on internal accounting processes. More data are now available faster than ever before. Electronic data interchange, XHTML, social media, data analytics, B2B (business-to-business) e-commerce, bar codes, data

Managerial Application: Big Data and Data Analytics

Every day, we create 2.5 quintillion bytes of data. Ninety percent of the data in the world was generated in the last two years. This data comes from web searches, sensors used to gather climate information, social media posts, digital pictures and videos, purchase transaction records, and cell phone GPS signals to name a few. This data is "**big data**."

Finance and accounting professionals at many firms struggle to learn how to apply statistical and computer science techniques called "data analytics" to extract valuable insights about their customers, products, and competitors from their big data. For example, large online retailers constantly monitor the prices of products offered by competitors to adjust their prices dynamically throughout the day. Managers pore over data to uncover the causes behind the company's sales, costs, and profits and to better understand what drive revenues and operating and sales expenses. Why are certain stores or factories more profitable? What are customers Tweeting or Facebook postings saying about our products and our competitors?

SOURCES: www-01.ibm.com/software/data/bigdata/what-is-big-data.html. D. Katz "Accounting's Big Data Problem," CFO .com. (March 4, 2014).

[6]P. Garner, *Evolution of Cost Accounting to 1925* (Montgomery, AL: University of Alabama Press, 1954); and A. Chandler, *The Visible Hand* (Cambridge, MA: Harvard University Press, 1977).

warehousing, and online analytical processing (OLAP) are just a few examples of new technology impacting management accounting. For example, managers now have access to daily sales and operating costs in real time, as opposed to having to wait two weeks after the end of the calendar quarter for this information. Firms have cut the time needed to prepare budgets for the next fiscal year by several months because the information is transmitted electronically in standardized formats and uploaded to the cloud where any authorized person in the firm can access it.

The history of management accounting illustrates how it has evolved in parallel with organizations' structure. Management accounting provides information for planning decisions and control. It is useful for assigning decision-making authority, measuring performance, and determining rewards for individuals within the organization. Because management accounting is part of the organizational structure, it is not surprising that management accounting evolves in a parallel and consistent fashion with other parts of the organizational structure.

Figure 1–3 presents a framework for understanding the role of accounting systems within firms and the forces that cause accounting systems to change. As described more fully in Chapter 14, environmental forces such as technological innovation and global competition change the organization's business strategies. For example, the Internet has allowed banks to offer electronic, online banking services. To implement these new strategies, companies must adapt their organizational structure or architecture, which includes management accounting. An organization's architecture (the topic of Chapter 4) is composed of three related processes: (1) the assignment of decision-making responsibilities, (2) the measurement of performance, and (3) the rewarding of individuals within the organization.

The first component of the organizational architecture assigns responsibilities to the different members of the organization. Decision rights define the duties each member of an organization is expected to perform. A person's job description specifies the decision rights assigned to that particular individual. Checkout clerks in grocery stores have the decision rights to collect cash from customers but don't have the decision rights to accept checks above a specific amount. A manager must be called for that decision. A division manager may have the right to set prices on products but not the right to borrow money. The president usually retains the right to issue debt, subject to board of directors' approval.

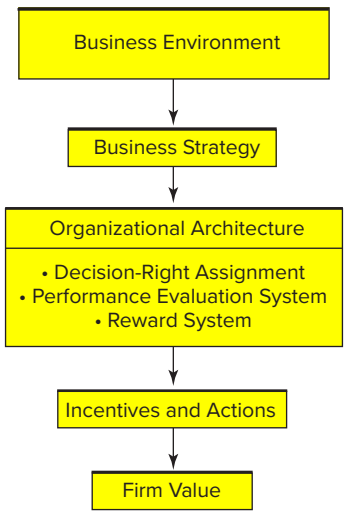


FIGURE 1-3
Framework for organizational change and management accounting

The next two parts of the organizational architecture are the performance evaluation and reward systems. To motivate individuals within the organization, organizations must have a system for measuring their performance and rewarding them. Performance measures for a salesperson could include total sales and customer satisfaction based on a survey of customers. Performance measures for a manufacturing unit might be number of units produced, total costs, and percentage of defective units. The internal accounting system is often an important part of the performance evaluation system.

Performance measures are extremely important because rewards are generally based on these measures. Rewards for individuals within organizations include wages and bonuses, prestige and greater decision rights, promotions, and job security. Tying rewards to performance measures creates incentives for individuals and groups whose performance is being measured to influence the performance measures. Therefore, the performance measures chosen influence individual and group efforts within the organization. These people can work hard to achieve better performance and, hence, rewards. Or they can game the performance metrics. A poor choice of performance measures often leads to conflicts within the organization and derails efforts to achieve organizational goals. For example, measuring the performance of a college president based on the number of students attending the college encourages the president to enroll ill-prepared students, thereby reducing the quality of the educational experience for other students.

As illustrated in Figure 1–3, changes in the business environment lead to new strategies and ultimately to changes in the firm's organizational architecture. These changes include altering the accounting system to better align the interests of the employees with the objectives of the firm. The new organizational architecture provides incentives for members of the organization to make decisions that enhance the value of the organization. Within this framework, accounting assists in the control of the organization through the organization's architecture and provides information for decision making. This framework for change is referred to throughout the book.

F. Vortec Medical Probe Example

To illustrate some of the basic concepts developed in this text, evaluate the following decision. Vortec Inc. manufactures a single product, a medical probe. Vortec sells the probes to distributors who then market them to physicians. Vortec has two divisions. The manufacturing division produces the probes; the marketing division sells them to distributors. The marketing division is rewarded on the basis of sales revenues. The manufacturing division is evaluated and rewarded on the basis of the average unit cost of making the probes. The plant's current volume is 100,000 probes per month. The following income statement summarizes last month's operating results.

VORTEC MANUFACTURING
Income Statement
Last Month

Sales revenue (100,000 units @ $5.00)	$500,000
Cost of sales (100,000 units @ $4.50)	450,000
Operating margin	$ 50,000
Less: Administrative expenses	27,500
Net income before taxes	$ 22,500

Medsupplies is one of Vortec's best distributors. Vortec sells 10,000 probes per month to Medsupplies at $5 per unit. Last week, Medsupplies asked Vortec's marketing division

to increase its monthly shipment to 12,000 units, provided that Vortec would sell the additional 2,000 units at $4 each. Medsupplies would continue to pay $5 for the original 10,000 units. Medsupplies argued that because this would be extra business for Vortec, no overhead should be charged on the additional 2,000 units. In this case, a $4 price should be adequate.

Vortec's finance department estimates that with 102,000 probes, the average cost is $4.47 per unit, and hence the $4 price offered by Medsupplies is too low. The current administrative expenses of $27,500 consist of office rent, property taxes, and interest and will not change if this special order is accepted. Should Vortec accept the Medsupplies offer?

Before examining whether the marketing and manufacturing divisions will accept the order, consider Medsupplies' offer from the perspective of Vortec's owners, who are interested in maximizing profits. The decision hinges on the cost to Vortec of selling an additional 2,000 units to Medsupplies. If the cost is more than $4 per unit, Vortec should reject the special order.

It is tempting to reject the offer because the $4 price does not cover the average total cost of $4.47. But will it cost Vortec $4.47 per unit for the 2,000-unit special order? Is $4.47 the cost per unit for each of the next 2,000 units?

To begin the analysis, two simplifying assumptions are made that are relaxed later:

- Vortec has excess capacity to produce the additional 2,000 probes.
- Past historical costs are unbiased estimates of the future cash flows for producing the special order.

Based on these assumptions, we can compare the incremental revenue from the additional 2,000 units with its incremental cost:

Incremental revenue (2,000 units × $4.00)		$8,000
Total cost @ 102,000 units (102,000 × $4.47)	$455,940	
Total cost @ 100,000 units (100,000 × $4.50)	450,000	
Incremental cost of 2,000 units		5,940
Incremental profit of 2,000 units		$2,060

The estimated incremental cost per unit of the 2,000 units is then

$$\frac{\text{Change in total cost}}{\text{Change in volume}} = \frac{\$455{,}940 - \$450{,}000}{2{,}000} = \$2.97$$

The estimated cost per incremental unit is $2.97. Therefore, $2.97 is the average per-unit cost of the extra 2,000 probes. The $4.47 cost is the average cost of producing 102,000 units, which is more than the $2.97 incremental cost per unit of producing the extra 2,000 probes.

Based on the $2.97 estimated cost, Vortec should take the order. Is this the right decision? Not necessarily. There are some other considerations:

1. Will these 2,000 additional units affect the $5 price of the 100,000 probes? Will Vortec's other distributors continue to pay $5 if Medsupplies buys 2,000 units at $4? What prevents Medsupplies from reselling the probes to Vortec's other distributors at less than $5 per unit but above $4 per unit? Answering these questions requires management to acquire knowledge of the market for the probes.

2. What is the alternative use of the excess capacity consumed by the additional 2,000 probes? As plant utilization increases, congestion occurs, production becomes less efficient, and the cost per unit rises. Congestion costs include the wages of the additional production employees and supervisors required to move, store, expedite, and rework products as plant volume increases. The $2.97 incremental cost computed from the average cost data provided above might not include the higher congestion costs as capacity is approached. This suggests that the $4.47 average cost estimate is wrong. Who provides this cost estimate and how accurate is it? Management must acquire knowledge of how costs behave at a higher volume. If Vortec accepts the Medsupplies offer, will Vortec be forced at some later date to forgo using this capacity for a more profitable project?
3. What costs will Vortec incur if the Medsupplies offer is rejected? Will Vortec lose the normal 10,000-unit Medsupplies order? If so, can this order be replaced?
4. Does the Robinson-Patman Act apply? The **Robinson-Patman Act** is a U.S. federal law prohibiting charging customers different prices if doing so is injurious to competition. It may be illegal to sell an additional 2,000 units to Medsupplies at less than $5 per unit. Knowledge of U.S. antitrust laws must be acquired. Moreover, if Vortec sells internationally, it will have to research the antitrust laws of the various jurisdictions that might review the Medsupplies transaction.

We have analyzed the question of whether Medsupplies' 2,000-unit special order maximizes the owners' profit. Will the marketing and manufacturing divisions accept Medsupplies' offer? Recall that marketing is evaluated based on total revenues, and manufacturing is evaluated based on average unit costs. Marketing will want to accept the order as long as Medsupplies does not resell the probes to other Vortec distributors and as long as other Vortec distributors do not expect similar price concessions. Manufacturing will accept the order as long as it believes average unit costs will fall. Increasing production lowers average unit costs and makes it appear as though manufacturing has achieved cost reductions.

Suppose that accepting the Medsupplies offer will not adversely affect Vortec's other sales, but the incremental cost of producing the 2,000 extra probes is really $4.08, not $2.97, because there will be overtime charges and additional factory congestion costs. Under these conditions, both marketing and manufacturing will want to accept the offer. Marketing increases total revenue and thus appears to have improved its performance. Manufacturing still lowers average unit costs from $4.50 to $4.4918 per unit:

$$\frac{(\$4.50 \times 100{,}000) + (\$4.08 \times 2{,}000)}{102{,}000} = \$4.4918$$

Unfortunately, the shareholders are worse off. Vortec's cash flows fall by $160 [or 2,000 units $\times$ ($4.00 $-$ $4.08)]. The problem is not that the marketing and manufacturing managers are "making a mistake." The problem is that their measures of performance create the wrong incentives. In particular, rewarding marketing for increasing total revenues and rewarding manufacturing for reducing average unit costs does not ensure that the incremental revenues from the order ($8,000 = $4 $\times$ 2,000) are greater than the incremental costs ($8,160 = $4.08 $\times$ 2,000). Both marketing and manufacturing are doing what they were told to do (increase revenues and reduce average costs), but the firm's cash flow falls because of poorly designed incentive systems.

Four key points emerge from this example:

1. *Beware of average costs.* The $4.50 unit cost tells us little about how costs will vary with changes in volume. Just because a cost is stated in dollars per unit does not mean that producing one more unit adds that amount of incremental cost.

2. *Use opportunity costs.* Opportunity costs measure what the firm forgoes when it chooses a specific action. The notion of opportunity cost is crucial in decision making. The opportunity cost of the Medsupplies order is what Vortec forgoes by accepting the special order. What is the best alternative use of the plant capacity consumed by the Medsupplies special order? (More on this in Chapter 2.)
3. *Supplement accounting data with other information.* The accounting system contains important data relevant for estimating the cost of this special order from Medsupplies. But other knowledge, not contained in the accounting system, must be assembled, such as what Medsupplies will do if Vortec rejects its offer. Managers must augment accounting data with other knowledge such as customer demands, competitors' plans, future technology, and government regulations.
4. *Use accounting numbers as performance measures cautiously.* Accounting numbers such as revenues or average unit manufacturing costs are often used to evaluate managers' performance. Just because managers are maximizing particular performance measures tailored for each manager does not necessarily cause firm profits to be maximized.

The Vortec example illustrates the importance of understanding how accounting numbers are constructed, what they mean, and how they are used in decision making and control. The accounting system provides a very important source of information to managers, but it is not the sole source of all knowledge. Also, in the overly simplified context of the Vortec example, the problems with the incentive systems and with using unit costs are easy to detect. In a complex company with hundreds or thousands of products or services, such errors become more difficult to detect. Finally, for the sake of simplicity, the Vortec illustration ignores the use of the accounting system for external reporting.

G. Outline of the Text

Internal accounting systems provide data for both decision making and control. The organization of this book follows this dichotomy. The first part of the text (Chapters 2 through 5) describes how accounting systems are used in decision making and providing incentives in organizations. These chapters provide the conceptual framework for the remainder of the book. The next set of chapters (Chapters 6 through 8) describes basic topics in managerial accounting, budgeting, and cost allocations. Budgets not only communicate knowledge within the firm for decision making but also serve as a control device and as a way to partition decision-making responsibility among the managers. Likewise, cost allocations serve decision-making and control functions. In analyzing the role of budgeting and cost allocations, these chapters draw on the first part of the text.

The next section of the text (Chapters 9 through 13) describes the prevalent accounting system used in firms: absorption costing. Absorption cost systems are built around cost allocations. The systems used in manufacturing and service settings generate product or service costs built up from direct labor, direct material, and allocated overheads. After first describing these systems, we critically analyze them. Absorption cost systems often produce inaccurate unit cost information, which can lead to dysfunctional decision making. Two alternative accounting systems (variable cost systems and activity-based cost systems) are compared and evaluated against a traditional absorption cost system. The next topic describes the use of standard costs as extensions of absorption cost systems. Standard costs provide benchmarks to calculate accounting variances: the difference between the actual costs and standard costs. These variances provide performance measures and thus are part of the firm's motivation and control system described earlier.

The last chapter (Chapter 14) expands the integrative approach summarized in section E of this chapter. This approach is then used to analyze four modifications of internal cost systems: quality measurement systems, just-in-time production, six sigma and lean production, and balanced scorecards. These modifications are evaluated within a broad historical context. Just because these systems are new does not suggest they are better. Some have stood the test of time, while others have not.

H. Summary

This book provides a framework for the analysis, use, and design of internal accounting systems. It explains how these systems are used for decision making and motivating people in organizations. Employees care about their self-interest, not the owners' self-interest. Hence, owners must devise incentive systems to motivate their employees. Accounting numbers provide measures of managers' performance and hence are part of the control system used to motivate managers. Most organizations use a single internal accounting system as the primary data source for external reporting and internal uses. Applying the economic Darwinism principle, the costs of multiple systems likely outweigh the benefits for most firms. The costs are not only the direct costs of operating the system but also the indirect costs from dysfunctional decisions resulting from faulty information and poor performance evaluation systems. The remainder of this book addresses the costs and benefits of internal accounting systems.

Problems

P 1–1: MBA Students

One MBA student was overheard saying to another, "Accounting is baloney. I worked for a genetic engineering company and we never looked at the accounting numbers and our stock price was always growing."

"I agree," said the other. "I worked in a rust bucket company that managed everything by the numbers and we never improved our stock price very much."

Evaluate these comments.

P 1–2: One Cost System Isn't Enough

Source: Robert S. Kaplan in "One Cost System Isn't Enough" (*Harvard Business Review*. January–February 1988, pp. 61–66):

> No single system can adequately answer the demands made by diverse functions of cost systems. While companies can use one method to capture all their detailed transactions data, the processing of this information for diverse purposes and audiences demands separate, customized development. Companies that try to satisfy all the needs for cost information with a single system have discovered they can't perform important managerial functions adequately. Moreover, systems that work well for one company may fail in a different environment. Each company has to design methods that make sense for its particular products and processes.
>
> Of course, an argument for expanding the number of cost systems conflicts with a strongly ingrained financial culture to have only one measurement system for everyone.

Describe the costs and benefits of having a single measurement system.

P 1–3: U.S. and Japanese Tax Laws

Tax laws in Japan tie taxable income directly to the financial statements' reported income. That is, to compute a Japanese firm's tax liability, multiply the net income as reported to shareholders by the appropriate tax rate to derive the firm's tax liability. In contrast, U.S. firms typically have more discretion in choosing different accounting procedures for calculating net income for shareholders (financial reporting) and taxes.

What effect would you expect these institutional differences in tax laws between the United States and Japan to have on internal accounting and reporting?

P 1–4: Using Accounting for Planning

The owner of a small software company felt his accounting system was useless. He stated, "Accounting systems only generate historical costs. Historical costs are useless in my business because everything changes so rapidly."

Required:

a. Are historical costs useless in rapidly changing environments?

b. Should accounting systems be limited to historical costs?

P 1–5: Budgeting

Salespeople at a particular firm forecast what they expect to sell next period. Their supervisors then review the forecasts and make revisions. These forecasts are used to set production and purchasing plans. In addition, salespeople receive a fixed bonus of 20 percent of their salary if they meet or exceed their forecasts.

Discuss the incentives of the salespeople to forecast next-period sales accurately. Discuss the trade-off between using the budget for decision making versus using it as a control device.

P 1–6: All Things Tennis

All Things Tennis (ATT), a French company, manufactures a variety of tennis gear, such as racket covers, tennis bags, and embroidered towels. ATT sells all its products exclusively in Europe through independent distributors. ATT's most popular line is a series of racket covers with various animal pictures on the cover.

ATT is currently making 500 animal racket covers a week at an average per unit cost of 3.50 €, which includes both variable costs and allocated fixed costs. The variable cost of each racket cover is 1.10 €. ATT sells the racket covers to distributors for 4.25 €. A distributor in Canada, Toronto Sports, wants to purchase 100 racket covers per week from ATT and sell them in Canada. Toronto offers to pay ATT 2 € per racket cover. ATT has enough capacity to produce the additional 100 racket covers and estimates that if it accepts Toronto's offer, the per unit cost of all 600 racket covers will be 3.10 €. Assume the cost data provided (3.50 € and 3.10 €) are accurate estimates of ATT's costs of producing the racket covers. Further assume that ATT's variable cost per racket cover does not vary with the number of racket covers manufactured.

Required:

a. Given the data in the problem, what is ATT's weekly fixed cost of producing the animal racket covers?

b. To maximize firm value, should ATT accept Toronto's offer? Explain why or why not.

c. Besides the data provided in the problem, what other factors should ATT consider before making a decision to accept Toronto's offer?

P 1–7: Parkview Hospital

Parkview Hospital, a regional hospital, serves a population of 400,000 people. The next closest hospital is 50 miles away. Parkview's accounting system is adequate for patient billing. The system reports revenues generated per department but does not break down revenues by unit within departments. For example, Parkview knows patient revenue for the entire psychiatric department but does not know revenues in the child and adolescent unit, the chemical dependence unit, or the neuropsychiatric unit.

Parkview receives its revenues from three principal sources: the federal government (Medicare), the state government (Medicaid), and private insurance companies (Blue Cross–Blue Shield). Until recently, the private insurance companies continued to pay Parkview's increasing costs and passed these on to the firms through higher premiums for their employees' health insurance.

Last year Trans Insurance (TI) entered the market and began offering lower-cost health insurance to local firms. TI cut benefits offered and told Parkview that it would pay only a fixed dollar amount per patient. A typical firm could cut its health insurance premium 20 percent by switching

to TI. TI was successful at taking 45 percent of the Blue Cross–Blue Shield customers. Firms that switched to TI faced stiff competition and sought to cut their health care costs.

Parkview management estimated that its revenues would fall 6 percent, or $3.2 million, next year because of TI's lower reimbursements. Struggling with how to cope with lower revenues, Parkview began the complex process of deciding what programs to cut, how to shift the delivery of services from inpatient to outpatient clinics, and what programs to open to offset the revenue loss (e.g., open an outpatient depression clinic). Management can forecast some of the costs of the proposed changes, but many of its costs and revenues (such as the cost of the admissions office) have never been tracked to the individual clinical unit.

Required:

a. Was Parkview's accounting system adequate 10 years ago?

b. Is Parkview's accounting system adequate today?

c. What changes should Parkview make in its accounting system?

P 1–8: Montana Pen Company

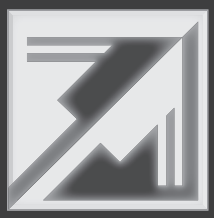
Montana Pen Company manufactures a full line of premium writing instruments. It has 12 different styles, and within each style, it offers ballpoint pens, fountain pens, mechanical pencils, and a roller ball pen. Most models also come in three finishes—gold, silver, and black matte. Montana Pen's Bangkok, Thailand, plant manufactures four of the styles. The plant is currently producing the gold clip for the top of one of its pen styles, no. 872. Current production is 1,200 gold no. 872 pens each month at an average cost of 185 baht per gold clip. (One U.S. dollar currently buys 32 baht.) A Chinese manufacturer has offered to produce the same gold clip for 136 baht. This manufacturer will sell Montana Pen 400 clips per month. If it accepts the Chinese offer and cuts the production of the clips from 1,200 to 800, Montana Pen estimates that the cost of each clip it continues to produce will rise from 185 baht to 212.5 baht per gold clip.

Required:

a. Should Montana Pen outsource 400 gold clips for pen style no. 872 to the Chinese firm? Provide a written justification of your answer.

b. Given your answer in part (*a*), what additional information would you seek before deciding to outsource 400 gold clips per month to the Chinese firm?

Chapter Two



The Nature of Costs

Chapter Outline

As described in Chapter 1, accounting systems measure costs that managers use for external reports, decision making, and controlling the behavior of people in the organization. Understanding how accounting systems calculate costs requires a thorough understanding of what **cost** means. Unfortunately, that simple term has multiple meanings. Saying a product costs $3.12 does not reveal what the $3.12 measures. Additional explanation is often needed to clarify the assumptions that underlie the calculation of cost. A large vocabulary exists to communicate more clearly which cost meaning is being conveyed. Some examples include average cost, common cost, full cost, historical cost, joint cost, marginal cost, period cost, product cost, standard cost, fixed cost, opportunity cost, sunk cost, and variable cost, just to name a few.

We begin this chapter with the concept of opportunity cost, a powerful tool for understanding the myriad cost terms and for structuring managerial decisions. In addition, opportunity cost provides a benchmark against which accounting-based cost numbers can be compared and evaluated. Section B discusses how opportunity costs vary with changes in output. Section C extends this discussion to cost–volume–profit analysis. Section D compares and contrasts opportunity costs and accounting costs (which are very different). Section E describes some common methods for cost estimation.

A. Opportunity Costs

Nobel Prize–winning economist Ronald Coase noted, "The cost of doing anything consists of the receipts that could have been obtained if that particular decision had not been taken."[1] This notion is called **opportunity cost**—the benefit forgone as a result of choosing one course of action rather than another. Cost is a sacrifice of resources. Using a resource for one purpose prevents its use elsewhere. The return forgone from its use elsewhere is the opportunity cost of its current use. The opportunity cost of a particular decision depends on the other alternatives available.

The alternative actions comprise the *opportunity set.* Before making a decision and calculating opportunity cost, the opportunity set itself must be enumerated. Thus, it is important to remember that opportunity costs can be determined only within the context of a specific decision and only after specifying all the alternative actions. For example, the opportunity set for this Friday night includes the movies, a concert, staying home and studying, staying home and watching television, inviting friends over, and so forth.

The opportunity cost concept focuses managers' attention on the available alternative courses of action. Suppose you are considering three job offers. Job A pays a salary of $100,000, job B pays $102,000, and job C pays $106,000. In addition, you value each job differently in terms of career potential, developing your human capital, and the type of work. Suppose you value these nonpecuniary aspects of the three jobs at $8,000 for A, $5,000 for B, and only $500 for C. The following table summarizes the total value of each job offer. You decide to take job A because it has the highest total pecuniary and nonpecuniary compensation. The opportunity cost of job A is $107,000 (or $102,000 + $5,000), representing the amount forgone by not accepting job B, the next best alternative.

Job Offer	*Salary*	*$ Equivalent of Intangibles*	*Total Value*
A	$100,000	$8,000	$108,000
B	102,000	5,000	107,000
C	106,000	500	106,500

[1] SOURCE: R. Coase, "Business Organization and the Accountant," originally published in *Accountant,* 1938. Reprinted in *L.S.E. Essays in Cost,* ed. J. Buchanan and G. Thirlby (New York University Press, 1981), p. 108.

The decision to continue to search for more job offers has an opportunity cost of $108,000 if job offer A expires. If you declined job offer L last week, which had a total value of $109,000, this job offer is no longer in the opportunity set and hence is not an opportunity cost of accepting job A now. Besides jobs A, B, and C, you learn there is a 0.9 probability of receiving job offer D, which has a total value of $110,000. If you wait for job D and you do not get it, you will be forced to work in a job valued at $48,000. Job D has an expected total value of $103,800 (or $\$110{,}000 \times 0.9 + \$48{,}000 \times 0.1$). Since job D's opportunity cost of $108,000 (the next best alternative forgone) exceeds its expected value ($103,800), you should reject waiting for job offer D.

1. Characteristics of Opportunity Costs

Opportunity costs are not necessarily the same as payments. The opportunity cost of taking job A included the forgone salary of $102,000 plus the $5,000 of intangibles from job B. The opportunity cost of going to a movie involves both the cash outlay for the ticket and popcorn, and also forgoing spending your time studying or attending a concert. Remember, the opportunity cost of obtaining some good or service is what must be surrendered or forgone in order to get it. By taking job A, you forgo job B at $107,000.

Opportunity costs are forward looking. They are the estimated forgone benefits from actions that could, but *will not,* be undertaken. In contrast, accounting is based on historical costs in general. **Historical costs** are the resources expended for actions actually undertaken. Opportunity cost is based on anticipations; it is necessarily a forward-looking concept. Job offers B, C, and D are part of the opportunity set when you consider job A, but job offer L, which expired, is no longer part of the opportunity set. Your refusal of job L last week is not an opportunity cost of accepting job A now.

Opportunity costs differ from (accounting) expenses. Opportunity cost is the sacrifice of the best alternative for a given action. An (accounting) expense is a cost incurred to generate a revenue. For example, consider an auto dealer who sells a used car for $7,500. Suppose the dealer paid $6,500 for the car and the best alternative use of cars like this one is to sell them at auction for $7,200. The car's opportunity cost in the decision to keep it for resale is $7,200. However, in matching expenses to revenues, the accounting expense is $6,500. Financial accounting is concerned with matching expenses to revenues. In decision making, the concern is with estimating the opportunity cost of a proposed decision. We return to the difference between opportunity and accounting costs in section D.

2. Examples of Decisions Based on Opportunity Costs[2]

Several examples illustrate opportunity costs. The first four examples pertain to raw materials and inventories.

Opportunity cost of materials (no other uses)

What is the opportunity cost of materials for a special order if the materials have no other use and they are in in stock? The firm paid $16,000 for the materials and anticipates no other orders in which it can use these materials. The opportunity cost of these materials is whatever scrap value they may have. If the materials have no alternative use and they have no storage or disposal cost, their opportunity cost is zero. If the firm incurs costs for storing the materials and if disposal is costly, then these materials have a negative opportunity cost. By using them in a special order, the firm saves their storage or disposal costs.

Opportunity cost of materials (other uses)

The opportunity cost of materials not yet purchased for a job is the estimated cash outflow necessary to secure their delivery. If the materials are already in stock, their opportunity cost is their highest-valued use elsewhere. If the materials will be used in another order,

[2]Some of the examples presented here are drawn from Coase (1938), pp. 10–22.

using them now requires us to replace them in the future. Hence, the opportunity cost is the cost of replacement.

Cost of capital on inventory as an opportunity cost

An automobile manufacturer plans to introduce a new car model. Included in the opportunity cost of the new model are the payments for materials, labor, capital, promotion, and administration. Opportunity cost also contains the cost of capital forgone on the additional inventory of cars and parts the firm carries as part of the normal operations of manufacturing and selling cars. If the average inventory of materials, work in process, and finished cars is $125 million and the cost of capital for this type of investment is 10 percent, then the opportunity cost on this investment is $12.5 million per year.

The next raw material example introduces the concept of *sunk costs,* expenditures that have already been made and are irrelevant for evaluating future alternatives.

Sunk costs and opportunity costs

A firm paid $15,000 for a coil of stainless steel used in a special order. Twenty percent (or $3,000 of the original cost) of the coil remains. The remaining steel in the coil has no alternative use; a scrap steel dealer is willing to haul it away at no charge. The remaining $3,000 of the original cost is a sunk cost. **Sunk costs** are expenditures incurred in the past that cannot be recovered. The $3,000 is sunk because it has already been incurred and is not recoverable. Because it cannot be recovered, the $3,000 should not influence any decision. In this case, the remaining steel coil has a zero opportunity cost. Sunk costs are irrelevant for future uses of this stainless steel. Suppose the scrap dealer is willing to pay $500 for the remaining coil. Using the remainder in another job now has an opportunity cost of $500.

Managerial Application: Sustainability and Opportunity Costs

Many large corporations utilize sustainability programs to create long-term shareholder value by identifying opportunities and managing risks from economic, environmental, and social developments. For example, in 2013 the catastrophic collapse of the Rana Plaza building in Bangladesh killed more than 1,100 garment workers. This plant produced clothing for some of the world's largest retailers such as H&M, Marks and Spencer, and Zara. Even though these retailers did not own this plant, they came under intense criticism by the media, governments, and customers for not imposing tighter building inspections on their Bangladesh supplier. Sustainability programs seek to identify, measure, and integrate social, environmental, and economic impacts into corporate strategy to manage those impacts and increase long-run profitability. As such, firms that outsource significant amounts of their products now proactively monitor the workplace safety of their suppliers. Before Nike introduces new footwear, the product design team compares alternative materials in terms of not just cost, but also environmental impacts such as energy use, greenhouse gas emissions, water use, land use, and waste and chemical use. By improving the environment, Nike hopes to increase the future demand for its products.

Well-functioning sustainability programs capture the opportunity cost of decisions managers make today on future cash flows of the firm arising from social, environmental, and political processes. For example, Home Depot drops suppliers that violate its workplace standards for safety and child labor. By avoiding such firms, Home Depot reduces its risk of bad publicity if a supplier experiences an adverse event.

SOURCES: M. Epstein and A. Buhovac, "A New Day for Sustainability," *Strategic Finance,* July 2014, pp. 25–33. www.pepsico.com/Purpose/Environmental-Sustainability/Water.

Remember that sunk costs are irrelevant for decision making unless you are the one who sunk them. However, sunk costs are not irrelevant as a control device. Holding managers responsible for past actions causes them to take more care in future decisions. Suppose $4 million was spent on new software that doesn't work and the firm buys a commercial package to replace it. The manager responsible for the failed software development will be held accountable for the failure and will have incentives to consume more firm resources trying to either fix it or cover up its failure before this knowledge becomes widely known.

The next example applies the opportunity cost concept to evaluating alternatives regarding labor.

Opportunity cost of labor

Suppose a firm's work force cannot be changed because of existing labor agreements. Employees are guaranteed 40 hours of pay per week. For the next three weeks, only 35 hours of work per week per employee exists. What is the cost of taking a special order that will add five hours of work per employee? One is tempted to cost the five hours of labor in the special order at zero because these employees must be paid anyway. But the question remains: What will these employees do with the five hours if this special order is rejected? If they would do preventive maintenance on the machines or do general maintenance or improve their skills through training, then the opportunity cost of the labor for the special order is not zero but the value of the best forgone alternative use of the employees' time.

Public accounting firms confront this issue. The summer months tend to be low-demand periods relative to year-end. How the firm prices summer (off-peak) audits depends in part on the perceived opportunity cost of the staff's time.

If a firm owns long-lived assets such as buildings and equipment, understanding their opportunity costs involves alternative uses of these assets. The next three examples describe the opportunity costs of capital assets.

Asset depreciation as an opportunity cost

Using assets can affect their value. Suppose a delivery van used four days a week can be sold next year for $34,000. If additional business is taken and the delivery van is used six

Managerial Application: The Opportunity Costs of a Data Breach

Data breaches generate large costs for companies. Consider Equifax, the credit-reporting company. In 2017, it revealed that cyber criminals gained access to names and Social Security numbers of up to 143 million people in its files. Not only did Equifax incur significant costs to upgrade its software and hardware, it paid for identity theft protection and credit file monitoring services for possible victims. These costs likely exceed $439 million. In addition to these out-of-pocket costs, cyber breaches generate significant indirect costs.

If a company shuts down its e-commerce site after a cyber-attack, lost sales occur. IBM reports the "biggest financial consequence to organizations that experienced a data breach is lost business." Sales also decline because of damage to the firm's brand name as customers lose confidence in the firm's ability to protect their identity.

Opportunity cost represents "the benefit forgone as a result of choosing one course of action rather than another." If the firm chooses to spend too little on cyber security, it forgoes reducing the risk of a data breach. The benefits of high cyber security are avoiding the costs of a data breach—the out-of-pocket costs plus the indirect costs.

SOURCES: www.pymnts.com/news/security-and-risk/2018/equifax-cost-275m/; and N. Amato, "The Hidden Costs of a Data Breach," *Journal of Accountancy,* July 25, 2016, www.journalofaccountancy.com/news/2016/jul/hidden-costs-of-data-breach-201614870.html.

days a week, its market value next year will be $28,000. Depreciation due to use for the additional business is $6,000 ($34,000 − $28,000).

The opportunity cost of using an asset is the decline in its value. Accounting depreciation (such as straight-line depreciation) is based on historical costs. Accounting depreciation unlikely reflects the actual opportunity cost of the van (its decline in value from use). However, accounting depreciation can be a reasonably accurate approximation of the decline in the market value of the asset. In any given year, accounting depreciation may not exactly capture the decline in the asset's market value. However, over the asset's economic life, accumulated accounting depreciation equals the decline in value. Holding managers responsible for accounting depreciation commits them to recovering the historical cost of the asset in either additional revenues or cost savings.

Opportunity cost of excess capacity

Suppose a plant operates at 75 percent capacity. Is the firm forgoing profits on the 25 percent of idle capacity? It is usually optimal to have some "excess" capacity in order to absorb random shocks to normal production, such as machine breakdowns and demand fluctuations, which increase production time and costs. When plants are built, rarely are they expected to run at 100 percent capacity. As plant utilization increases, per-unit costs increase as congestion rises. The opportunity cost of increasing the plant's expected utilization—say, from 75 percent to 85 percent of capacity—is the higher production cost imposed on the existing units that currently utilize 75 percent of the capacity.

Consider this illustration. The following table lists the output of a plant in units of production and the average cost per unit. Average costs rise as volume increases because congestion increases. This causes more machine breakdowns, and indirect labor (expediters, material handlers, production schedulers) must be hired to manage the increased congestion. The plant is currently operating at 75 percent capacity (150 units) and incurring average costs of $6.04 per unit.

Units	*Capacity*	*Average Cost*
130	65%	$6.00
140	70	6.02
150	75	6.04
160	80	6.06
170	85	6.08
180	90	6.11
190	95	6.15
200	100	6.20

Suppose production increases from 150 units (75 percent capacity) to 170 units (85 percent capacity). Increasing production by an extra 20 units causes the average cost of the base production of 150 units to rise from $6.04 to $6.08, or 4¢ per unit. The opportunity cost of producing 20 more units is not the average cost of $6.08 but the incremental cost of the last 20 units, $6.38 {or [(170 × $6.08) − (150 × $6.04)] ÷ 20 units}. Another way of computing the opportunity cost of the last 20 units is

$$\$6.38 = \$6.08 + (4¢ \times 150) \div 20$$

Or the opportunity cost of producing 20 more units is composed of their average cost ($6.08) plus the cost increase that each of the 20 units imposes on the first 150 units [(4¢ × 150) ÷ 20].

The final example describes evaluating the opportunity costs of introducing new products.

Opportunity cost of product line cannibalization

A company that produces tablet computers has 60 percent of a particular market niche. The company plans to introduce a new, high-end, faster tablet with additional features. The major competition for the new tablet is the firm's current high-end tablet. In the first year, management projects sales of the new model to be 20,000 units. Sales of the existing tablet are expected to fall by 7,000 units. Thus, the new tablet "cannibalizes" the old tablet's sales by 7,000 units. Are the forgone profits from the 7,000 units that could have been sold an opportunity cost of introducing the new tablet? It depends on the opportunity set. If management expects competitors to introduce a device that competes with the old tablet, meaning that the company is likely to have lost those units anyway, then the profits forgone on the 7,000 units are not an opportunity cost of introducing the new tablet.

Concept Questions

- Define *opportunity cost.*
- What are some characteristics of opportunity costs?
- A firm paid $8,325 last year for some raw material it planned to use in production. When is the $8,325 a good estimate of the opportunity cost of the material?
- Define *sunk cost* and give an example.
- What are avoidable and unavoidable costs? How are they related to opportunity costs?

B. Cost Variation

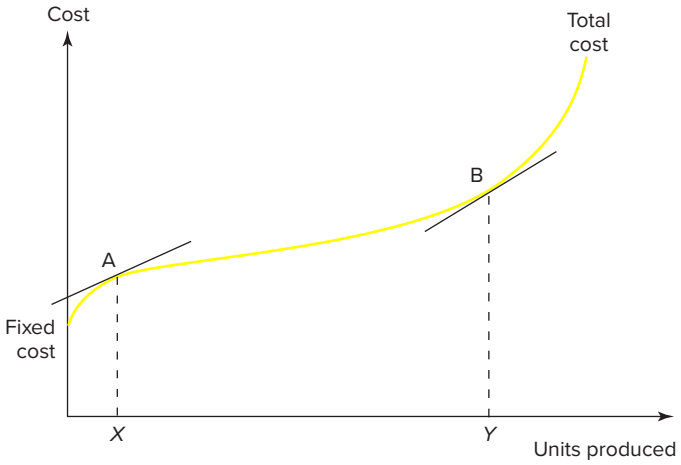
Managers commonly decide how many units to produce or how much service to provide during a certain time period. Apple must decide how many Apple watches of a particular model to manufacture next quarter. United Airlines must decide whether to fly a 90-passenger jet or a 130-passenger jet between Denver and Palm Springs next month. Making these decisions requires an understanding of how costs change with volume—the topic of this section.

1. Fixed, Marginal, and Average Costs

Cost behavior is defined relative to some activity, such as the number of units produced, hours worked, pounds of ore mined, miles driven, or meals served. Usually, units produced is the measure of activity. For example, consider Figure 2–1, which illustrates the general relation between cost and units produced. Two important points emerge from Figure 2–1. First, even with no units produced, the firm still must incur some costs. The costs incurred when there is no production are called **fixed costs**. If the plant is idle, some costs such as property taxes, insurance, plant management, security, and so on must be incurred to provide production capacity. For example, Intel acquires land and builds a plant to manufacture a specific quantity of microprocessors. It pays annual property taxes of $1.75 million on this land. The $1.75 million expenditure on property taxes is part of the cost Intel pays to have this manufacturing capacity at this plant.

Second, in general the cost curve is not a straight line as output expands, but rather is curvilinear. The particular shape of the curve arises because marginal cost varies with the level of production. **Marginal cost** is the cost of producing one more unit. In Figure 2–1, marginal cost is the slope of a line drawn tangent to the total cost curve. For the first few

FIGURE 2–1
Nonlinear cost curve



units, such as to the left of output level *X,* the slope of the tangent is quite steep. The marginal cost for the first few units is high because employees must be hired, suppliers must be found, and marketing channels must be opened. Therefore, the cost of starting operations and producing the first few units may be extremely high. Expanding output beyond the first few units allows the organization to achieve smooth, efficient production techniques. At normal production rates, the marginal cost of making additional units is relatively low. At high levels of output (output level *Y*), additional costs are incurred because of constraints on the use of space, machines, and employees. Machines are more likely to fail when operating at or near capacity. Labor costs increase because employees are paid for overtime. Therefore, the marginal cost of making additional units when operating near capacity is higher than under normal operations.

By definition, a fixed cost is not an opportunity cost of the decision to change the level of output. The decision to expand output usually does not affect property insurance premiums. Therefore, property insurance is a fixed cost with respect to volume and is not a cost when deciding to increase output.

Just because a cost is fixed with respect to volume changes, it can still be managed and reduced. A firm can reduce insurance premiums by increasing deductibles or by lowering the risks being insured (installing fire alarms and sprinkler systems). Many fixed costs can be altered in the long run by closing a plant. If a cost is fixed, this does not mean it is a constant and known with certainty. Fixed costs vary over time due to changes in prices. But fixed costs do not vary with changes in the number of units produced.

Another important cost term is **average cost**. Average cost per unit is calculated by dividing total cost by the number of units produced. Average cost is the slope of the line drawn from the origin to the total cost curve and is depicted in Figure 2–2 as the slope of the line from point *O* through point *C*.[3] The average cost at output level *Z* represents the cost *per unit* of producing *Z* units. For the pattern of costs in Figure 2–2, the average cost per unit is very high at low levels of output but declines as output increases. The average cost per unit increases as output nears capacity. Notice that at *Z* units of production, the average cost is larger than the marginal cost. (The slope of *OC* is steeper than the slope of the tangent at point *C*.)

[3]Recall that the slope of a line is the ratio of the change in its vertical distance divided by the change in its horizontal distance. In Figure 2–2 , the slope of the line *OC* is the distance *CZ* divided by the distance *OZ*. *CZ* ÷ *OZ* is the total cost of producing *Z* units divided by *Z* units, which is the average cost of producing *Z* units.

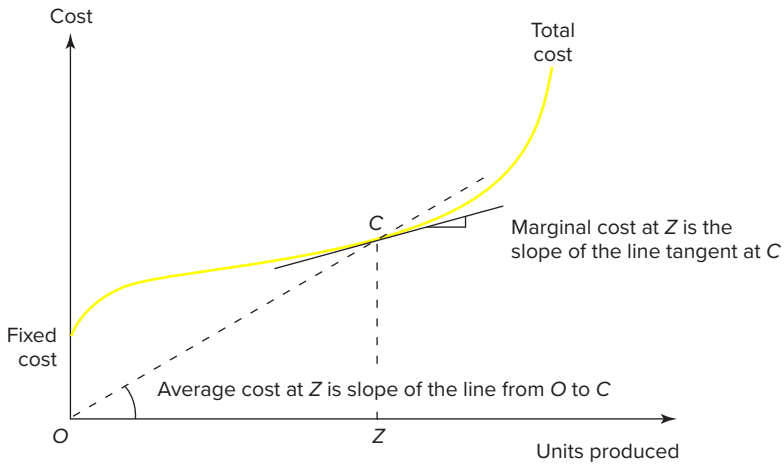
Managerial Application: Metro-Goldwyn-Mayer Inc.

MGM Studios produces and distributes entertainment products worldwide, including motion pictures, television programming, home video, interactive media, and music. The company owns a large film library, consisting of approximately 4,000 titles. MGM significantly improved its operating performance after a careful analysis of the fixed and variable costs of distributing movies to local cinemas. It reduced head count 10 percent and stopped distributing independent films through United International Pictures. It now distributes these films itself. This allowed MGM to convert a large fixed cost into a variable cost.

SOURCE: L. Calabro, "Everything in Moderation," *CFO,* February 2004, pp. 59–65.

FIGURE 2-2

Average and marginal cost



Exercise 2-1

Suppose that a plant making steam boilers has the following costs per month:

Number of Boilers	*Total Cost*
1	$ 50,000
2	98,000
3	144,000
4	184,000
5	225,000
6	270,000
7	315,000
8	368,000
9	423,000
10	480,000

Required:

a. What are the marginal and average costs for each level of output?

b. The plant is currently making and selling eight boilers per month. The company can sell another steam boiler for $53,000. Should the company accept the offer?

continued

Solution:

a.

Number of Boilers	*Total Cost*	*Marginal Cost*	*Average Cost*
1	$ 50,000	$50,000	$50,000
2	98,000	48,000	49,000
3	144,000	46,000	48,000
4	184,000	40,000	46,000
5	225,000	41,000	45,000
6	270,000	45,000	45,000
7	315,000	45,000	45,000
8	368,000	53,000	46,000
9	423,000	55,000	47,000
10	480,000	57,000	48,000

b. The company should reject the offer because the marginal cost of making the ninth boiler is $55,000, whereas the price is only $53,000. The average cost of $47,000 should not be used in this decision.

2. Linear Approximations

The cost of changing production levels is not always easy to estimate. Estimating the total cost curve in Figure 2–1 requires knowledge of both fixed cost and how the total costs of facilities, labor, and materials vary as the rate of production increases. Such estimates are difficult to obtain, so managers often approximate these costs. One such approximation assumes the curve is linear instead of curvilinear.

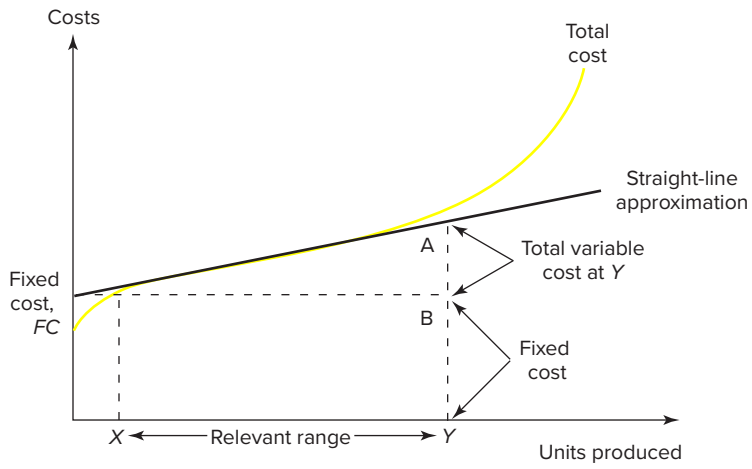
An approximation of total cost in Figure 2–1 using a linear cost curve is displayed in Figure 2–3. In this figure, estimating total cost requires an estimate of the *y*-axis intercept and the slope of the straight line. The intercept, *FC*, approximates the fixed costs. The slope of the line is the variable cost per unit. **Variable costs** are the additional costs incurred when output is expanded. When Honda expands the production of minivans at a particular plant from 200 to 250 vans per day, it must buy more parts, hire more employees, use more power, and so forth. Variable costs include all costs that increase as more minivans are produced.[4]

In Figure 2–3, the straight line represents the sum of the fixed and variable cost approximations of total cost. The line is closest to the total cost in the range of normal operations. This range between output levels *X* and *Y* is called the *relevant range.* The **relevant range** encompasses the rates of output for which the sum of fixed and variable costs closely approximates total cost. Because the slopes of the total cost curve and the straight-line approximation are about the same, the variable cost is a close approximation of the marginal cost. In the relevant range, variable cost can be used to estimate the cost of making additional units of output.

Notice that variable cost per unit approximates marginal cost per unit. The slope of the variable cost line is constant as the activity measure increases. Variable cost per unit is usually assumed to be constant. Later chapters relax this assumption. The terms *marginal cost* and *variable cost* are often used interchangeably, but the two are not necessarily the

[4]While most managers understand intuitively the difference between fixed and variable costs, not everyone does. When asked the difference between a fixed cost and a variable cost, one employee replied, "A fixed cost? If it's broke, I fix it and it costs me." See R. Suskind, "Guys Holding Axes and Chainsaws Get to Use Any Name They Like," *The Wall Street Journal,* February 26, 1992, p. B–1.

FIGURE 2-3
Linear approximation of total cost



same. Marginal cost refers to the cost of the last unit produced and in most cases varies as volume changes. In some situations, marginal cost per unit does not vary with volume. Then marginal cost (per unit) and variable cost per unit are equal.

The straight-line approximation of total cost can be represented by the following equations:

$$\text{Total cost} = \text{Fixed cost} + \text{Variable cost}$$
$$\text{Total cost} = \text{Fixed cost} + (\text{Variable cost per unit})(\text{Units produced})$$
$$TC = FC + VC \times Q$$

where *TC* represents total cost, *FC* represents fixed cost, *VC* is variable cost per unit, and *Q* is the number of units. For example, suppose the fixed cost is $100,000 per month, the variable cost per unit is $3, and 15,000 units are to be manufactured. Total cost is calculated to be $145,000 (or $100,000 + $3 × 15,000 units). The total cost of $145,000 is an estimate of the cost of manufacturing 15,000 units.

3. Other Cost Behavior Patterns

Some costs vary with output (variable costs) and others do not (fixed costs). Between these two extreme cases are step costs and mixed (semivariable) costs. Each of these is described in turn and illustrated in Figure 2–4.

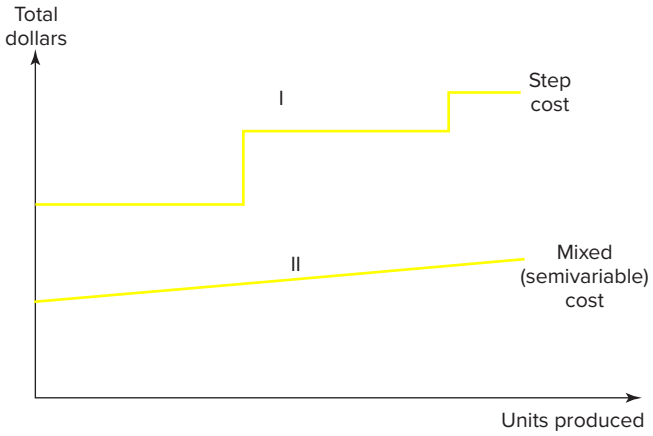
Step costs

One type of cost behavior involves **step costs**, expenditures fixed over a range of output levels (line I in Figure 2–4). For example, each supervisor can monitor a fixed number of employees. As output expands, more employees are needed and eventually another supervisor is added. Hence, supervisory personnel expenditures are a step function. Likewise, once the number of transactions a computer system can process is exceeded, the firm must acquire a larger machine. Expenditures on data centers often behave as step costs.

Mixed (semivariable) costs

Many costs cannot be neatly categorized as purely fixed or variable. The cost of electricity used by a firm is a good example. Producing more output requires some additional electricity. But some portion of the electric bill is just for turning on the lights and heating or cooling the plant whether the plant produces 1 unit or 50,000 units. In this case, the cost of electricity is a mixture of fixed and variable costs. **Mixed** or **semivariable costs** are cost categories that cannot be classified as being purely fixed or purely variable (line II in Figure 2–4).

FIGURE 2-4
Step and mixed costs



4. Activity Measures

The discussion so far has focused on how total cost varies with changes in output (units produced). Output is the *measure of activity.* Consider a steel mill that makes 1 million tons of two-inch steel plate in one month and 1 million tons of one-inch steel plate in the next month. The cost of the one-inch steel plate will likely be higher because more work is required to roll out the thinner plate. In this factory, costs vary not only with weight of the output but also with its thickness. In general, costs vary based on units produced as well as on the size, weight, and complexity of the product.

In many costing situations, managers choose a single activity measure, such as the total number of toys painted or pounds of toys painted. This activity measure is then assumed to be the primary cost driver. The **cost driver** is that measure of physical activity most highly associated with variations in cost. For example, in the painting department, the quantity of paint used often will be chosen as the cost driver if it has the highest association with total costs in the painting department.

An input measure, such as the quantity of paint used, is often used as a single cost driver to capture the many factors and to simplify the process of estimating total cost. The choice of the activity/volume measure is often critical to the perceived variation of costs. This issue is discussed in greater detail in Chapter 11.

The problem with using a single activity measure is that it can be correct for one class of decisions but incorrect for others. Such categorizations indicate how costs vary but only for that particular decision. For example, expanding the volume of an existing product in a given plant will cause a different set of costs to vary than will adding a new product line in the same plant or expanding the volume of a given product by building a new plant. Consider an automobile assembly line producing a single car model. Adding 125 cars per day of a second car model costs more than increasing production of the existing model by 125 cars. More labor is required to schedule, order parts, and store them for two different models than if just one model is produced. Thus, the variable costs of 125 cars depend on whether the additional cars are for an existing model or a new model.

Some costs are fixed with respect to some decisions but not others. Consider machine setups. Before a computer-controlled milling machine can begin milling parts, a technician must set up the machine by loading the proper computer program, loading the correct tools into the machine, adjusting the settings, making a few parts, and checking their tolerances. Once set up, the machine can produce a large number of parts without another machine setup. The cost of the setup is the cost of the technician's time, the material used to check the machine, and the forgone profits of not using the machine while it is being set up.

This setup cost is independent of the number of units produced and thus is a fixed cost. However, if the machine produces 1,000 parts per batch, expanding volume from 1,000 parts to 2,000 parts doubles the number of setups and doubles the setup costs. On the other hand, if the plant increases volume to 2,000 parts by doubling batch size, setup costs remain fixed. Therefore, classifying setup costs as being either fixed or variable can be right for some decisions and wrong for others, depending on whether batch sizes change. If some decisions cause batch sizes to change and others do not, then any classification of setup costs as fixed or variable will be wrong for some decisions.

Exercise 2-2

Total cost in the painting department of a toy factory varies not only with the number of toys painted but also with the sizes of the toys, the types of surfaces painted, the kinds of paint applied, and so on.

Paint costs $15 per gallon. To set up the painting machines to paint a part costs $500, which includes cleaning out the old color. Using the paint machine for one hour costs $70, which also includes the labor to operate it.

A particular part with 4,200 pieces in the batch requires 10 gallons of paint and eight hours of paint machine time.

Required:

Calculate the total cost to paint this batch.

Solution:

Using multiple activity bases, the cost of painting this part is calculated as

Setup cost	$ 500
Paint (10 gallons × $15 per gallon)	150
Machine time (8 hours × $70 per hour)	560
Total painting cost	$ 1,210

Notice that the cost of painting the parts includes a fixed setup cost of $500, which does not vary with the number of parts painted.

Concept Questions

Define *mixed cost* and give an example.

Define *step cost* and give an example.

Define *fixed cost.*

Define *variable cost.* Is it the same as marginal cost? Explain.

C. Cost-Volume-Profit Analysis

1. Copier Example

Once costs are classified into fixed/variable categories, managers can perform cost–volume–profit analysis. The following example illustrates the essential features of this analysis. Suppose Xerox Corp. has a walk-up copy division that places coin-operated

color photocopying machines in public areas such as libraries, bookshops, and supermarkets. Customers pay 25¢ per copy and the store providing the space receives 5¢ per copy. Xerox provides the machine, paper, toner, and service. Machines are serviced every 20,000 copies at an average cost of $200 per service call. Paper and toner cost 4¢ per copy. Xerox's walk-up copy division is charged $150 per month per machine placed (the opportunity cost of the machine). The variable costs per copy are

Paper and toner	$ 0.04
Store owner	0.05
Service ($200 ÷ 20,000)	0.01
Variable costs	$ 0.10

The **contribution margin** is the difference between the price and the variable cost per copy. The contribution margin is the net receipts per copy that are contributed toward covering fixed costs and providing profits. In this example, the contribution margin is calculated as

Price	$ 0.25
Less variable costs	(0.10)
Contribution margin	$ 0.15

Given the contribution margin and monthly fixed costs, the number of copies each machine must sell monthly to recover fixed costs is the ratio of fixed costs to the contribution margin. This quantity of copies is called the **break-even point** and is calculated as

$$\text{Break-even point} = \frac{\text{Fixed costs}}{\text{Contribution margin}} = \frac{\$150}{\$0.15} = 1{,}000 \text{ copies}$$

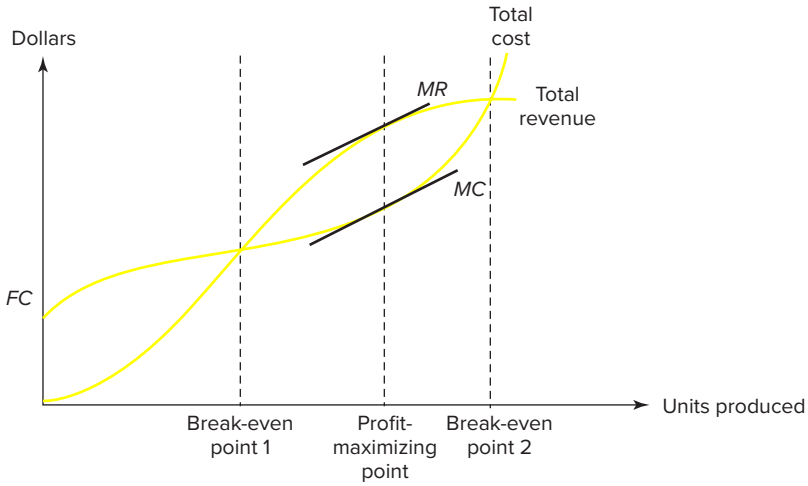
In other words, if the copier makes 1,000 copies each month, it produces net receipts (after variable costs) of $150 (or 1,000 × $0.15), which is just enough to recover the fixed costs.

The Xerox copier example illustrates that classifying costs into fixed and variable components provides a simple decision rule as to where to place copiers. If a store is expected to produce (or actually produces) fewer than 1,000 copies per month, a copier should not be located there. The break-even volume provides a useful management tool for where to place machines.

2. Calculating Break-Even and Target Profits

Let us study the cost–volume–profit analysis further. For simplicity, assume that production equals sales (to avoid inventory valuation issues such as the LIFO/FIFO choice). Also assume that the firm produces a single product. Figure 2–5 displays the total cost and revenue of producing various levels of output. The total revenue curve has a decreasing slope beyond some quantity because more unit sales can be achieved only at lower prices. At high prices, volumes are low. As prices fall, volume increases and the slope of the total revenue curve becomes less steep. The total cost curve, also nonlinear, is the same cost curve depicted in Figure 2–1. Break-even occurs when total revenues equal costs. In Figure 2–5, two break-even volumes exist, labeled "Break-even point 1" and "Break-even point 2." The profit-maximizing point of output occurs when marginal

FIGURE 2–5
Total cost and revenue curves



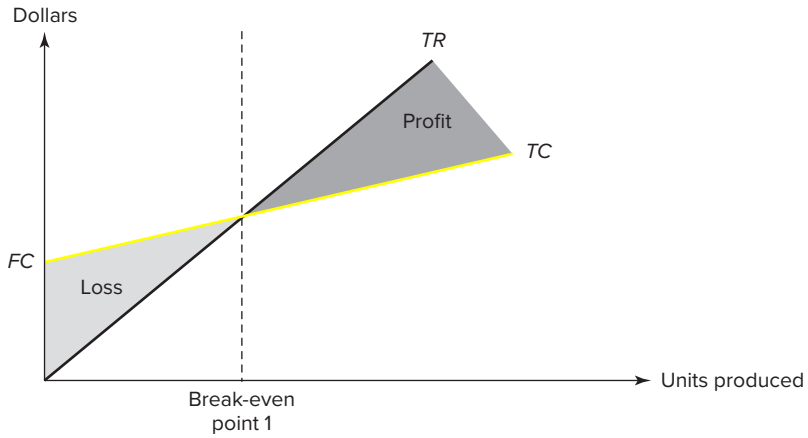
MC: Marginal cost is the slope of the total cost curve.
MR: Marginal revenue is the slope of the total revenue curve.
MC and *MR* are equal at the profit-maximizing point.

revenue equals marginal cost ($MR = MC$). **Marginal revenue** refers to the receipts from the last unit sold. At any point, marginal revenue is the slope of the line just tangent to the total revenue curve.

As described in section B, it is difficult to estimate nonlinear functions. Linear approximations are often used. Figure 2–6 substitutes linear cost and linear revenue approximations for nonlinear curves. Instead of allowing price to vary with quantity, assume a constant price, P. The total revenue function, TR, is then

$$TR = P \times Q$$

FIGURE 2–6
Straight-line approximations of cost and revenue curves and cost–volume–profit analysis



FC: Fixed cost
TR: Total revenue equals a constant price times total output ($P \times Q$)
TC: Total cost equals fixed costs plus the variable cost per unit times output ($FC + VC \times Q$)

where Q is output. If the firm can sell as much as it wants without affecting price, then assuming a linear revenue function, TR, does not distort the analysis. Likewise, total cost is assumed to follow a linear function of the form

$$TC = FC + VC \times Q$$

where FC is the fixed cost and VC is the variable cost per unit. For the moment, ignore income taxes.

Using straight-line approximations of total revenue and total cost allows managers to simplify analyzing how profits vary with output. In particular,

$$\text{Profit} = TR - TC = P \times Q - VC \times Q - FC \tag{2.1}$$

$$\text{Profit} = (P - VC) \times Q - FC \tag{2.2}$$

Break-even volume is the number of units sold that just covers fixed and variable costs. To find break-even volume, Q_{BE}, set equation (2.2) equal to zero and solve for Q_{BE}.

$$\text{Profit} = 0 = (P - VC) \times Q_{BE} - FC \tag{2.3}$$

$$Q_{BE} = \frac{FC}{P - VC} = \frac{FC}{\text{Contribution margin}} = \frac{FC}{CM}$$

Price minus variable costs ($P - VC$), the contribution margin per unit (CM), is the profit per unit sold that can be used to cover fixed costs (FC). Contribution margin is important because it measures the incremental net receipts of selling one more unit. Refer to Figure 2–6. If units produced is less than the break-even point, a loss occurs. If output exceeds break-even quantity, a profit is earned.

Note that the estimated break-even point, Q_{BE}, will not exactly correspond to the "real" break-even point, where total revenue equals total cost. The discrepancy occurs because TR and TC do not represent exactly total revenue and total costs, respectively.

Suppose we want to make a target after-tax profit of Profit_T and the income tax rate is t. We can compute the number of units needed to make an after-tax profit by modifying equation (2.2) and solving for Q_T, target output:

$$\text{Profit}_t = [Q_T \times (P - VC) - FC] \times (1 - t) \tag{2.4}$$

$$Q_T = \frac{\text{Profit}_t}{(1 - t) \times CM} + \frac{FC}{CM} \tag{2.5}$$

Instead of memorizing this formula, it is better to start with equation (2.1) or (2.2) and make the necessary modifications to solve the particular problem at hand. Exercise 2–3 illustrates how to modify the formula.

Exercise 2-3

DGA Tile manufactures ceramic flooring tiles. DGA's annual fixed costs are $740,000. The variable cost of each tile is $0.25, and tiles are sold for $6.50. DGA has a combined state and federal tax rate of 30 percent.

Required:

a. How many tiles does DGA need to make and sell each year to earn an after-tax profit of $85,000?

b. DGA must pay 10 percent of before-tax profits as a royalty payment to its founder. Now how many tiles must DGA make and sell to generate $85,000 after taxes? (Assume the royalty payment is not a tax-deductible expense.)

Solution:

a. Let Q denote the number of tiles made and sold that generates $85,000 of after-tax profit. Given the preceding data, we can write

$$(\$6.50Q - \$0.25Q - \$740{,}000)\,(1 - 0.30) = \$85{,}000$$
$$(6.25Q - \$740{,}000) \times 0.70 = \$85{,}000$$

Solving for Q:

$$\$4.375Q = \$85{,}000 + \$740{,}000 \times 0.70$$
$$Q = 137{,}829 \text{ tiles}$$

Therefore, to generate an after-tax profit of $85,000, about 138,000 tiles must be sold.

b. The formula with the royalty payment, R, is

$$(\$6.25Q - \$740{,}000) \times 0.70 - R = \$85{,}000$$

where

$$R = (\$6.25Q - \$740{,}000) \times 0.10$$

Substituting R into the earlier equation,

$$(\$6.25Q - \$740{,}000)\,(0.70 - 0.10) = \$85{,}000$$
$$Q = \quad 141{,}067$$

Exercise 2-4 illustrates another use of contribution margins. It involves choosing the most profitable product to produce when capacity is constrained.

Exercise 2-4

The Ralston Company produces three shirts. It only has 200 machine hours per day to produce shirts and has the following cost and production information:

	Basic	*Deluxe*	*Super*
Selling price	$7.50	$9	$13
Variable cost of production	$6.00	$7	$7
Machine hours to complete one shirt	0.6	2	3
Demand per day (shirts)	50	50	50

Ralston has fixed costs of $75 per day. How many shirts of each type should be produced?

Solution:

The opportunity cost of producing one type of shirt arises from not using those machine hours to produce another type of shirt. In this problem, to maximize firm profits in light of a capacity constraint, we must produce those products with the highest contribution margin *per unit of capacity*. First calculate the contribution margin per shirt and then convert this to the contribution margin per machine hour.

continued

	Basic	*Deluxe*	*Super*
Selling price	$7.50	$9	$13
Variable cost of production	$6.00	$7	$7
Contribution margin per shirt	$1.50	$2	$6
Hours to complete one shirt	÷ 0.6	÷ 2	÷ 3
Contribution margin per machine hour	$2.50	$1	$ 2
Demand per day (shirts)	50	50	50
Production schedule (shirts)	50	10	50
× Hours to complete one shirt	0.6	2	3
Hours consumed	30	20	150

To maximize profits, Ralston should produce the shirt(s) with the highest contribution margin per unit of scarce resource (machine hours). This is an application of the opportunity cost principle. Even though Super has the highest contribution margin per unit, Basic has the highest contribution margin per machine hour. Therefore, to maximize profits, produce 50 units of Basic, which will consume 30 hours (or 50 units × 0.6 hours per unit). Next, produce 50 units of Super, which consumes 150 hours of capacity. This leaves 20 hours of capacity to be used to produce 10 units of Deluxe.

The preceding analysis suggests producing the market demand for Basic and Super but not for Deluxe. Fixed costs never enter the analysis. By definition, fixed costs are fixed and cannot be relevant to the decision, which depends only on selling price, variable cost, and the capacity constraint.*

*One artificial aspect of this exercise is that the quantity demanded and the price are taken as constants. Clearly, at lower prices, more shirts will be demanded. Fixed demand is assumed to simplify the problem.

The Ralston Company example illustrates a very simple situation in which there is only one constraint. If there are multiple constraints, linear programming is a useful technique for identifying the profit-maximizing mix of products. The next section describes some of the shortcomings of cost–volume–profit analysis.

3. Limitations of Cost-Volume-Profit Analysis

Exercise 2-5

Using equation (2.2), find the output, Q, that maximizes profits.

Solution:

Profits are maximized by setting output to infinity. That is, equation (2.2) cannot be used to maximize profits.

Exercise 2–5 illustrates that cost–volume–profit analysis is not useful for choosing the profit-maximizing output quantity when both revenues and costs are assumed linear. Given this conclusion, what good is it? Cost–volume–profit analysis offers a useful place to start analyzing business problems. It gives managers an ability to do sensitivity analysis