FOURTH EDITION

MANAGEMENT ACCOUNTING FOR MANAGERS

AN INTERACTIVE USER-ORIENTED PRIMER

David W. Young, D.B.A.

The 4th Edition of Management Accounting for Managers

Enables faculty to introduce contemporary management accounting and control theory and concepts, and, when combined with cases from The Crimson Press Curriculum Center, can contribute in a significant way to student learning.

Key Features:

- An interactive text, with problems throughout each chapter for students to solve so they learn as they go along
- One (sometimes two) case studies (with solutions in an appendix) at the end of each chapter to help solidify student learning
- A focus on users rather than preparers of management accounting information
- Three sections (full cost accounting, differential cost accounting, and responsibility accounting) that describe the multiple uses of management accounting information
- Examples of service organizations as well as manufacturing organizations to illustrate the concepts

Faculty Comments about David Young's texts and cases:

- His frequent use of real-world examples enhances student comprehension
- He makes complex concepts on management control easy to understand
- His inclusion of practice cases greatly enhances student learning
- He is a master at successfully integrating didactic materials with real-world situations
- His cases are fun to teach and provide just the right amount of context and challenge for both masters students and executives.
- I have used his case studies in my courses for over a decade
- His cases are short and to the point, but rich in educational content

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Fourth Edition

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INTRODUCTION

This primer is written for individuals who use or will use management accounting in their day-to-day managerial activities but who do not aspire to become management accountants. It assumes no prior formal exposure to management accounting concepts or techniques, and, while it demonstrates several techniques in some detail, its primary emphasis is on the *use*, rather than the *preparation,* of management accounting information. As such, the goal is to help managers be more effective in a business environment where an understanding of management accounting is important to success. A related goal is to give readers an improved ability to communicate with their organizations' accountants to help assure that the management accounting information provided to line managers and others is as useful as possible for decision making.

Management accounting information can be classified into three areas: full-cost accounting, differential cost accounting, and responsibility accounting. Exhibit I-1 lists the specific learning objectives within each of these three areas. As it indicates, many of the learning objectives are either behavioral or organizational in nature, especially in the area of responsibility accounting.

Exhibit I-1. LEARNING OBJECTIVES

Full Cost Accounting (Chapters 1, 4, and 5)

- The meaning of the terms *cost object, cost center, direct costs, indirect costs, overhead costs, cost allocation,* and *cost systems*
- The way costs can be allocated to determine the full cost of a particular product or service
- The distinction between production (or mission) centers and service centers
- The nature of the managerial choices inherent in a cost accounting system
- Overhead rates and overhead variances, including predetermined overhead rates
- The distinction between absorption costing and variable costing
- The concept of activity-based costing (ABC) and the role of second-stage cost drivers

Differential Cost Accounting (Chapters 2 and 3)

- The rationale for the statement "different costs are used for different purposes"
- The distinction between full costs and differential costs, and when each should be used
- The nature of the factors that influence changes in cost, including the distinction among fixed, variable, step-function, and semi-variable costs
- The technique of cost-volume-profit analysis, how to prepare such an analysis, and its uses and limitations
- The nature of alternative choice decision making, and the types of alternative choice decisions that most organizations make
- The concepts of unit contribution margin and total contribution, and their roles in alternative choice decision making

Responsibility Accounting (Chapters 5-12)

- The definition of a responsibility center, the different types of responsibility centers, and the basis for choosing the most appropriate type
- The definition of a transfer price and its role in a responsibility accounting system
- The phases of the management control process and the characteristics of each
- The formal techniques used to asses the financial viability of a capital investment proposal
- The special considerations faced by nonprofit and public sector organizations in capital budgeting

- The key elements of a good operational budgeting process, including its relationship to responsibility centers
- The distinction among the capital budget, the operating budget, and the cash budget.
- The considerations involved in preparing a cash budget
- The meaning of the term "flexible budget" and its role in a responsibility accounting system
- The technique of variance analysis, its uses and limitations, and the relationship between it and management reporting
- Some of the issues involved in measuring non-financial performance
- The linkages among the responsibility accounting system and other organizational activities, including the organization's strategy formulation process

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KEY CHARACTERISTICS

This primer is nontraditional in three important respects: its user orientation, its organizational focus, and its emphasis on interactive learning.

User Orientation

While it would be nice if a user orientation could be achieved without working through some of the details of accounting, that is unrealistic. However, accounting details are discussed only to the extent that they are needed to describe the concepts and techniques used in most organizations. The phrase *used in most* is key in this regard. In general, the text does not cover exceptions to the rules or some of the possible variations on traditional themes. However, each chapter contains footnotes that assist a reader to pursue a particular topic if he or she wishes to do so.

The focus on users is based on the fact that management accounting is one the most neglected topics in both the popular business literature and management education. Its neglect is partially a result of the fact that most organizations delegate the design of the needed systems to the accounting department, but accounting training in most schools and universities gives the topic only cursory treatment. The goal of most undergraduate accounting programs, for example, is to prepare students to become CPAs and enter public accounting, and there are very few questions on the CPA exam concerning management accounting. Given that many CFOs began their careers in public accounting, the unfortunate consequence is that they have had little formal education in management accounting principles. What they know they have learned on the job, and, as a result, their knowledge frequently is incomplete and sometimes ill-informed. This is especially true in the arena of responsibility accounting, where in many schools of management there are no courses that address the topic in even a minor way.

Despite this lack of formal responsibility accounting training on the part of most organization's accounting staffs, all organizations, even the tiniest, engage in some form of responsibility accounting. In large organizations the responsibility accounting system tends to be formal; in smaller ones it is often quite informal. Responsibility accounting has been around as long as organizations have been in existence, but it often could be more comprehensive and sophisticated if senior and middle managers took an active role in its development and ongoing operation. By having a user orientation, this primer aims to help these managers be more effective in carrying out that role.

Organizational Focus

Many texts use manufacturing examples to illustrate management accounting concepts and principles. This primer uses both manufacturing and non-manufacturing examples. Some examples are of service organizations and some are of nonprofit organizations. Since most management accounting concepts are universal, the type of organization used to illustrate a point is relatively unimportant. Service and nonprofit organizations are used as examples in recognition of their growing importance in

the economy, and to help readers see the universal applicability of the concepts. Moreover, examples have been chosen with the hope that they will "resonate" with the reader as an organization with which he or she has some familiarity. The same is true for the practice cases.

Interactive Learning Process

A key philosophical underpinning of the primer is that the development of new skills requires practice. Learning management accounting is a bit like learning to get around in a new city. If another person took you on many drives around the city, you would learn very little about the location of landmarks and how to get from one place to another. If you took a single drive by yourself, however, you would learn a great deal about the city—far more than you would learn in dozens of trips as a passenger.

In this primer, you are more of a driver than a passenger. Throughout each chapter you are given opportunities to practice using the techniques covered. You do so by preparing answers to problems that appear throughout the chapter, and by analyzing one or two practice case studies at the end of the chapter. The idea behind these interactive materials is to shorten the "feedback loops" in the learning process. Rather than waiting until the end of a chapter to answer questions or analyze problems, you are asked to do so immediately following the discussion of a particular topic. Sometimes, if the discussion of a topic is lengthy, there are problems within it.

Deceptively Short Chapters. Some of the chapters may seem rather short. Unlike chapters in some other texts, however, they are not meant to be read quickly. Because of the interactive nature of the learning process, you should move through each chapter at a relatively slow pace. Depending on your own speed of mastering the material, your coverage of a chapter might take several hours. Additionally, you also may find that you need time to digest the material as you go along, so you should not try to work through the whole primer in a single sitting.

Nature of the Problems. You can best prepare for the problems by having a pencil and a calculator next to you while you are reading a chapter. A problem begins with a dotted line like the one below.

Problem: The problem is in a smaller type font like this, and ends with a pencil, as follows:

Immediately following the pencil is a space that should be sufficient for you to work out a solution, followed by another dotted line.

Answer: The answer to the problem, also in a smaller type font, immediately follows this second dotted line, and ends with a third dotted line.

You should work out the solution in the space provided and then compare it and your associated reasoning to the answer that is given. If you had the right answer, you should continue reading. If you had the wrong answer, you should spend as much time as you need to figure out where you went wrong. This may require rereading the section of the chapter immediately preceding the problem. Similarly, if you believe you understand the material in a particular section, and therefore do not need to read that section, you might prepare answers to the section's problems to verify your understanding.

Nature of the Practice Case Studies. As with the problems, you should attempt to analyze the practice case(s) at the end of each chapter to the best of your ability before looking at the solutions (which are contained in the Appendix at the end of the primer). As the case(s) cover some of the concepts discussed in the chapter, they will give you an opportunity to test your knowledge of the chapter's content, generally in a broader, more managerially oriented context than with the problems.

Some of the practice cases are are quite short, and might even be thought of as extended problems. Others, especially those in the chapters on responsibility accounting, are somewhat longer and more involved. In most instances, a case describes a situation where there is no right answer. There may be correct *accounting* answers, but, as you will see, there sometimes is considerable room for judgment, and perhaps disagreement with the answer given in the Appendix.

Thus, what may seem like a simple problem frequently has some of the flavor of a more typical organizational decision-making situation. As such, the practice cases require you to be thoughtful—to apply a chapter's principles rather than just memorize them. Indeed, the cases require analysis, judgment and attention to nuances, all of which increasingly are required for success in real world organizational settings.

Skipping the Interactive Materials. If you are seeking an overall understanding of management accounting, you may wish to skip the interactive materials and simply read the text. Much depends on your goals, your prior knowledge, your available time, and other factors. However, the deepest learning takes place when you attempt to answer the problems and cases to the best of your ability before looking at the solutions.

If you are considering skipping the interactive materials, you should bear in mind that while management accounting is rather intuitive, a true understanding of its subtleties and intricacies requires working with the concepts and techniques to see how they are used in practice. This can happen most effectively via the interactive materials. Regardless of how you approach the interactive materials, however, you should work through the chapters in order, since the discussion in each assumes an understanding of the material covered in previous ones.

ORGANIZATION OF THE PRIMER

Each chapter is discussed briefly below. The Table of Contents shows the major headings of each chapter. As mentioned above, the Appendix contains solutions to the practice cases.

Chapter 1. Essentials of Full Cost Accounting

The question "What did it cost?" is one of the trickiest in accounting for all organizations—manufacturing, service, and nonprofit. This chapter discusses the kinds of managerial decisions that are made in answering this question, as well as the managerial utility of full cost information. It also links the cost accounting effort to the economist's three factors of production: land, labor, and capital.

Chapter 2. Cost Behavior

The notion that different costs are used for different purposes is a basic underpinning of management accounting. This chapter explains why such a notion is important, focusing in particular on cost behavior, and including the distinction among fixed, variable, step-function, and semi-variable costs. It takes up the subject of cost-volume-profit (CVP) analysis, looking at CVP analysis (sometimes called *breakeven* analysis) in its most basic form, and then examining a variety of special considerations that can serve to complicate it.

Chapter 3. Differential Cost Accounting

Chapter 2 identifies a number of instances where full costs are inappropriate for decision-making, and where a manager needs to analyze cost behavior. This chapter takes that idea one step further, showing how full costs are inappropriate for several types of decisions that managers frequently must make. These decisions, called *alternative choice decisions,* occur when a manager must analyze cost behavior under two or more approaches to accomplishing a particular task. The chapter discusses how full cost information can lead managers to make decisions that are financially detrimental to the

organization, and makes the point that for alternative choice decisions the appropriate information is differential costs.

Chapter 4. Absorption Costing

Chapter 1 focuses principally on service organizations. Chapter 4 looks at various types of costs that exist in a manufacturing setting and shows how to compute cost of goods manufactured and cost of goods sold with job order and process systems. The chapter also discusses overhead rates, including predetermined overhead rates, flexible overhead budgets, the computation of overhead variances, and the managerial uses of overhead variances.

Chapter 5. Activity-Based Costing and Variable Costing

This chapter first examines the concept of activity-based costing (ABC) and cost drivers, including second-stage cost drivers. Many service and manufacturing organizations are using ABC as a way to both measure costs more accurately and exert greater control over them. Thus, this chapter also bridges forward to the chapters on responsibility accounting. In addition, it looks at the distinction between absorption costing and variable costing, and discusses the advantages and disadvantages of each.

Chapter 6. Responsibility Accounting: An Overview

This chapter emphasizes the distinction between measuring and managing resources, a key underpinning of responsibility accounting. It begins with an analysis of the relationship between cost accounting and responsibility accounting systems, and then moves into the realm of responsibility accounting. To design a good responsibility accounting system, a manager must think about both the *responsibility accounting structure* and the *management control process*. The chapter puts most of its emphasis on structure, discussing the different types of responsibility centers that can exist in an organization, the basis for choosing one type over another, and the relationship between the responsibility accounting structure and the organization's formal authority structure. The chapter also briefly describes the characteristics of the four phases of the management control process: programming, budgeting, measuring, and reporting.

Chapter 7. Key Issues in Designing the Responsibility Accounting Structure

This chapter expands upon the concepts covered in Chapter 6, and discusses the topics of transfer prices, residual income, fairness, and goal congruence. Inadequate senior management attention to these four topics—either individually or in combination—explains why many responsibility accounting systems fail to achieve the goal of allowing managers to exert control over the resources for which they are being held responsible.

The chapter also examines three important issues: (a) the link between the responsibility center structure and the organization's motivation system, (b) some of the informal matters that arise in the context of decentralizing responsibility in large, complex organizations, and (c) the issues that senior managers must consider in order to make either profit or investment centers work to the overall benefit of the organization, including some tricky design matters in matrix-like organizations. It concludes by emphasizing the contingency notion of responsibility accounting systems, i.e., that there is no one *right* responsibility accounting system. Rather, a responsibility accounting system must *fit* with the organization's strategy and structure.

Chapter 8. Programming

Because money can earn interest, a given sum of money received at some point in the future is worth less than that same sum received today. This concept lies at the heart of capital budgeting, where an organization invests some money today so as to receive some returns on that investment over a number of years in the future. This chapter discusses some of the techniques for analyzing investments using the

concept of present value. It also looks at the effect of taxes and accelerated depreciation on a capital investment decision, and examines the issues involved in choosing a discount rate for assessing a capital project, including how companies deal with risk in assessing a capital investment proposal. The chapter concludes with a discussion of political, behavioral, and other considerations that can serve to influence senior management's choice of a proposal, including ways that programming links to both an organization's culture and its conflict management processes.

There are two appendices associated with this chapter. The first discusses the concept of net present value. The second discusses some of the special programming issues faced by nonprofit and governmental organizations in attempting to assess non-financial benefits.

Chapter 9. Operational Budgeting

In addition to capital budgets, which flow from the programming phase of the management control process, organizations typically prepare both operational budgets and cash budgets. The budgeting phase of the management control process usually entails preparation of both. This chapter focuses on the operating budget. Among the topics addressed are the relationship between responsibility centers and the operating budget, the organizational and strategic contexts in which budgeting takes place, the mechanical aspects of building a budget, and a description of seven important linkages between the budget and other organizational activities.

Chapter 10. Cash Budgeting

Preparation of the cash budget is largely an accounting function that is driven by the combination of the capital and operating budgets (discussed in the two previous chapters). However, to the extent that the cash budget indicates some anticipated cash shortfalls, senior management needs to be involved in determining the approaches that the organization will take to raise the requisite funds. In particular, the chapter focuses on the choices that managers make about (a) the use of debt or equity to finance assets, (b) the structure of debt, (c) the magnitude of net income, and (d) the management of growth. The chapter relates the capital budget (which emerges from the programming phase discussed in Chapter 8) and the operating budget (discussed in Chapter 9) to cash forecasts. The chapter concludes with a description of the statement of cash flows—the formal financial accounting document that shows the results of these sorts of decisions.

Chapter 11. Measuring and Reporting

Two important phases in the management control process are those that measure and report information to managers. This chapter discusses them, placing particular emphasis on flexible budgets and variance analysis—techniques that allow managers to identify the reasons underlying a difference between budgeted and actual revenues and expenses. It also discusses the limitations of variance analysis, and some of the criteria that are necessary for a good reporting process. It concludes with the topic of measuring and reporting *non-financial performance,* an issue that is taking on increasing importance in many organizations.

Chapter 12. Management Accounting in Context

This chapter briefly summarizes the material in the first eleven chapters and places it into a broader context. It begins with a discussion of the idea that different costs are used for different purposes, and then summarizes the criteria for a good responsibility accounting system. Next, it positions responsibility accounting systems as one of several activities that take place in an organization and that must be integrated if the organization is to be successful. The chapter concludes with a "Managerial Checklist" concerning these interrelationships.

Chapter 1. Essentials of Full Cost Accounting

The question "What did it cost?" is an important one for managers to answer in many different organizational settings. Arriving at an answer is much more difficult than it might first appear. Obviously, the question is rather easily answered if we are discussing the purchase of inputs (supplies, labor, and so on) for a production or service-delivery process. Even calculating the full cost of a unit produced—be it a wide-bodied jet plane or a manicure—is relatively easy as long as the organization is producing goods or services that are completely homogeneous. Complications arise, however, when an organization produces multiple goods and services, particularly when it uses different kinds and amounts of resources to manufacture the goods or provide the services.[1]

The purpose of this chapter is to address some of the key decisions that are made in designing a full cost accounting system, and to discuss how those decisions can influence an answer to the "What did it cost?" question. In this regard, you should be aware of three important considerations. First, the chapter is not meant to be an all-inclusive description of cost accounting; rather, its goal is to provide an introduction to the topic. Second, we will be looking at service organizations as examples to illustrate the principles. This is because cost accounting can be quite complicated in other kinds of organizations, especially manufacturing companies. The key concepts and principles are best seen in relatively uncomplicated settings, such as those of service organizations. We will look at cost accounting for manufacturing companies in Chapter 4.

The third consideration is that there is considerable disagreement among managers and accountants over the best way to calculate full costs. There even is disagreement as to whether *full* cost is the most appropriate calculation. Indeed, many managers and accountants believe that a computation of full costs is inherently distorted, and therefore of little value for managerial decision-making. Nevertheless, for purposes of this chapter, we will assume that senior management wishes to know the full cost of providing a particular service, and we will look at the choices it must make to arrive at that figure.

ORGANIZATION OF THE CHAPTER

The chapter begins with a discussion of the uses of full cost information. It then turns to the broad set of issues that must be considered in calculating costs. Next, it looks conceptually at the activities that influence the use of resources, linking cost accounting to the economist's three factors of production: land, labor, and capital. Following this, the chapter turns to an assessment of the basic decisions that must be made in calculating full costs, or the *cost accounting methodology*. The chapter concludes by looking at the effect of the cost accounting methodology on an important managerial decision: pricing an organization's goods or services.

USES OF FULL COST INFORMATION

Information on the full cost of carrying out a particular endeavor has three basic uses: pricing, profitability assessments, and comparative analyses.

Pricing

A basic functions of cost information is to assist management in setting prices. Clearly, cost information is not the only information that management uses for this purpose, but it is an important ingredient in the decision-making process. Many firms are "price takers;" that is, they must accept

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[1] The term "product" refers to either a good or a service. Throughout the primer, I will use this term when I am referring to either. I also will use "good" and/or "service" when the distinction is important.

whatever price prevails in their market. In these instances, prices are not based on costs but on the market. For other firms, especially market leaders, cost information is much more important to the pricing decision, although even these firms must consider other factors.

One such factor might be the goal to increase market share, which may justify setting a price below full cost.[2] A firm also may price one product below full cost to increase its sales, which may lead to the sale of other products at prices set well above full cost. For example, Hewlett-Packard (or a similar company) may sell its printers at or below full cost in an effort to maximize printer sales. Once consumers have printers, they will purchase toner cartridges and paper, which is where the company earns most of its profits. Of course, if a firm is to deliberately price below full cost, it must have a good understanding of its costs. Thus cost information remains an important ingredient in price setting.

Cost-Plus Pricing. An important variant of pricing based on full cost is cost-plus pricing. With cost-plus pricing, a purchaser agrees to pay full cost plus an agreed-upon increment, usually a percentage. Many government contracts are written this way, especially in the defense industry, where the argument is made that the activities needed to design and manufacture a product are so uncertain that it would be impossible to determine the cost in advance, and hence set a reasonable price.

Profitability Assessments

Even firms that are price takers must calculate full costs if management is to know whether a particular product is profitable. There are a variety of actions that management might take if a product is not profitable on a full-cost basis, which we will examine in Chapters 2 and 3. For the moment, it is sufficient to say that if the price for a good or service is not greater than its full cost, the product is a "loss leader." Since a company cannot have all its products be loss leaders, cost accounting serves to highlight where the cross subsidization is taking place, thereby allowing senior management to assess whether pricing decisions are consistent with the organization's overall strategy.

Comparative Analyses

Many organizations can benefit from comparing their costs with those of similar organizations manufacturing similar goods or delivering similar services. Organizations that have franchises, for example, no doubt find it useful to compare the costs of different franchisees. Full cost information can assist in this effort. Other organizations may have access to industry norms either via common knowledge, trade associations, or other sources. For example, in the restaurant industry there are well-established norms for each cost element as a percent of revenue. This applies not only to food and beverage costs, but to all other items, such as linens, cleaning, and so forth.

Analyses such as these usually present a variety of comparability problems. If, for example, we were making such a comparison, we would need to know whether the organizations with which we are comparing ourselves measure their costs in the same way we do. Typically this is not a concern for a company with, say, franchised operations, since the cost accounting effort for franchisees can be standardized. In other types of organizations, however, there can be a variety of complexities.[3]

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[2] This is quite different from "predatory pricing," in which a large firm sets its prices below full cost in an effort to drive smaller firms out of the industry.

[3] For a discussion of the sorts of issues that an organization must consider, see David W. Young, "Cost Accounting and Cost Comparisons: Methodological Issues and Their Policy and Management Implications," *Accounting Horizons,* Volume 2, Number 1 (March 1988).

Problem: Northern College, a small private liberal arts college, is interested in comparing its cost per student with the cost per student in some other similar colleges. What are some of the issues it must consider in making this comparison? Please write your thoughts below before reading the analysis that follows.

Answer: The college must consider issues such as average class size, the existence of specialized programs in athletics, art, music or other subjects, special services (such as career counseling), whether it wishes to include room and board and/or the library costs in the comparison, and the method used to calculate the cost (e.g., whether it amortizes its library collections and, if so, over what time period), and a variety of similar matters.

As this example suggests, the definition of what is to be included in a "full cost" calculation requires a managerial decision. Indeed, because there is such a wide range of choices embedded in an organization's cost accounting system, managers frequently find it difficult to compare costs between their organization and other similar organizations where the cost accounting choices may have been made differently.

ISSUES TO CONSIDER IN CALCULATING FULL COSTS

If senior management does not wish to undertake pricing, profitability assessments, or comparative analyses, it does not need to become involved in the effort to calculate full costs. Rather, it can delegate the responsibility for cost calculation to the accounting staff. Generally accepted accounting principles (GAAP) require manufacturing companies to calculate the full manufacturing cost of the products they produce to determine a cost of goods sold figure that abides by GAAP's matching principle. Therefore, these organizations must undertake a full cost accounting effort if they are to receive a clean opinion on their audited financial statements. Senior management usually does not become involved in this effort.

In most merchandising and service organizations, full cost accounting is not required by GAAP. Indeed, in merchandising organizations, the cost of goods sold figure generally includes only the cost of the items that the company sold during the relevant accounting period. All other operating items are expensed as incurred. Few if any merchandising organizations will make an effort to allocate these items to their products so as to obtain the "full cost" of each product sold.

In situations where a "third party payer" pays on the basis of cost, an organization usually must calculate its full costs according to certain guidelines. The organization then must submit the resulting cost report to the third party before receiving payment.

This sort of requirement by an oversight organization happens in many instances where a governmental entity reimburses an organization's costs.

Example: When the federal government contracts with a university to do research, the university's reimbursement must be in accordance with the principles set forth in the Office of Management and Budget's *Circular A-21, Cost Principles for Educational Institutions*. These principles provide for direct costs plus "an equitable share" of overhead costs. Overhead costs include a use allowance for depreciation of buildings and equipment, operations and maintenance of plant, general administration, departmental administration, student administration and services, and library.[4]

[4] For additional details, see David W. Young, *Management Control in Nonprofit Organizations,* 10th Edition, Cambridge Massachusetts, The Crimson Press, 2016.

But these are the exceptions. In most merchandising and service organizations, there is no requirement to calculate full costs. Rather, full costs are calculated only if senior management believes the information will assist them in decision making. Because of this, some service and merchandising organizations do not undertake a full-cost accounting effort, and some manufacturing organizations do no more than satisfy the requirements of GAAP.

Example: Most restaurants do not calculate the full cost of a meal. Instead, the chef computes the cost of the ingredients for each item on the menu, and the item's price is set at a certain markup over the ingredient cost. The difference between the price and the ingredient cost must cover the costs of kitchen labor, bussers, expediters, the wait staff, management, and all other operating expenses. As indicated above, management then typically computes each expense item (such as kitchen labor) as a percentage of total revenue and uses industry standards to see if it is on target. However, senior management makes no effort to determine, for example, the cost of kitchen labor included in each meal. As a result, the cost of goods sold on a restaurant's financial statement refers only to ingredients, and not to labor.

Role of Senior Management

As the above discussion suggests, if senior management sees a need for cost information, it can compute costs in a variety of ways, many of which can be defended as valid. However, because the cost-accounting effort is inherently complex in any good sized organization, some approaches to computing full costs can produce quite misleading results. Moreover, in many organizations, the cost accounting effort is complicated by matters such as product mix, standby capacity, customers' use of related products and services, seasonal purchase patterns, managerial efficiency, and periodic changes in wages and supply prices. Nevertheless, if senior management has made the decision to calculate full costs, it then must work with its accounting staff to select an appropriate methodology.

The expression "work with" rather than "delegate to" highlights an important distinction. Because the analytical issues are complex, the decisions are not ones that can be delegated completely to the accounting staff. Rather, senior management must be intimately involved in setting the ground rules for the cost accounting effort, and in guiding the work of the accounting staff. Otherwise, the information that emerges from the effort may be of little managerial use. Indeed, because there is no one "right" full cost figure, managers with differing needs will set different ground rules, and request that the cost accounting decisions be made in different ways. Moreover, the decisions may change at different times in the life of an organization as managers' needs change. Consequently, the key question is "What does management find useful for decision making?" It is this question that must drive the cost-accounting effort.

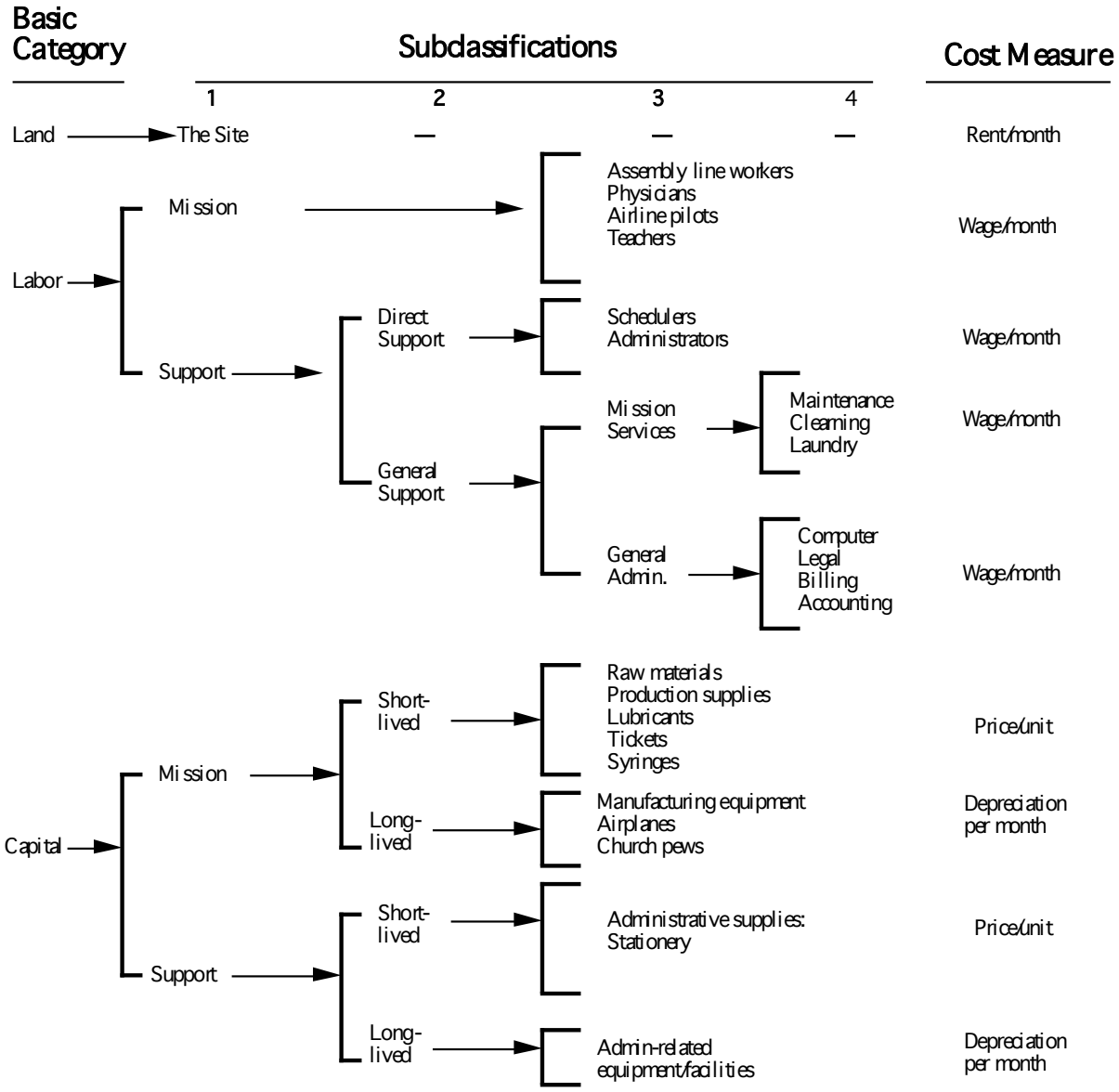
Because there are no cost-accounting rules similar to GAAP in financial accounting, we need to examine the conceptual structure that underlies a cost-accounting effort, after which we will look at several key cost accounting decisions. These decisions will affect the way the accounting staff gathers and presents information for the purpose of determining the full cost of an organization's products.

RESOURCE USAGE: A CONCEPTUAL FRAMEWORK

The fundamental issue that cost accounting addresses is the *use of resources*. Accordingly, an appropriate question to ask is "What are these resources and how might they be defined and measured?"

At the most fundamental level, the resources used in any organization—manufacturing, merchandising, or service—are the classic ones of the economist: land, labor, and capital. These resources are shown schematically in Exhibit 1-1. Take a few minutes now to review this exhibit so you can relate it to the following discussion.

Exhibit 1-1. RESOURCE USAGE: A CONCEPTUAL FRAMEWORK



Land

Land is the simplest of the three resources. Unlike the other two, it has no sub-classifications. It can be somewhat complicated for agricultural firms or companies in the extraction industries (oil, coal, etc.), but in general, it consists of the properties on which a company's plants and offices are located.

Labor

Labor can be sub-classified into *mission* (sometimes called *production)* and *support*. Mission labor comprises the individuals who actually manufacture the organization's goods or deliver its services—that is, personnel who are directly associated with the organization's main mission. Support labor consists of everyone else in the organization. It can be subdivided between *direct support* and *general support*.

Direct support consists of the activities that take place within any given *mission department* (e.g., scheduling production in a factory or providing secretarial support for a research project). General support can be related to mission services or it can be part of general administration. If the former, it includes centralized functions that assist the organization's production departments but that are organized separately from them, such as central maintenance or cleaning. General administration consists of the organization's central office staff activities, which typically are not directly related to specific production departments. These activities include computer operations, payroll, purchasing, legal work, and billing.

Capital

Capital also can be looked at as either mission or support. The former includes all capital resources needed to provide direct support to the manufacturing or service-delivery activity. It can be divided between *short-lived* (used up in one year or less) or *long-lived* (used up over several years).

Short-lived mission capital consists of *raw materials* (sometimes called *direct* materials) and *production-related supplies*. Raw materials are the items in a manufacturing effort that enter the final product; that is, the items to which a manufacturer adds value. Production-related supplies do not enter the final product. Instead they support the manufacture of that product. They range from lubricants in a factory to tickets in a symphony orchestra. Long-lived mission capital includes equipment and facilities used in production or service-related activities. Manufacturing plant and equipment, airplanes, classroom facilities, church pews, and x-ray machines are all examples of long-lived mission capital.

Support capital is also either short-lived or long-lived, and consists of those items that provide general support rather than being associated directly with manufacturing or service delivery. Supplies used in the president's office of an oil company or the controller's office of a hospital would be examples of short-lived support capital. Similarly, equipment such as centralized photocopying machines, fax machines, or a computing center would be considered long-lived support capital.

Units of Measure

Land is rather easily measured in terms of rent per unit of time (e.g., a month) per unit of land (e.g., a square meter or foot). An exception is land that "depletes" over time, such as land from which minerals or oil are being extracted. The complications associated with depletion are beyond the scope of this primer.

The cost of labor is measured by wages—either per unit of time (e.g., an hour) or per unit of activity (e.g., a visit, flight, etc.). Short-lived capital—either mission or support—usually is measured in terms of the factor price per unit, i.e., what the organization paid to obtain the item. Long-lived capital typically is measured in terms of depreciation per unit of time.

THE FULL COST ACCOUNTING METHODOLOGY

The conceptual framework in Exhibit 1-1 serves to put cost accounting into its broader economic context. Specifically, the principal objective of full cost accounting is to measure as accurately as possible the consumption of resources associated with producing a particular good or delivering a particular service. In some instances, the measurement process is quite easy.

Example: An organization that produces a single good or service will have little difficulty in calculating the cost of each unit. All land, labor, and capital costs associated with the organization can be added together and divided by the number of units produced during a particular accounting period to arrive at a cost per unit.

Problem: Lawncare, Inc. (LI) does gardening work. From management's perspective, the company produces a single product: an hour of gardening work, and it wishes to calculate its cost per hour. Last year, LI had total costs of $350,000 and delivered 15,625 hours of service. What is LI's cost per hour? Make your calculations below.

Answer: Under these circumstances, the cost accounting process is simple: $350,000 ÷ 15,625 hours = $22.40 per hour of service.

Organizations that produce a variety of goods or services, each requiring different amounts of land, labor, and capital, will have a much more difficult time determining the cost for each unit sold. For example, the cost accounting process for Lawncare, Inc. would become somewhat more complex if senior management wished to distinguish between its hourly cost for lawn mowing and its hourly cost for other gardening services.

This more complex process requires management to make several decisions to determine the cost of each activity. The decisions include (1) defining a cost object, (2) determining cost centers, (3) distinguishing between direct and indirect costs (sometimes called *traceable* and *non-traceable* costs), (4) choosing bases to allocate overhead costs, (5) selecting an allocation method, and (6) attaching costs to cost objects. Taken together these six decisions constitute the cost accounting methodology.

Decision #1. Defining the Cost Object

The cost object is the unit of good or service for which we wish to know the cost. Generally, as the cost object becomes more specific, the methodology needed to account for the associated costs becomes more complex. In some acute care hospitals, for example, the cost object is a day of care. Sometimes the day is "all inclusive;" that is, it includes surgical procedures, laboratory tests, radiology exams, pharmaceutical usage, and so on. When this is the case, calculating the cost of a day of care is as simple as the above calculation for Lawncare, Inc.

In most hospitals, however, there are several cost objects, each of which is more specific than an all-inclusive day of care. In some instances, for example, it is a day of care for "routine" activities only (e.g., room, dietary, housekeeping, laundry, and nursing costs), with separate cost objects for other activities, such as laboratory tests. Obviously, various other combinations are possible, and even the routine/non-routine distinction is not used in a uniform way among similar institutions. For example, nursing supplies may be classified as routine in some hospitals and as non-routine in others.

Hospitals also could consider a totally different cost object from a day of care, such as an admission (or discharge). If an admission were the cost object, the hospital would include all costs associated with the patient's entire stay (i.e., for all days of care, rather than just an average single day).

In general, then, depending on the particular cost object chosen, we would have a need for either different kinds of cost information or different ways of analyzing and presenting that information. As a result, the choice of a cost object can have a significant effect on the answer to the question "What did it cost?" In effect, the cost object defines the *it* in the question.

Problem: LI's management has decided to become more specific about its activities. It has classified them into lawn mowing and special projects. The latter category includes activities such as trimming shrubs, fertilizing, and weeding. What do you think should be the cost object for LI? Write the various possibilities below for *Mowing* and for *Special Projects*, and choose one. What criteria did you use in making your choices?

Mowing

Special Projects

●●●

Answer: In the mowing category, the possibilities would seem to be (1) a mown lawn; (2) a mown lawn of a certain size (perhaps distinguishing among large, medium, and small lawns); (3) a mown lawn of a certain complexity (perhaps distinguishing among flat lawns with no trees or complications, compared to lawns with steep slopes, or many trees, or many small areas where a mower won't fit; and (4) an hour of lawn mowing.

In the Special Projects category, we might identify fertilizing, hedge trimming, weeding, and other services as potential cost objects. If we did so, we would need to make some of the same size and complexity distinctions we made for lawns. Alternatively, we might use an hour of time.

●●●

Final versus Intermediate Cost Objects. For simplicity purposes, an hour of time would seem to be the best approach. The choice of an hour of time poses a small problem in that customers will most likely want to know the price for an entire job, rather than LI's cost. The price will be LI's cost plus a markup. LI then would need to look at the customer's project, determine the number of hours needed, calculate a total estimated cost, and add its markup to determine its price. In effect, then, a "job" becomes a cost object, and just as no two jobs are alike in an automobile repair garage, a law office, a custom home builder, and many other "job order" organizations, no two LI jobs would be alike. As a result, LI would need to link its cost object (an hour of service) to the customer's cost object (a completed job).

Because of this need, managers tend to distinguish between *final* and *intermediate* cost objects. A final cost object typically is the unit that fits with the price charged to a customer. Intermediate cost objects are smaller units that are summed to produce the final cost object. For example, at Lawncare, Inc., whereas the final cost object is a mown lawn (or a completed special project), the intermediate cost object would be an hour. In this regard, an important question is whether the cost of an hour of mowing is the same as the cost of an hour of special projects. To answer this question, we need to examine some of the other cost accounting choices.

Decision #2. Determining Cost Centers

Cost centers are categories used to collect cost information, and they therefore affect how cost data will be accumulated. To best understand how they work, consider again the organization that provides a single product. The organization would treat itself as a single cost center, thereby creating a relatively simple cost accounting system. In this case, the category used to collect cost information would be the organization itself.

If it provides more than one product, the organization would need to subdivide itself into several cost centers—such as manufacturing, administration, maintenance, and the like—for purpose of the cost accounting effort. If this is done, the cost of a particular cost object will be the sum of the costs attributed to it in each of the separate cost centers.

The criteria for selecting an appropriate cost center arrangement will be discussed later in the chapter. At the moment, we are concerned principally with the *effects* of different choices on the full cost of a cost object. In this regard, the distinction between an intermediate cost object and a cost center can

be confusing. On occasion, both can be viewed as "purposes" for which costs are collected; indeed, cost centers are sometimes called intermediate cost objects. The distinction should become clearer in the pages that follow.

Problem: LI is choosing between two cost center arrangements. The first possibility is to make the entire organization into one cost center; the second is to use three cost centers: mowing, special projects, and administration. Cost data are available for administrative supplies ($28,850), mowing supplies ($27,150), special project supplies ($24,000), administrative salaries ($80,000), mowing salaries ($100,000), special project salaries ($70,000), and the contracted maintenance services for the trucks the company uses to transport its mowers to job sites ($20,000).

As with the prior problem, the company provided 15,625 hours of services. These were divided between 11,772 hours of mowing and 3,853 hours of special projects. What would its the costs be under the one-cost-center approach? Under the three-cost-center approach? Make your computations below.

For One Cost Center

For Three Cost Centers

Answer: If we use only one cost center, our computation would look as follows:

Salaries ($80,000+$100,000+$70,000)	$250,000
Supplies ($28,850+27,150+$24,000)	80,000
Contracted services	20,000
Total costs	$350,000
Hours of service	15,625
Cost per unit	$22.40

If we were to use three cost centers, our analysis would give the same overall result, but with a very different structure:

		Cost centers		
Cost items	**Administration**	**Mowing**	**Special Projects**	**Total**
Salaries	$80,000	$100,000	$70,000	$250,000
Supplies	28,850	27,150	24,000	80,000
Contracted services	_____	20,000	_____	20,000
Total	$108,850	$147,150	$114,000	$350,000
Hours of service	— (1)	11,772	3,853	
Cost per hour of service		$12.50	$24.40	$22.40 (2)

Notes:

(1) Hours of service applies to customers only, not administration.

(2) Cost per hour figures do not sum to $22.40 since the $350,000 includes the cost of administration (for which there is no hourly cost of service)

Note that the total cost per hour remains the same in both situations. This must be the case, since total costs ($350,000) and total hours (15,625) are unchanged. What value, then, derives from the extra effort associated with separating the company into three cost centers?

There are two related answers to this question: an accounting-oriented one and a management-oriented one. From an accounting perspective, costs are better understood and more easily computed if they are for relatively homogeneous groupings of activities.

Example: If a photocopying company had an extremely sophisticated photocopying machine and an extremely simple one, it would most likely want to create two cost centers: one for each machine. The sophisticated machine no doubt was more costly to purchase (and hence has higher depreciation), is more costly to service and repair, and perhaps requires a more highly skilled (and hence higher salaried) operator. Calculating the average cost of a photocopy by combining the two machines, their operators, and their other costs would produce a misleading cost figure. The average would overstate the cost of a copy on the simple machine and understate it on the sophisticated machine.

For this reason, senior management's choice of cost centers ordinarily is based on homogeneity; that is, a cost center ideally includes a collection of completely homogeneous activities. Clearly, *complete* homogeneity rarely is possible, and even if it were, the cost of making the requisite computations might be prohibitive. Thus, compromises frequently are necessary. We will return to this issue later in the chapter, after we have covered the remaining cost accounting decisions.

The management-oriented answer to the question is that the choice of cost centers depends largely on senior management's plans for using the information. For example, LI's three-cost-center structure may be helpful to management in pricing its services competitively, or in comparing its costs with those of other lawn care companies. A comparison between LI's hourly mowing cost and that of other similar organizations, for example, could reveal areas of potential inefficiency, and thereby assist management in an effort to streamline the company's mowing operations. Of course, management would need to bear in mind the caveats discussed earlier about the difficulty of making such comparisons.

Production Centers versus Service Centers. In a multi-cost-center structure, an organization's cost centers generally are divided into two broad categories: production centers and service centers. Production centers, as the name implies, are those that produce the organization's goods or deliver its services. They sometimes are called "mission centers" since they are considered to be representative of the organization's mission. In some organizations, they are called "revenue centers," since they are the centers that charge for their products and hence earn revenue.

Service centers, by contrast, contain the costs of those activities the organization carries out to support its production centers. In the above example, Administration would be considered a service center, while Mowing and Special Projects would be production centers. In a larger setting, administration, building-wide depreciation, human resources, and grounds maintenance are examples of activities that ordinarily would be service centers, while manufacturing departments would be treated as production centers.

The cost of a given cost object would then depend on (a) the production center or centers in which a good was manufactured or a customer received services, (b) the number of units of activity that a product (good or service) received in each (such as hours of labor), and (c) the cost for each unit of activity. As we will see in the next few pages, the cost per activity unit in each production center depends, in part, on that center's "fair share" of the organization's service center costs.

Problem: In addition to the cost center decision described in the last example, Lawncare Inc. has decided to establish a machine maintenance department, and to treat the department as a separate service center. In so doing, it hired a mechanic at a salary of $40,000. The maintenance supplies totaled $10,000. What do the company's costs look like now? Enter your computations in the appropriate spaces below.

	Service Centers		Production Centers		
Cost items	**Maintenance**	**Administration**	**Mowing**	**Special Projects**	**Total**
Salaries		$80,000	$ 100,000	$70,000	
Supplies		28,850	27,150	24,000	
Contracted Services			20,000		
Total		$108,850	$147,150	$94,000	

Answer: We now have an additional service center, giving us two service centers and two production centers. Our total costs now look as follows:

	Service Centers		Production Centers		
Cost items	**Maintenance**	**Administration**	**Mowing**	**Special Projects**	**Total**
Salaries	$40,000	$80,000	$ 100,000	$70,000	$290,000
Supplies	10,000	28,850	27,150	24,000	90,000
Contracted Services			20,000		20,000
Total	$50,000	$108,850	$147,150	$94,000	$400,000

At this point, the cost per hour of service becomes somewhat more difficult to calculate, since it now relies on some further decisions. We will thus defer the per-unit calculations until those decisions have been discussed. Note, however, that our total costs have increased to $400,000 as a result of the additional $50,000 for the maintenance department.

Decision #3. Distinguishing Between Direct and Indirect Costs

A third decision inherent in a cost accounting system is the distinction between direct and indirect costs. *Direct costs* are unambiguously associated with, or physically traceable to, a specific cost center. *Indirect costs* apply to more than one cost center, and thus must be distributed among the cost centers that use them.

Again, under the simplest of circumstances, where an organization produced one product in one cost center, there would be no indirect costs, since it would not be possible to have costs that applied to more than one cost center. The creation of multiple cost centers means that some costs become indirect, thereby necessitating their distribution.

The distribution of indirect costs can be carried out in one of two ways: (1) by developing techniques that measure indirect cost usage in considerable detail, or (2) by establishing formulas that distribute them as fairly as possible into the appropriate cost centers.

Problem: The mechanic in the Maintenance cost center at Lawncare Inc. is supervised by someone whose salary at present is included in the Administration cost center. What kind of a cost is the supervisor's salary? Why? What should be done with it? Write a general answer to each question below. Do not attempt to make any calculations yet.

Kind of cost:

Why?

What should be done with it?

Answer: The salary of the supervisor is an indirect cost since it applies to activities in both the Maintenance and Administration cost centers. This means that it must be distributed between the two cost centers.

There are several possible ways to distribute the salary to the two centers. We might ask the supervisor to maintain careful time records, which then could be used to distribute the salary. If we did this, we effectively would have converted the indirect cost into a direct cost, since we would have created a situation in which the cost (time) is physically traceable to each cost center. Alternatively, we might establish a distribution formula, using, say, salary dollars or number of personnel in each cost center as the distribution mechanism.

Problem: Assume we decide to use number of personnel as the means to distribute the supervisor's salary. Also assume that the supervisor's salary is $30,000, and that, other than the supervisor (who does not supervise herself), there are two people working in Administration and one person working in maintenance. How would you distribute her salary? Make your computations below.

Answer: The calculations are as follows:

Salary	$30,000
Number of people supervised	3
Cost per person supervised	$10,000
Distributed to Administration (2 x $10,000)	$20,000
Distributed to Maintenance (1 x $10,000)	10,000
Total distributed	$30,000

The conclusion of this analysis is that $10,000 of the supervisor's salary should be distributed to the maintenance department. As a result, the following adjustments must be made to our costs:

Cost center	Cost	
Maintenance	$ 60,000	($50,000 + $10,000 for supervisor)
Administration	98,850	($108,850 - $10,000 for supervisor)
Mowing (no adjustment)	147,150	
Special Projects (no adjustment)	94,000	
Total	$400,000	

Note that this approach effectively has distributed the supervisor's salary between the two relevant cost centers, based on a distribution formula. Of the $30,000 salary, $10,000 is now in the Maintenance cost center, and $20,000 is in the Administration cost center. Note also that, although we distributed this particular indirect cost between two service centers, we could have an indirect cost that applied to more than two service centers, or even, conceivably, to several service and production centers.

Decision #4. Choosing Allocation Bases for Service Center Costs

The hourly cost of mowing is based on more than just the direct (and, perhaps, distributed indirect) costs of the mowing cost center. It also must include the mowing center's *fair share* of the organization's service center costs. The same is true for the hourly cost of special projects. As you might imagine, the notion of *fair* can be highly debatable in cost accounting—just as it is in other aspects of life.

Determining fair share requires us to *allocate* service center costs (sometimes called "overhead" costs). Thus, the fourth decision in the cost accounting effort is the choice of *bases of allocation*. That is, we choose a metric for each service center that measures its use by the remaining cost centers (both other service centers as well as production centers) as accurately as possible. In this regard, we are seeking the *activity* that *causes* the existence of a service center's costs.

We then determine each remaining cost center's proportion of the activity. For example, if the "activity" for the service center containing plant-wide depreciation is square feet, we determine each other cost center's proportion of square footage. We use that proportion to allocate the service center's costs to all remaining cost centers (both service centers and production centers).

Distribution versus Allocation. It is important to distinguish between "distribution" and "allocation." Distribution, discussed in Decision #3, precedes allocation, and serves to place costs into service and production centers. Costs that are direct for a given cost center need not be distributed, while indirect costs (i.e., those applying to more than one cost center) must be distributed to the centers to which they apply. By contrast, *allocation* places service center costs in production centers to determine the full cost of each production center.

This terminology can be confusing, since *allocation* is sometimes called *apportionment* and vice versa. Moreover, the terms *distribution, allocation,* and *apportionment* occasionally are used interchangeably. In addition to these terminology differences, service center costs that are allocated to revenue centers are often called *indirect costs*. The context usually clarifies the meaning, but, because of

these terminology differences, it is important to understand the processes being used rather than to attempt to memorize the meanings of the terms.

In summary, before we can allocate service center costs, we must (1) determine the direct costs of each cost center, (2) distribute indirect costs to the appropriate cost centers, and (3) choose a basis of allocation for each service center. We then are ready to allocate service center costs to the production centers.

Determining an Appropriate Basis of Allocation. In the case of Lawncare, Inc., we already have determined the direct costs of each cost center and distributed indirect costs to the appropriate cost centers. If we are to determine the cost for each production center, we now must choose an allocation basis for each service center (maintenance and administration at LI) so that we can allocate its costs. How might we go about this?

Let's begin with maintenance. Our goal is to find a basis of allocation that measures the use of the maintenance resource by the other cost centers as accurately as possible. Although several allocation bases may be available, one that might be appropriate is the number of machines. That is, the more machines a receiving cost center has, the more it will use the maintenance resource, and therefore the greater should be its share of the maintenance expense.

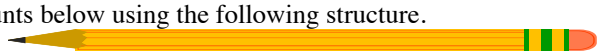
Problem: The following information is available to us about the machines in the cost centers that will receive an allocation from the maintenance cost center:

Cost center	No. of Machines
Administration	2
Mowing	17
Special Projects	11
Total	30

How much of the cost of the Maintenance cost center will be allocated per machine. Write your answer below before continuing.

Answer: The allocation rate is $2,000 per machine ($60,000 of maintenance ÷ 30 machines).

Problem: Given the above calculation, how much maintenance should be allocated to each cost center. Write in your computations and allocation amounts below using the following structure.



Cost center	**Computation**	**Allocation**
Administration		
Mowing		
Special Projects		
Total		

Answer: The amount of maintenance allocated to each cost center would be calculated as follows:

Cost center	Number of Machines	x	Rate	=	Allocation
Administration	2	x	$2,000	=	$ 4,000
Mowing	17	x	$2,000	=	34,000
Special Projects	11	x	$2,000	=	22,000
Total	30				$ 60,000

There are three items of importance here. First, it is possible to allocate maintenance only to production centers and not to other service centers. Alternatively, maintenance could allocated to other service centers (such as we did here with the Administration cost center) as well as to the production centers (Mowing and Special Projects here). This approach, known as the *sequential* or *stepdown* allocation method is discussed more fully in the next section. Second, although maintenance is a service center, it has not been allocated to itself; that is, we do not calculate the cost of maintaining the maintenance department. (This is the reason we do not need to know the number of machines located in the maintenance department.) Third, regardless of the method being used, all costs eventually end up in production centers.

We will defer the allocation of the Administration cost center until we have discussed a few other matters concerning the allocation rate, and until we have looked at Decision #5 (selecting an allocation method).

Determining the Allocation Rate. As the above example suggests, the following formula can be used to determine the allocation rate.

Allocation rate =
Total Costs in the Service Center to be Allocated ÷ Total Units of the Allocation Basis in *Receiving* Cost Centers

The important point to note here is that the denominator of the formula does not include the units of the allocation basis in the cost center from which the allocation is taking place. Nor, in the stepdown method, does it include any units from cost centers that already have been allocated. It includes only the units in *receiving* cost centers. The reason for this will become clear in the next few examples.

Precision of Allocation Bases. In the context of deciding on allocation bases, it should be noted that increased precision generally requires greater measurement efforts and hence higher accounting costs. For example, rather than using number of machines to allocate maintenance costs, we could allocate them on the basis of hours of service. Clearly, while hours of service is a more accurate basis, and would give us a more accurate cost figure, its use requires compiling the necessary data.

A decision to use the more accurate basis depends largely on senior management's planned uses for the information. In some instances, the information can enhance profitability assessments; in others, it may improve pricing decisions; in still others, it may influence the motivation of people responsible for managing the cost centers. These sorts of considerations will determine whether senior management wishes to use more accurate (and generally more costly) allocation bases.

In summary, the more precise the distribution and allocation processes, the more accurately one captures true resource consumption. Exact measurement of resource consumption can be a time-consuming and complicated process, however, and less accurate approaches occasionally are adopted in response to time, staffing, and technical constraints.

Example: The historical basis of allocation for a given service center might be square feet of floor space. Computation of square footage for all cost centers is a one-time activity. Once it has been completed, the service center's costs can be allocated quite easily. By contrast, the hours-of-service method generally requires regular measurement of the number of units of the allocation basis. While the square footage allocation basis can lead to over- or under-representation of the actual use of a service center, the hours-of-

service basis presumably would not have this problem. As with many other full-cost-accounting decisions, if senior management is to use the information, it needs to make the choice. It should be informed by the accounting staff of the options and tradeoffs, but the decision should not be delegated to the accounting staff.

Decision #5. Selecting an Allocation Method

Three methods of varying complexity and accuracy are available for allocating service center costs to production centers: *direct*, *stepdown*, and *reciprocal*.

The Direct Method. With the direct allocation method, service center costs are allocated to production centers only and not to other service centers. This is the simplest method of the three, and is used by many organizations. It is the least precise of the three, however, in that it does not include the cost effects associated with one service center's use of another service center.

The Stepdown Method. The stepdown method sequentially "trickles down" service center costs into both other service centers and production centers. This stepping-down process begins with the first service center in the sequence, and spreads its costs over both the remaining service centers as well as the production centers. The distribution is based on each receiving center's use of the service center's services as determined by the chosen allocation basis. This process is followed for all remaining service centers.

Because it allocates service centers to other service centers as well as to production centers, the stepdown method is more complicated than the direct method, but it's also more precise in that it includes the cost effects associated with one service center's use of another service center. However, once a service center's costs have been allocated, it cannot receive an allocation; thus, for a given service center, the stepdown method includes only the cost effects of its use of the service centers that precede it in the sequence, and not those that follow it.

The Reciprocal Method. The reciprocal method is the most complex technique; in it, all service centers make and receive allocations to and from each other. The allocation amounts are determined by a set of simultaneous equations, which usually are solved on a computer. Because all service centers can both make and receive allocations, the reciprocal method is the most accurate of the three.

An example of the reciprocal method is contained in the Appendix at the end of this chapter. As the appendix demonstrates, the simultaneous equations make this method quite complex. When the number of service centers (and hence simultaneous equations) exceeds three, a human has some considerable difficulty using the method. It is relatively easy for a computer to solve the equations, however. Because of the method's precision, and the increasing availability of the necessary software, the reciprocal method is preferred by the Cost Accounting Standards Board (CASB).

Despite the CASB's preference for the reciprocal method, many organizations find the stepdown method has about the right balance between accuracy and ease of use. We thus will use it here for illustrative purposes.

Choosing a Service Center Sequence. When the stepdown method is used, the sequence followed in allocating the service centers can have an impact on the costs in each production center. The sequence will not affect total costs, however, which will remain the same under all sequences (400,000 for Lawncare, Inc.). Occasionally, the effect of the sequence decision on a particular production center is significant, however. Therefore, the sequence decision should be considered carefully.

In general, the approach to choosing a sequence is to allocate service centers in order of their use by other service centers. That is, the service center that uses other service centers the *least* is allocated *first*,

and the service center that uses other service centers the *most* is allocated *last*. Clearly, considerable judgment is required to determine this sequence.

Problem: What judgment has management made by its decision to allocate the Maintenance cost center before the Administration cost center? Is a similar judgment involved in choosing the sequence of production centers? Why or why not?

Answer: Management's judgment apparently is that the Maintenance Department uses the Administration Department less than the Administration Department uses the Maintenance Department. That is, less effort is spent administering the maintenance department that is spent maintaining the equipment in the administration department. As a result, the totals will include the cost of maintaining the machines in the Administration Department, but not the cost of administering the activities of the Maintenance Department. With regard to production centers, since there is no allocation *out of* production centers, their sequence is unimportant.

Allocating Administration Costs at Lawncare, Inc. We have not yet allocated the costs of the Administration cost center to the remaining cost centers. Doing so will allow us to demonstrate the stepdown method.

As with the Maintenance center, the first step in allocating the Administration center's costs is to choose an allocation basis. There are several alternatives that we might use, such as number of personnel or salary dollars. Assume the company decides to use salary dollars, presumably reasoning that there is a causal relationship between increases in salary dollars in a given cost center and increases in the use of the administration resource by that cost center. Also assume that the following information is available:

Cost center	Initial Salary Costs	With Supervisor Distribution	
Maintenance	$40,000	$ 50,000	(a)
Administration	80,000	70,000	(b)
Mowing	100,000	100,000	
Special Projects	70,000	70,000	
Total	$290,000	$290,000	

Notes: a. $10,000 added for supervisor;
b. $10,000 deducted for supervisor.

Determining the allocation rate per salary dollar for administration is somewhat more complicated than it was for maintenance. This is because total costs in the administration cost center have been increased by the amount allocated to it from the maintenance cost center. When we include the allocation of maintenance, the total costs in the administration cost center become $51,425, calculated as follows:

Direct plus distributed indirect costs ($108,850 - $10,000 for supervisor)	$98,850
Maintenance allocation	4,000
Total costs to be allocated	$102,850

You may wish to return to the data on previous pages to verify the sources of these figures.

Problem: Since the administration costs must be allocated to the remaining cost centers (Mowing and Special Projects), and since the basis of allocation is salary dollars, we need to determine the allocation rate, i.e. administration dollars per salary dollar. Make this computation below. Careful, this is a little tricky.

Answer:

Total costs to be allocated =	$102,850	
Total salary dollars =	$170,000	($100,000 in mowing + $70,000 in Special Projects)
Allocation rate =	$0.605 per salary dollar	

Note that, as specified in the formula above, the denominator for the rate calculation has used only the salary dollars in the two *receiving* cost centers, i.e., the cost centers to which the administration costs are to be allocated. We have not included the salary dollars for either the Maintenance or Administration cost centers in the denominator of the computation.

We can't use salary dollars from the Maintenance cost center since Maintenance costs already have been allocated, and, with the stepdown method, once a cost center's costs have been allocated, it cannot receive allocations. This is why the *sequence* of service center allocations is an important consideration under the stepdown approach. (As discussed earlier, this problem is avoided with the *reciprocal allocation* technique.)

We can't use salary dollars from the Administration cost center, since to do so would result in an inability to fully allocate all of the Administration costs. The reason for this may be unclear at the moment; it will be clarified once we have allocated the costs of the Administration cost center.

Problem: Use the above allocation rate to allocate administrative service costs to the remaining cost centers.

Receiving cost center	Salary Dollars	x	Rate	=	Allocation
Mowing					
Special Projects					
Total					

Answer: The allocation of the Administration service center costs now can be carried out as follows:

Receiving cost center	Salary Dollars	x	Rate	=	Allocation
Mowing	$100,000	x	$0.605	=	$60,500
Special Projects	70,000	x	$0.605	=	42,350
Total	$170,000				$102,850

Note that the full $102,850 has been fully allocated to Mowing and Special Projects. Also note that if we were to use the salary costs in Administration, as well as in Mowing, and Special Projects, to determine the allocation rate, the rate would not allow us to fully allocate the $102,850.

If you do not understand why the $80,000 in Administration salaries are excluded from the denominator in calculating the rate, you should carry out the allocation of the Administration cost center *including* the $80,000 in the denominator, and observe what happens. The allocated costs will not total $102,850, meaning that you will not have fully allocated the Administration costs to the receiving cost centers.

Final Step. The final step in this stage of the cost accounting effort is to determine the cost of each production centers, as follows:

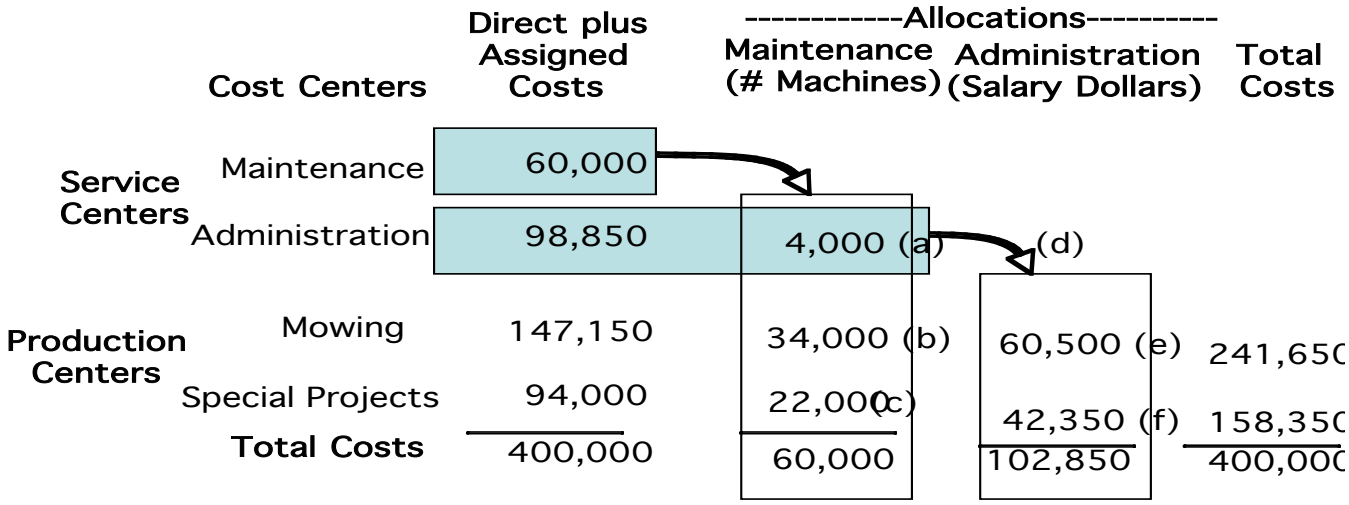
	Direct	Allocated Costs		Total
Production Center	Costs	Maintenance	Administration	Costs
Mowing	$147,150	$34,000	$60,500	$241,650
Special Projects	94,000	22,000	42,350	158,350
Total				$400,000

Note that our total costs of $400,000 remain the same as they were prior to the allocation of service center costs. However, we now have fully allocated the service center costs (Maintenance and Administration) to the two production centers. We did so by first allocating the Maintenance service center costs to the Administration service center as well as to the two production centers, and then allocating the Administration service center costs (with its maintenance allocation included) to the two production centers.

Summary of the Allocation Process. In summary, the total costs in a given production center are the sum of (a) its direct costs, (b) any indirect costs distributed to it, plus (c) the costs allocated to it from the service centers. Exhibit 1-2 shows this process schematically, using the service and production centers for Lawncare, Inc. You should spend a few minutes now reviewing this exhibit and relating it to the discussion that follows so that you can see how it works. The stepdown method is a little tricky, so be sure you spend enough time to make sure you understand all of its elements.

The process used to prepare Exhibit 1-2 begins with the total of direct and distributed costs in the Maintenance Department. This amount of $60,000 is located in the *row* labeled "Maintenance." The total *allocated* maintenance costs are shown in the *column* labeled "Maintenance." The allocations are shown in the box, with the $60,000 total at the bottom. As this column shows, the $60,000 in the Maintenance service center has been allocated to the Administration service center and the two production centers.

Exhibit 1-2. THE STEPDOWN PROCEDURE



Notes:

(a) $2,000 per machine x 2 machines = $4,000
(b) $2,000 per machine x 17 machines = $34,000
(c) $2,000 per machine x 11 machines = $22,000
(d) Administration costs = $102,850 ($98,850 + $4,000); per salary dollar = $0.605 ($102,850 ÷ $170,000)
(e) $0.605 per salary dollar x $100,000 salary dollars = $60,500
(f) $0.605 per salary dollar x $70,000 salary dollars = $42,350

The use of number of machines as the basis of allocation for Maintenance is shown by including the term "# machines" in parentheses at the top of the "Maintenance" column.

With the allocation of the maintenance costs, the Administration service center now has a total of $102,850 to be allocated, i.e. its $98,850 of direct plus distributed costs, *plus* the $4,000 of maintenance that was allocated to it. These amounts are shown in the heavily outlined box in the Administration row (the sum of the two amounts is not shown). Administration costs are allocated using salary dollars (shown in parentheses at the top of the Administration *column)*, and the box shows the allocation of the $102,850 to the remaining cost centers, i.e., the two production centers in this case. The total amount allocated is shown at the bottom of the column.

As discussed previously, Note *d* in Exhibit 1-2 is of particular importance. In calculating Administration costs per salary dollar, the denominator consists of the salary dollars in the Mowing and Special Projects cost centers only, i.e. the receiving cost centers.

In summary, the total costs in an organization's production centers are determined by a combination of their direct and distributed indirect costs, plus the costs allocated to them from the service centers. The stepdown method shown in Exhibit 1-2 illustrates the formal technique used to carry out the process.

Key Aspects of the Stepdown Method. There are several important points to keep in mind when carrying out an allocation effort using the stepdown method.

1. Only service center costs are allocated; production center costs are not. Production centers receive costs from service centers, but once a service center cost has been allocated to a production center it stays there.
2. To carry out the stepdown process, a *basis of allocation* must be chosen for each service center. The basis attempts to measure the use of that cost center's resources by the other cost centers—both service centers and production centers. For example, in organizations that have a laundry (such as a hospital or a hotel) "pounds of laundry" frequently is used as the basis for allocating the costs of a laundry service center. Each cost center thus receives a portion of the institution's laundry costs in accordance with its proportion of the total pounds of laundry processed. If a particular cost center used no pounds of laundry, it would not receive any allocation from the laundry cost center.
3. The amount of a given service center's costs allocated to a particular production center will depend, in part, on whether that service center is allocated early or late in the sequence. If it is allocated late in the sequence, it will contain some costs from service cost centers allocated earlier in the sequence. If it is allocated early, it will not.
4. Total costs do not change. All that changes with different distribution methods, allocation bases, and stepdown sequences is the distribution of total costs among the various production centers.

Decision #6. Attaching Costs to Cost Objects

A final decision in a full cost accounting system concerns the way production center costs are "attached" to an organization's cost objects. Although there is a range of choices, we will look here at only the two ends of the spectrum. At one end is the *process system,* which typically is used when all units of output are roughly identical. The production of chairs, plastic cups, and so on— activities often performed by a production line—usually calls for a process system of cost accounting. All production-related costs for a given accounting period are calculated and then divided by the total number of units produced to give an average cost per unit.

At the other end of the spectrum is a *job order system,* which typically is used when the units of output are different. A good example is an automobile repair garage, where adding all costs for a given accounting period, such as a day, and dividing by the number of cars repaired to determine an average cost per repaired car, would provide quite misleading information to management (and unfair prices to customers). Instead, the cost accounting system uses a job ticket on which the time and parts associated with each repair effort are recorded separately, and then are costed out by means of hourly wage rates, unit prices, and so on.

Job order and process systems are discussed in greater detail in Chapter 4. As we will see there (and also in Chapter 5), attaching costs to cost objects can be quite tricky at times.

EFFECT OF THE METHODOLOGY ON PRICING DECISIONS

Since all of the cost-accounting decisions discussed in the previous section have an impact on costs, they frequently will affect an organization's pricing decisions as well. This is especially true in those situations where prices are based almost exclusively on full costs.

Of all the decisions discussed in the previous section, the two that typically require the most judgment from senior management are the definition of a cost object and the determination of cost centers. The distinction between direct and indirect costs is largely a matter for the accounting staff. The choice of allocation bases and the selection of an allocation method require some involvement by senior management, but largely with regard to the balance between the precision that a particular basis or method provides versus the cost of using it.

Defining the Cost Object

Defining an organization's cost object requires senior management's judgment about how a given cost object fits with its pricing policies. In LI's case, as discussed previously, the *final* cost object probably is a job, since this is how most customers think about LI's work. However, senior management also will be interested in the cost per hour—which would be its intermediate cost object.

The Importance of the Cost Center Choice

Lawncare, Inc.'s cost per hour depends to a great extent on senior management's choice of cost centers. As a result, this choice is an extremely important one.

Problem: LI currently bills its customers on the basis of number of hours spent on a job. How would its hourly rate differ between the one-cost-center and multi-cost-center approaches? (Recall that 11,772 hours were spent in Mowing and 3,853 hours in Special Projects.) Make your computations before continuing.

One Cost Center

Multiple Cost Centers

Answer: If the company used one cost center, it would calculate its hourly cost as follows:

Total costs	$400,000
Total hours	15,625
Average cost per hour	$25.60 ($400,000 ÷ 15,625)

If, on the other hand, the company decided to use multiple cost centers, it would have different rates for Mowing and Special Projects. Its cost per hour for each would look as follows:

Activity	Total cost	Number of hours	Cost per hour
Mowing	$241,650	11,772	$ 20.53
Special Projects	$158,350	3,853	$41.10

Cost Homogeneity as a Goal in Choosing Cost Centers. The potential use of the multiple cost center approach raises the issue of deciding on the most appropriate number and kind of cost centers. So far, we have focused most of our attention on the *impact* of one versus several cost centers, and we have addressed only briefly the criteria for choosing the most appropriate cost center structure.

As discussed earlier in the chapter, the main objective in choosing cost centers is to organize costs into homogeneous collections of activities. When this is the case in a service center, and when an appropriate allocation basis has been chosen, we can be fairly certain that the portion of the service center's costs that are allocated to other cost centers is a reasonably fair measure of their use of that service center.

Similarly, with homogeneous activities in a production center, the portion of the center's costs that are attached to a cost-object passing through (or worked on in) that center are completely dependent on the *amount of time* the product spent in the cost center, not on *what happened* to the product while it was in the cost center (since, if the cost center consists of homogeneous activities, the same activities will take place for every cost object; the only difference will be the length of time that they take place).

Consider the photocopying example from earlier in the chapter, where there were two photocopying machines: a simple one and a sophisticated one. If senior management sets up each machine as a separate cost center, the cost of a job will depend on (a) the rate for the machine that is used and (b) the amount of time the machine is used. The cost thus will come close to the true consumption of resources. If, on the other hand, senior management uses one cost center, the cost will be based on an average rate for the two machines. It will overstate the cost of using the simple machine, and understate the cost of using the sophisticated one.

Unfortunately, resource and time constraints sometimes make it necessary to group heterogeneous activities into a single cost center. When this happens, the costs that are allocated to a receiving cost center or attached to a cost object will not be solely a function of the allocation basis or the time the product spends in a given cost center. They also will depend on the nature of the activities that take place while the cost object is in the cost center.

Problem: What additional information would you like to have about the maintenance cost center at LI to determine if it is appropriately structured as a single cost center or if it should be divided into two or more cost centers? Write your answer below before continuing.

Answer: We would like to know what sorts of activities take place in the Maintenance cost center, and whether there are different kinds of maintenance that would influence the costs allocated to Administration, Mowing, and Special Projects. For example, we would like to know if mowing machines require special equipment to maintain that is not used for maintaining equipment in administration or special projects. If this is the case, we probably need two cost centers: one for Special Equipment Maintenance and one for General Maintenance.

Problem: Assume we create the two maintenance cost centers suggested above. What might we use as the allocation bases? What additional information would you need to collect as a result?

Answer: We probably still could use the number of pieces of equipment in a receiving cost center, but we now would want to determine which equipment used which maintenance cost center. Thus, the costs of the Special Equipment Maintenance center would be allocated on the basis of the number of machines in the receiving cost centers that require special maintenance. The costs of the General Maintenance center would be allocated on the basis of all other machines in a receiving cost center. There, of course, would be complications if certain pieces of equipment required both general and special maintenance.

Impact on Customer Prices. Information structured into multiple cost centers can be extremely useful for pricing purposes. If we assume for the moment that LI's management wants a 20 percent markup over costs when pricing its services, the multi-cost-center approach will give a very different pricing structure than the single-cost-center approach.

Problem: A customer has asked Lawncare, Inc. for a bid on mowing his lawn, which the manager estimates will require 3 hours. Another customer has asked the company for a bid on fertilizing her lawn and weeding her garden, which the manager estimates also will require 3 hours. If LI uses a 20% markup over cost as its price, how would the prices LI proposes to these customers differ between the one-cost-center and multi-cost-center approaches?

	One Cost Center	Multiple Cost Centers
Lawn Mowing		
Fertilizing and weeding		

Answer: Under the one-cost-center approach, the price per hour for either mowing or special projects would be the cost plus 20 percent, or $30.72 ($25.60 + $5.12). Under the multi-cost-center approach, the price per hour would differ for mowing and special projects. Mowing's hourly price would be $24.62 ($20.52 + $4.10). The hourly price for special projects would be $49.32 ($41.10 + $8.22). Thus, the cost-based prices proposed to the customers for the two jobs would be as follows:

One Cost Center		
Lawn Mowing	3 hours @ $30.72 =	*$92.16*
Fertilizing and weeding	3 hours @ $30.72 =	*$92.16*
Multiple Cost Centers		
Lawn Mowing	3 hours @ $24,62 =	*$73.86*
Fertilizing and weeding	3 hours @ $49.32 =	*$147.96*

Note that with the one cost center approach, the prices are identical for a 3-hour job. By contrast, with multiple cost centers, the fertilizing and weeding price is some 60 percent above the one cost center price, and the lawn mowing job is about 20 percent below it. If we assume that the multi-cost-center approach gives us a more homogeneous collection of activities in each cost center, then the cost on which the price is based comes closer to the true consumption of resources needed for each job. As a result, the multi-cost-center approach helps to eliminate the cross subsidization that takes place in the one-cost-center approach.

SUMMARY OF COST ACCOUNTING CHOICES

As the discussion in this chapter has indicated, the managerial choices involved in developing a cost accounting system frequently are quite difficult. Moreover, they are highly interdependent. The choice of cost centers will influence the distinction between direct and indirect costs. The choice of a particular final cost object frequently will require the use of certain intermediate cost objects, or call for certain kinds of cost centers. Allocation of service center costs will be determined, in part, by the choice of the service centers themselves, but also by the chosen allocation bases, and the allocation method (e.g., stepdown) selected.

In this context, it is important to emphasize that any change to the cost of one cost center always is accompanied by changes in another direction to other cost centers. That is, once total costs have been incurred, they do not change. Hence the total will be the same on any given cost report. The effect of any change in methodology is solely one of making shifts among cost centers. Sometimes these cost shifts can be quite significant, however, as we saw in the Lawncare, Inc. situation.

You are now ready to work on the practice case, Mossy Bog Transportation Agency, which will give you some practice in using the stepdown method. You should work through the case to the best of your ability before looking at the solution in the Appendix at the end of the primer.

TWO ITEMS OF CAUTION

1. **This chapter has focused on direct and indirect costs and the allocation of service center costs into production centers. This way of viewing costs has some limitations. Specifically, whether a cost is direct or indirect says little about its actual behavior as the volume of activity in a production center increases or decreases. For this reason, full cost information is not especially useful for making certain kinds of decisions, called "alternative choice decisions." The costs appropriate for these decisions are discussed in the next two chapters.**

2. **This chapter has only covered "Stage 1" of the cost accounting effort. In this stage, we define cost centers and allocate service center costs into production centers. In "Stage 2," we attached production center costs to the cost objects passing through those centers, so that we know the full cost of each. We did this in a minor way with Lawncare, Inc. However, when we move into more complex settings, this activity becomes considerably more tricky, as discussed in Chapters 4 and 5.**

PRACTICE CASE. MOSSY BOG TRANSPORTATION AGENCY

The Mossy Bog Transportation Agency (MBTA) has two service departments (maintenance and administration) and two mission departments (rapid transit and slow transit). Rapid Transit uses high-speed trains and is highly equipment-intensive, while Slow Transit, using rickshaws, is highly labor-intensive. Management has decided to allocate maintenance costs on the basis of depreciation dollars in each department, and administration costs on the basis of labor hours worked by the employees in each department.

The following data appear in the agency's records for the current period:

	Service Centers		Production Centers		
	Maintenance	**Administration**	**Rapid Transit**	**Slow Transit**	**Total**
Direct plus distributed costs ($000)	$1,160	$2,400	$8,000	$4,000	$15,560
Depreciation dollars ($000) (1)	$200	$2,000	$3,000	$800	$6,000
Labor hours	20,000	10,000	10,000	40,000	

Note (1). Depreciation dollars are included in the direct cost figures. For example, the $1,160,000 in the maintenance department includes the $200,000 of depreciation.

Assignment

1. Allocate the service center costs to production centers using the stepdown method, and determine the relevant total costs. Begin with the maintenance department.

2. To what use would you put this information? Please be specific: what are the next steps you would take based on this information?

Appendix. The Reciprocal Method of Cost Allocation

To see how the reciprocal allocation method works, assume that we wish to allocate an overnight mail delivery company's two service center costs of maintenance and administration to its two production centers: next-day delivery and two-day delivery. Management has decided to allocate maintenance costs on the basis of the square footage in each department, and administration costs on the basis of the number of hours worked by the employees in each of their respective departments. Exhibit A1 shows how the initial data for the company might look.

Exhibit A1. Basic Information for a Reciprocal Cost Allocation

	Adminis-tration	*Main-tenance*	*Two-Day Delivery*	*Next-Day Delivery*	*Totals*
Basic Information:					
Area occupied (square feet)	1,000	--	1,000	3,000	5,000
Labor hours	--	100	100	400	600
Production center costs ($000)			$1,500	$4,000	$5,500
Service center costs ($000)	$1,200	$2,400			3,600
Total costs ($000)					$9,100

Note that there are no square feet shown for maintenance and no labor hours shown for administration. Since we are using square feet as the basis of allocation for maintenance, and labor hours as the basis of allocation for administration, we therefore exclude these measures from the two departments. In effect, we do not calculate the cost of maintaining the maintenance department or administering the administration department.

To perform the reciprocal allocation in this illustration, we must set up two equations with two unknowns; the unknowns are the amount of administration to be allocated (which is designated as A) and the amount of maintenance to be allocated (designated as M). Then, since maintenance costs are allocated on the basis of square feet, and administration occupies 1/5 (1,000/5,000) of the square footage,

$$A = \$1{,}200 + 1/5M$$

In effect, the amount of administration to be allocated is the sum of its direct costs plus its share of the maintenance costs.

Since administration costs are allocated on the basis of hours worked, and maintenance uses 1/6 (100/600) of the hours,

$$M = \$2{,}400 + 1/6A$$

That is, the amount of maintenance to be allocated is the sum of its direct costs plus its share of the administration costs.

We now can substitute terms, as follows:

$$A = \$1{,}200 + 1/5\ (\$2{,}400 + 1/6A)$$

or

$$A = \$1{,}200 + \$480 + 1/30A$$

Therefore,

A = $1,738

And, since M = $2,400 + 1/6A

M = $2,690

To complete the reciprocal allocation, we remove $1,738 from administration and allocate it to the remaining three cost centers on the basis of labor hours, and we remove $2,690 from maintenance and allocate it to the three other cost centers on the basis of square feet. The result is that the service center costs are fully allocated to both the other service centers and the production centers, and the full $9,100,000 in costs now resides only in the production centers. These allocations are shown in Exhibit A2.

Exhibit A2. Allocation of Service Center Costs to Mission Centers

	Adminis-tration	*Main-tenance*	*Two-Day Delivery*	*Next-Day Delivery*	*Totals*
Initial costs ($000)	$1,200	$2,400	$1,500	$4,000	$9,100
Maintenance allocation (1)	538	(2,690)	538	1,614	--
Administration allocation (2)	(1,738)	290	290	1,158	--
Total costs	--	--	$2,328	$6,772	$9,100

Notes: (1) $2,690 from formula. Allocated 1/5 to administration, 1/5 to Two-Day Delivery, and 3/5 to Next-Day Delivery

(2) $1,738 from formula. Allocated 1/6 to maintenance, 1/6 to Two-Day Delivery, and 4/6 to Next-Day Delivery.

As you might imagine, once the number of cost centers exceeds three or four, solving the set of simultaneous equations becomes quite complex for a person, although it can be done easily with a computer. Moreover, even the stepdown method can benefit from the use of a rather simple spreadsheet application that carries out the allocations automatically. Designed properly, the computer software will allow an analyst to determine how the costs of each mission center are affected by different cost center structures, different allocation bases, and, when using the stepdown methodology, different service center sequences.

Chapter 2. Cost Behavior

One of the most significant concepts in cost accounting is that *different costs are used for different purposes*. The full cost accounting principles discussed in Chapter 1, while helpful for activities such as pricing, profitability analysis, and cost comparisons, have some important limitations. Specifically, they do not address how costs vary with changes in volume (or other factors, such as time). Yet information on cost *behavior* is important for several types of decisions that managers make on a fairly regular basis. As this chapter and the next discuss, using full cost information as a basis for deciding how costs will change under different decision-making scenarios, can lead managers to make decisions that are financially detrimental to their organizations.

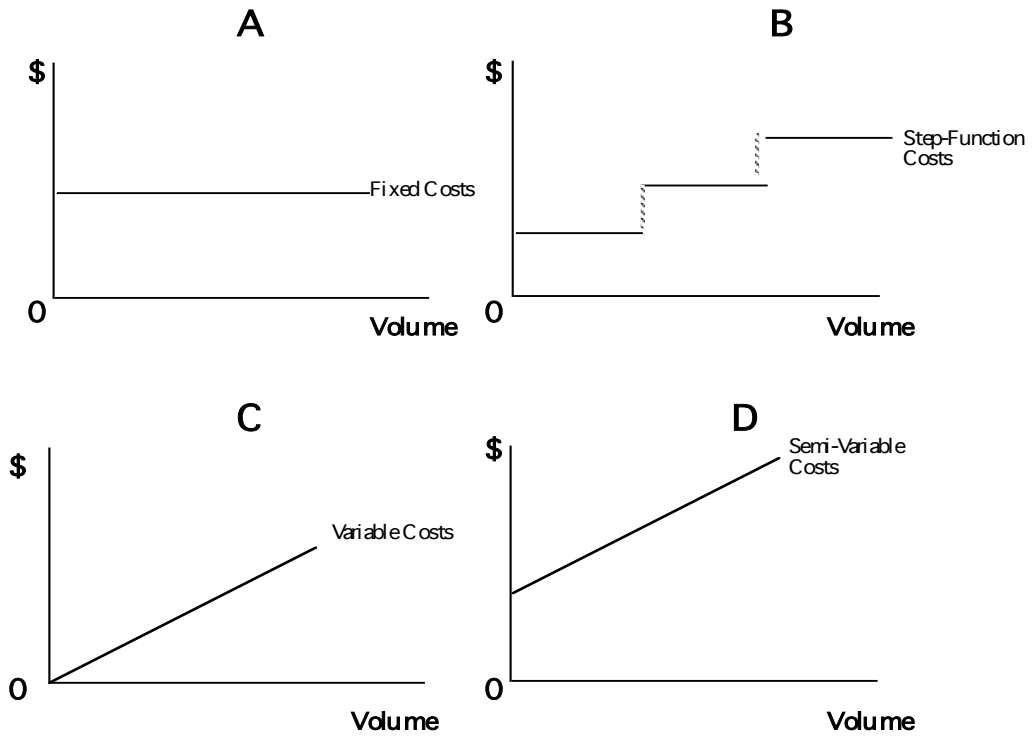
ORGANIZATION OF THE CHAPTER

The chapter first addresses the nature of costs. Once terms and concepts have been defined, we take up the subject of cost-volume-profit (CVP) analysis. We look at CVP analysis (sometimes called a *breakeven* analysis) in its most basic form, and then examine a variety of special considerations that can serve to complicate it.

THE NATURE OF COSTS

Fundamental to any discussion of costs is the question of their behavior. Chapter 1 identified the distinction between production center and service center costs. But costs also can be assessed in terms of whether they are relatively fixed or relatively variable. In general, the fixed-versus-variable distinction lets us see more clearly how a change in the volume of activity of a given cost center will affect the behavior of its costs. To fully understand this idea, we also need to include the refinements of semi-variable and step-function costs. The four types of costs are shown in Exhibit 2-1. A discussion of each type follows.

Exhibit 2-1. TYPES OF COST BEHAVIOR



Fixed Costs

Fixed costs are independent of the number of units produced. While no cost is fixed if the time period is long enough, the *relevant range* for fixed costs (i.e., the span of units over which they remain unchanged), or the time period within which they are considered) generally is quite large. They can be viewed graphically as shown in Quadrant A of Exhibit 2-1.

A good example of a fixed cost in most organizations is rent. Regardless of the number of units produced or other volume of activity, the amount of rent will remain the same. Of course, when the relevant range is exceeded, perhaps because the organization has grown so large that it needs to rent new facilities, even this cost will increase.

Step-Function Costs

Step-function costs are similar to fixed costs, except they have a much smaller relevant range. As such, they are added in "lumps," or "steps." The result is that, graphically, they take the form shown in Quadrant B, where the dotted lines represent discontinuous jumps.

An example of a step-function cost in many organizations is supervision. As the number of workers increases, supervisory personnel must be added. Since it is difficult for most organizations to add part-time supervisory help, supervisory costs will tend to behave in a step-function fashion.

Variable Costs

Variable costs behave in a roughly linear fashion in accordance with changes in volume. That is, as volume increases, total variable costs will increase in some constant proportion. The result is a straight line, the slope (vertical rise per horizontal unit) of which is determined by the amount of variable costs associated with each unit of output, as shown in Quadrant C.

Raw materials are an example of variable costs in most manufacturing organizations, i.e., they increase in almost direct proportion to increases in the number of units of output. Some organizations will have relatively high variable costs per unit, resulting in a line that slopes upward quite steeply; others will have variable costs that are relatively low for each unit of output, so the variable-cost line has a more gradual slope. A hospital's pharmacy will have a steeper slope than its social service department, for example.

Semi-Variable Costs

Semi-variable costs (sometimes called *mixed* or *semi-fixed* costs) share features of both fixed and variable costs. There is a minimum level of costs that is fixed, but the cost line then increases with increases in volume. The result is a line that begins at some level above zero, and slopes upward in a linear fashion, as shown in Quadrant D.

An example of a semi-variable cost is electricity. Typically, there is some base cost each month for electricity that an organization must incur even if it uses none at all. Costs then increase in a linear fashion in accordance with the number of kilowatt hours used. Similar cost patterns exist for other utilities as well.

Cost Behavior in Organizations

Most of an organization's costs can be classified as either fixed, step-function, variable, or semi-variable. Doing so requires analyzing the actual or expected behavior of each item and attempting to determine how it changes with changes in the volume of activity.

Problem: The Hawthorne Hair Salon currently provides 2,000 haircuts each month. At this level of activity it incurs, among others, the following costs:

Stylists	$11,000
Hair supplies (e.g., shampoo)	4,000
Other supplies (e.g., aprons)	2,000
Utilities	1,000
Rent	3,000
Total	$21,000

Classify each cost into one of the four categories:

Cost Item	**Category**
Stylists	
Hair supplies	
Other supplies	
Utilities	
Rent	

Answer: Stylists are probably step function costs—they will remain fixed until the number of haircuts increases by a fairly sizable number. Hair supplies, by contrast, are variable costs—they will change in direct proportion to a change in the number of haircuts.

Other supplies probably vary with the number of personnel, so they also could be thought of as step-function costs.

Utilities are probably semi-variable; the center probably pays a fixed amount each month with a variable component based on usage. Usage will be proportional to the number of hours the salon is open, which is related to the number of haircuts.

Rent probably is fixed (although with some ceiling on the number of haircuts—once they reach a certain level, the salon will need to rent a larger facility.

Relation of Cost Behavior to Full Cost Accounting

The analysis of cost behavior would be simplified if, as occasionally is assumed, all service center costs were fixed and all production center costs were variable. Unfortunately, this rarely if ever is the case. Exhibit 2-2 contains an illustration of four different cost types and their fixed-versus-variable and production center-versus-service-center distinctions. The example refers to the costs of Lawncare, Inc., which was discussed in Chapter 1.[5]

[5] In reviewing this exhibit, keep in mind that terms can vary. Sometimes, as was discussed in Chapter 1, "service center costs," are called "indirect" costs, and sometimes they are called "overhead" costs. In general, the context will make the meaning clear

Exhibit 2-2. FIXED AND VARIABLE COSTS VERSUS PRODUCTION AND SERVICE CENTER COSTS

	Fixed	Variable
Production Center Costs	Supervisor's salary in the Mowing production center	Gasoline costs for operating the lawn mowers in the Mowing production center
Service Center Costs	Portion of chief executive officer's salary (which is a cost of administration that is allocated to the Mowing production center)	Lubricant costs for maintaining the lawnmowers (which are costs of maintenance that are allocated to the Mowing production center)

Estimating Cost-Volume Relationships

In working with cost information, it sometimes is difficult to separate fixed from variable costs. This is especially problematic when a cost is semi-variable. To make the separation, one needs at least two historical or projected data points.

The Two-Point Method. With two data points, we can draw a straight line and determine where it intersects the vertical axis. We then can use algebra to determine both its slope and its fixed-cost component. As an example, suppose a company used 10,000 kilowatt hours of electricity in June and 12,000 kilowatt hours in July. The June electric bill was $1,500; the July electric bill was $1,700. To compute the fixed and variable components of the cost line, we would take the following steps:

1. Begin with the total cost formula: Total cost = fixed costs + (variable costs/unit * volume), or algebraically: TC = a + bx, where *a* represents fixed costs and *b* is variable costs/unit.

2. Apply the formula to June, as follows: $1,500 = a + b (10,000). Rearranging the elements, we get the following: a = $1,500 – 10,000b

3. Then, apply the formula to July, as follows: $1,700 = a + b (12,000)

4. Substitute from the June equation, as follows: $1,700 = ($1,500 – 10,000b) + 12,000b

5. This permits us to solve for b, as follows: $200 = 2,000b; b = $.10

6. We can then solve for a: a = $1,500 – 10,000 ($.10) = $500

7. Our total cost formula therefore is TC = $500 + $.10 * kilowatt hours

8. We can test this with July: TC = $500 + $.10 (12,000) = $1,700

Scatter Diagram Method. With a scatter diagram method, we have several data points, which we plot on a graph. We then manually fit a straight line to the data points, measure where is intersects the vertical axis of the graph (its fixed cost component), and compute its slope.

Least Squares (or Linear Regression) Method. This is essentially the same as the scatter diagram method, except that a statistical technique is used to fit the points to a line rather than doing so manually. When this method is used, it is important to eliminate outliers so that the fit will reflect the general experience. This, of course, raises the question of what constitutes an outlier. Because of this complexity, many analysts prefer the scatter diagram method, reasoning that, when outliers are taken into consideration, the precision of the least squares method is compromised.

Problem: The Woodruff Cafeteria has the following information for the past three months:

	December	January	February
Number of meals served	3,000	5,000	8,000
Cost of food sold	$18,000	$30,000	$48,000
Staff salaries and fringe benefits	14,500	16,500	19,500
Rent and depreciation	4,000	4,000	4,000
Utilities and other	2,100	3,300	5,100
Total	$38,600	$53,800	$76,600

In March, the cafeteria expects to serve 10,000 meals.

Develop a cost equation for the cafeteria that can be used to predict total monthly costs, then use it to predict costs for March.

Answer: A cost equation requires analyzing each cost for its fixed and/or variable components. The results are shown below, followed by the calculations for each item.

Cost of food sold	Variable	$6 per meal
Salaries and fringe benefits	Semi-variable	$11,500 + $1 per meal
Rent and depreciation	Fixed	$4,000 per month
Utilities and other	Semi-variable	$300 + $.60 per meal

Cost of food sold. This is relatively easy. For each month, it is the total divided by the number of meals. For example, in December, it is $18,000 ÷ 3,000 = $6.00 per meal

Salaries and fringe benefits. This calculation requires using the two-point method:

Begin with the total cost formula: TC = a + bx
Apply it to December, as follows: 14,500 = a + b (3,000); a = 14,500 – 3,000b
Then, apply it to January, as follows: 16,500 = a + b (5,000)
Substitute from the December equation, as follows: 16,500 = (14,500 – 3,000b) + 5,000b
This permits us to solve for b, as follows: 2,000 = 2,000b; b = $1
We can then solve for a: a = 14,500 – 3,000 (1) = $11,500

Rent and Depreciation. This is a flat $4,000 per month.

Utilities and Other. This also requires using the two-point method:

TC = a + bx 2,100 = a + b (3,000); a = 2,100 – 3,000b
3,300 = a + b (5,000); 3,300 = (2,100 – 3,000b) + 5,000b
1,200 = 2,000b; b = $.60
a = 2,100 – 3,000(.60) a = $300

Overall. The cost equation is the sum of all of the individual elements, or

TC = (11,500 + 4,000 + 300) + (6.00 + 1.00 + .60)x
TC = 15,800 + 7.60x

Costs in March would be predicted as 15,800 + 7.60 (10,000), or $91,800.

Estimating Cost Behavior as an Organization Grows

One reason for analyzing cost behavior is that it helps managers to assess what will happen to costs as the organization grows, and to be better able to manage growth as a result. Once we have determined that certain costs are variable, for example, we can assume that they will grow in a linear fashion as our volume grows. On the other hand, both fixed and step function costs will not grow linearly. Since revenue tends to grow in a linear fashion, and more steeply (one hopes) than variable costs, growth should allow us to increase our profits.

Problem: Hawthorne Hair Salon incurred the costs shown earlier in delivering 2,000 haircuts. Management also has determined the following: (1) there currently are five stylists, each of whom can provide 20 haircuts a day, or 400 haircuts a month (the salon hires only full-time stylists and each works a 20-day month), (2) hair supplies are variable costs, (3) other supplies will increase to $3,000 when the number of haircuts reaches 5,000, and to $4,000 when the number of haircuts reaches 10,000, (4) utilities are semi-variable costs with a fixed component of $600 a month regardless of the number of haircuts, and (5) rent remains at $3,000 as long as the number of haircuts does not exceed 10,000.

What will the salon's costs be for these five items at 5,000 haircuts? At 10,000 haircuts? Write your answer below. In some places, you will need to use your intuition to reach an answer.

	5,000 Haircuts	10,000 Haircuts
Stylists		
Hair supplies		
Other supplies		
Utilities		
Rent		
Total		

Analysis. Let's look at each cost item separately.

Stylists. At the moment, we have 5 stylists (2,000 haircuts ÷ 400), who have a total cost of $11,000. Therefore, the cost per stylist must be $2,200 per month ($11,000 ÷ 5 stylists). A stylist can deliver 400 haircuts a month. That means that every time we increase our haircuts by 400, we must add a stylist.

At 5,000 haircuts per month, we will need 12.5 stylists (5,000 ÷ 400), but since we cannot add half a stylist, we must have 13 stylists for 5,000 haircuts. You may have decided to "stretch" your 12 stylists, and not hire the 13th stylist until total haircuts reach 5,200 (13 x 400). That is a very reasonable approach. If you take the "stretch" approach, your stylist cost for 5,000 haircuts will be $26,400 (12 x $2,200).) This is the nature of a step function cost. By similar reasoning, we can conclude that for 10,000 haircuts, we will need 25 stylists; this time there are no fractions of a stylist. Thus, at 5,000 haircuts (with 13 stylists), our stylist cost will be $28,600 (13 x $2,200), and at 10,000 haircuts (25 stylists), it will be $55,000 (25 x $2,200).

Hair Supplies. Using our baseline information, we can see that hair supplies must increase at a rate of $2.00 per haircut. That is, since we incurred $4,000 in costs with 2,000 haircuts, and since the cost is variable, the variable cost rate must be $4,000 ÷ 2,000 haircuts. This means that at 5,000 haircuts, the cost will be $10,000 (5,000 x $2.00), and that at 10,000 haircuts, the cost will be $20,000 (10,000 x $2.00).

Other Supplies. These were given as $3,000 and $4,000 respectively.

Utility Costs. Since utility costs are semi-variable, they have both a fixed and a variable component. The fixed component is $600. Since utility costs totaled $1,000 at 2,000 haircuts, the variable component must by $400 ($1,000 - $600). Therefore, these costs must increase at a rate of $.20 per haircut ($400 ÷ 2,000 haircuts). Alternatively, we could use the following formula: [(total costs at volume x - fixed component) ÷ x]. In this case: [($1,000 - $600) ÷ 2,000] = $.20. Given this, the utility costs at 5,000 haircuts will be $1,600 ($600 + [5,000 x .20]). At 10,000 haircuts, they will be $2,600 ($600 + [10,000 x .20]).

Rent. This was given as $3,000 as long as we don't exceed 10,000 haircuts.

To summarize, the cost figures are all three levels are as follows:

	2,000 Haircuts	5,000 Haircuts	10,000 Haircuts
Stylists	$11,000	$28,600	$55,000
Hair supplies	4,000	10,000	20,000
Other supplies	2,000	3,000	4,000
Utilities	1,000	1,600	2,600
Rent	3,000	3,000	3,000
Total	$21,000	$46,200	$84,600
Average cost per haircut	$10.50	$9.24	$8.46

The fact that the per-haircut cost declines as the number of haircuts increases is indicative of the fact that all costs do not increase in proportion to volume. As we have seen, several costs are either fixed, have fixed components, or are step function in nature.

COST-VOLUME-PROFIT ANALYSIS

The purpose of cost-volume-profit analysis is to determine either (a) the volume of activity needed for an organization to achieve its profit goal, (b) the price that an organization needs to charge to achieve its profit goal, or (c) the cost limits (fixed and/or variable) that an organization needs to adhere to if it is to achieve its profit goal.

CVP analyses usually are done for a particular activity within an organization—such as a product line or program. A CVP analysis thus begins with the basic equation for profit:

$$\text{Profit} = \text{Total revenue (TR)} - \text{Total costs (TC)}$$

Total revenue for most activities is quite easy to calculate. If we assume that an organization's price is represented by the letter p and its volume by the letter x, then total revenue is price times volume, or:

$$TR = px$$

To compute total costs, CVP analysis requires a recognition of the different types of cost behavior: fixed, step-function, variable, and semi-variable. Let us begin with the simplest of cases, in which there are no step-function or semi-variable costs. In this instance, the formula would be quite simple:

$$\text{Total costs} = \text{Fixed costs} + \text{Variable costs}$$

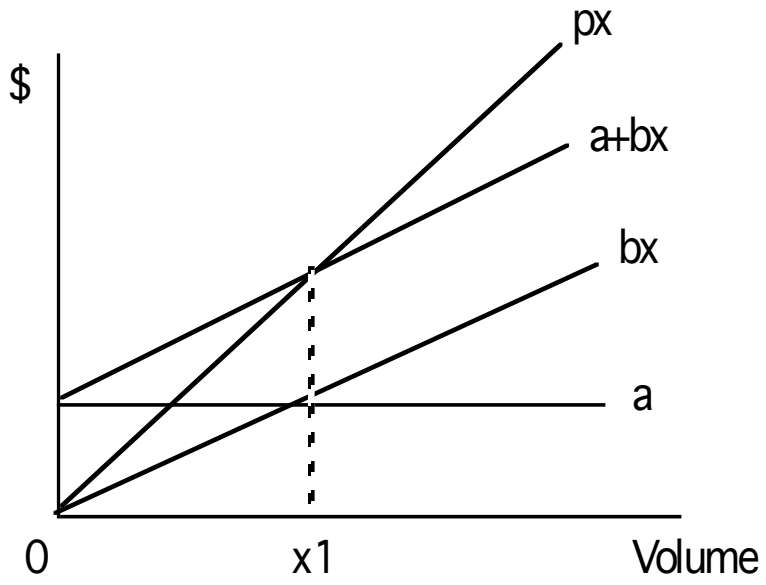
As before, fixed costs are represented by the letter a, and variable costs per unit by the letter b. Thus, total variable costs can be represented by the term bx, where, as before, x represents volume. The resulting cost equation is the one we saw earlier:

$$TC = a + bx$$

This means that the fundamental profit equation can be shown as:

$$\text{Profit} = px - (a + bx)$$

Graphically, we can represent the formula as follows:



Point x1, where px = a + bx is the *breakeven volume*—it is the point at which total revenue, px, equals total costs, a+bx. With volume greater than x1, the organization earns a profit; below x1, it incurs a loss.

To illustrate how this formula can be used, let's assume an organization wishes to determine its breakeven volume. If we know price, fixed costs, and variable costs per unit, we can solve the formula algebraically for x, or our breakeven volume. Similarly, if we know any three of the four items in the equation, we can solve for the fourth.

Problem: Littleton News, Inc. publishes a monthly magazine. The company has fixed costs of $100,000 a month, variable costs per magazine of $.80, and charges $1.80 per magazine. What is its breakeven volume (number of magazines per month)? Make your computations below.

Answer: We can begin with the cost-volume-profit formula, and substitute the known elements. We then solve for the unknown, which, in this case, is volume, or x.

$$\text{Profit} = px - (a + bx$$

At breakeven, Profit = 0; therefore, px = a + bx, or

$$\begin{aligned} 1.80x &= 100{,}000 + .80x \\ 1.00x &= 100{,}000 \\ x &= 100{,}000 \end{aligned}$$

Breakeven is 100,000 magazines. To confirm:

Revenue: $1.80 (100,000) =		$180,000
Less: costs:		
Variable: $0.80 (100,000) =	80,000	
Fixed:	100,000	
Total		180,000
Profit		$ 0

Unit Contribution Margin

An important element of CVP analysis is "unit contribution margin," which is the difference between price and unit variable cost (p - b). This is the *contribution* to fixed costs that comes about as a result of each additional unit sold. By rearranging the terms of the CVP formula, we can arrive at the conclusion that breakeven volume is simply fixed costs divided by unit contribution margin, as follows:

$$\begin{aligned} px &= a + bx \\ px - bx &= a \\ x\,(p-b) &= a \\ x &= a \div (p-b) \end{aligned}$$

In effect, price minus unit variable cost tells us how much each unit sold contributes to the recovery of fixed costs. When we divide this amount into fixed costs, we arrive at the volume (number of units of activity) needed to recover all our fixed costs, which is our breakeven volume.

To illustrate, Littleton News has a unit contribution margin of $1.00 ($1.80 - $.80). When we divide this amount into its fixed costs of $100,000, we arrive at its breakeven volume of 100,000 magazines.

Incorporating Other Variables into a CVP Analysis

Thus far, we have been using CVP analysis to solve only for the breakeven volume. Clearly, if we knew how many units of our product we were likely to sell, our fixed costs, and our unit variable costs, we could then determine the price we would need to charge to breakeven. Similarly, if we were in an environment where price was market-driven, and we knew about how many units we could sell at that price, we could set up either fixed costs or unit variable costs as the unknown and solve for either one.

Profit Considerations. We can incorporate a profit goal into a CVP analysis simply by adding the amount of desired profit to fixed costs, and then calculating a breakeven point with that new level of "fixed costs." Similarly, if we were planning to pay dividends, or needed a margin of safety, we could incorporate these amounts into our so-called fixed cost figure.

SPECIAL CONSIDERATIONS IN COST-VOLUME-PROFIT ANALYSES

A number of special considerations can complicate a CVP analysis: the presence of semi-variable costs, the behavior of step function costs, and the existence of more than one product. Let's look at each of these.

CVP Analysis with Semi-Variable Costs

Incorporating semi-variable costs into a cost-volume-profit analysis is relatively easy. Since these costs have a fixed component and a variable component, we simply need to add the fixed component to the fixed cost total, and add the unit variable cost figure to the existing unit variable cost figure.

Problem: In addition to its other costs, Littleton News has electricity costs that are $2,000 a month regardless of usage, plus an additional amount per kilowatt hour of use. Electricity usage is tied directly to the number of magazines produced. The company's accountants have determined that the rate is about $.04 per magazine. What is its monthly breakeven volume (number of magazines)?

Answer: Again, we can begin with the basic formula, insert the known elements, and solve for the unknown.

$$
\begin{aligned}
px &= a + bx \\
1.80x &= (100{,}000 + 2{,}000) + (.80x + .04x) \\
96x &= 102{,}000 \\
x &= 106{,}250
\end{aligned}
$$

Breakeven is 106,250 magazines.

CVP Analysis with Step-Function Costs

The introduction of step-function costs is somewhat more difficult than might first be imagined. Ideally, for any given relevant range, we would simply add together the step-function costs and the fixed costs to give us the total applicable fixed costs. We then could use the formula as described above. Unfortunately, the process is not quite that simple, as the following example illustrates.

Problem: Return to the first problem for Littleton news (i.e., ignore the electricity costs). In addition to the $100,000 in fixed costs stipulated in the first problem, Littleton also has supervision costs. These costs behave as follows

Volume (# magazines)			Supervision Costs
0	-	50,000	$ 10,000
50,001	-	100,000	20,000
100,001	-	150,000	30,000
150,001	-	200,000	40,000

What is Littleton's breakeven volume? Be careful; this is a little tricky.

Answer: If we attempt to solve the breakeven formula at the first level of fixed costs, we have the following equation:

$$\begin{aligned} 1.80x &= (100{,}000 + 10{,}000) + .80x \\ 1.00x &= 110{,}000 \\ x &= 110{,}000 \end{aligned}$$

The problem with this solution is that, while the breakeven volume is 110,000 magazines, the relevant range for the step-function costs was only 0 - 50,000 magazines. Thus, a breakeven of greater than 50,000 magazines is invalid, and we must move to the next step on the step function, which gives us the following equation:

$$\begin{aligned} 1.80x &= (100{,}000 + 20{,}000) + .80x \\ 1.00x &= 120{,}000 \\ x &= 120{,}000 \end{aligned}$$

This solution is also invalid. Only when we get to the third level do we encounter a valid solution, as follows:

$$\begin{aligned} 1.80x &= (100{,}000 + 30{,}000) + .80x \\ 1.00x &= 130{,}000 \\ x &= 130{,}000 \end{aligned}$$

The conclusion we can draw from this analysis is that the incorporation of step-function costs into the cost-volume-profit formula requires a trial-and-error process to reach the breakeven volume.

CVP Analysis with Multiple Products

Thus far, we have made all of our CVP calculations using situations where there was only one product. When there are two or more products involved in the calculation, the analysis becomes considerably more complicated. Consider the following situation:

Problem: Quicky Legal Services—a firm of lawyers offering one-stop resolution of legal problems—has three types of cases: Regular, Hard, and Extra Hard. Annual fixed costs are $2,565,000. Other information is as follows:

	Regular	Hard	Extra Hard
Fee per case	$3,000	$4,000	$5,000
Variable costs	1,800	2,200	2,500
Unit contribution margin	$1,200	$1,800	$2,500
Cases served per year	1,000	400	600

What is the breakeven point for the law firm? Use your intuition to make some calculations.

Answer: To determine breakeven under these circumstances, we must calculate a weighted average unit contribution margin, and then divide it into fixed costs. The easiest way to calculate a weighted average unit contribution margin is to begin by calculating total contribution for all case types, as follows:

	Regular	Hard	Extra Hard	Total
Unit contribution margin	$1,200	$1,800	$2,500	
Cases per month	1,000	400	600	2,000
Total contribution	1,200,000	$720,000	$1,500,000	$3,420,000

The weighted average unit contribution margin then can be calculated by dividing total contribution by total cases:

$$\$3,420,000 \div 2,000 = \$1,710$$

Thus, on average, each case contributes $1,710 to fixed costs. Therefore, we now can calculate the breakeven point by dividing fixed costs by the weighted average unit contribution margin, or $2,565,000 ÷ 1,710 = 1,500. Thus, we must serve 1,500 cases a year to break even.

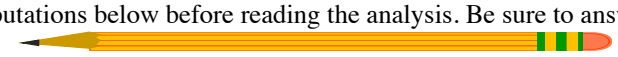
The Impact of a Changing Product Mix. One problem with the weighted average approach is that changing the mix of products (case types in the above example) will change the breakeven point. It is relatively easy to visualize this problem in the above example since we can see that changing the mix of cases (but keeping the total number of cases at 2,000) will change total contribution. This, in turn, will change the weighted average unit contribution margin. The result is that fixed costs will be divided by a different number than before, resulting in a different breakeven figure.

To illustrate, assume that the agency served 2,000 cases during a year, but with the following mix:

Regular	500
Hard	200
Extra Hard	1,300

All other cost and fee figures given above remained the same.

Problem: What is the breakeven point now? Why, if the cost and price figures have remained the same, has the breakeven point changed? Make your computations below before reading the analysis. Be sure to answer the second question.



Answer: The computations are are as follows:

	Regular	Hard	Extra Hard	Total
Contribution margin	$1200	$1800	$2500	
Cases per month	500	200	1,300	2,000
Total contribution	$600,000	$360,000	$3,250,000	$4,210,000

The weighted average unit contribution margin now is $2,105, calculated as follows:

$4,210,000 ÷ 2,000 = $2,105

Breakeven now is $2,565,000 ÷ $2,105 = 1,219 cases (rounded).

The breakeven number of cases has changed because the mix of cases has changed. This will happen any time an organization's products have different individual unit contribution margins. In this instance, the mix of products has changed to more higher unit-contribution-margin cases. Other things equal, a higher unit contribution margin means a lower breakeven. That is why the breakeven point fell from 1,500 cases to 1,219 cases with the change in mix.

••

An important conclusion to be drawn here is that a breakeven figure with multiple products or services is very unstable—as mix changes, so will the breakeven figure. It is important to bear in mind, however, that an unstable breakeven volume arises only when the individual contribution margins are substantially different. If they are roughly similar, changes in mix, even if they are large, will have relatively little impact on breakeven.

Because of this instability, CVP analysis tends to be used relatively little on an ongoing basis in companies with multiple products. It frequently is used, however, in conjunction with an analysis of the possible introduction of a new product. Indeed, it is an essential aspect of a good marketing analysis for a new product.

TOTAL CONTRIBUTION

On an ongoing basis, managers tend to be interested in each product's *total contribution* to the company's overhead costs, i.e., the unit contribution margin, as discussed above, multiplied by the product's actual or anticipated volume.

To understand how this works, let's look at the situation in a hypothetical company, Clearwater Taxi Service. Clearwater operates just one taxi. It charges $1.00 a mile for each passenger mile driven. Last year, the taxi drove 60,000 passenger miles. The variable cost per mile (gasoline, tires, wear and tear) was 40 cents. The driver was paid a salary of $10,000 per year (the remainder of the driver's income was earned in tips). Rent and administration were fixed costs totaling $30,000. As the following analysis shows, Clearwater lost money:

Item		**Amount**
Revenue 1.00 x 60,000 =		$60,000
Expenses:		
Variable costs .40 x 60,000 =	24,000	
Driver	10,000	
Overhead costs		
(rent and administration)	30,000	64,000
Profit (loss)		$ (4,000)

In thinking about how to address this problem, management has decided that one possibility is to add a second taxi.

Problem: Assuming the second taxi will charge the same amount per mile and have the same variable cost per mile as Taxi 1, but will require no additional overhead costs, how many miles must it drive to eliminate the loss that Clearwater currently incurs?

Analysis: Let's use the format suggested earlier in which we compute a unit contribution margin and divide it into fixed costs plus the desired profit. Unit contribution margin is price minus variable costs, or $1.00 - $0.40 = $0.60. Fixed costs (the driver) are $10,000 and we need $4,000 in profit to cover the loss from Taxi 1. Therefore, we divide $0.60 into $14,000. The conclusion is that Taxi 2 must drive $23,333 miles to cover its costs and earn a $4,000 profit.

Now assume that management believes Taxi 2 will actually drive 30,000 miles during the upcoming year and that overhead costs will remain at $30,000. It has asked the accountants to prepare an analysis of the profitability of Taxi 2. The accountants allocate overhead on the basis of number of miles driven, and Taxi 2 is expected to drive 1/3 of the miles (30,000 out of a total of 90,000 miles).

Problem: What would the accountant's profitability analysis look like for Taxi 2?

Answer. The accountant's profitability analysis might look as follows:

Revenue 1.00 x 30,000 =		$30,000
Expenses:		
Variable costs .40 x 30,000 =	12,000	
Driver	10,000	
Overhead costs (1/3 of $30,000)	10,000	32,000
Profit (loss)		$ (2,000)

This would appear to raise a perplexing problem for management. When overhead costs are included, Taxi 2, which was projected to operate considerably above breakeven (30,000 miles versus breakeven of 23,333 miles), is being presented as a money-losing proposition.

The problem, of course, lies in the allocation of overhead. It is because of situations such as this, that many managers prefer to think in terms of the total contribution of each product to the organization's

overhead costs, rather than profit on a full-cost basis. *Total Contribution* refers to the amount of money that remains after a product's specific costs have been deducted from its revenue. Product-specific costs include variable, semi-variable, fixed, and step-function. The amount left after deducting these costs *contributes* to the recovery of overhead costs. More specifically, a product or service (a taxi in this case) earns some revenues and incurs some direct costs. The difference between its revenue and direct costs (both fixed and variable) is the contribution of it makes to the organization's overhead costs.

Contribution Income Statement

One way to structure cost information to deal with the above situation is with a contribution income statement. A contribution income statement has a different format from a more traditional income statement, and can be constructed in several different ways. One typical construction is as follows:

Total Revenue
Less: total variable costs
Equals: margin (for fixed and overhead costs)
Less: the product's fixed costs
Equals: product's contribution to overhead costs
Less: allocated overhead costs
Equals: profit (loss) on a full cost basis

Problem: Prepare a contribution income statement for Clearwater. Use the following format:

Item	Taxi 1	Taxi 2	Total
Total revenue			
Less: total variable costs			
Margin (for fixed and overhead costs)			
Less: product's fixed costs (drivers)			
Contribution (to overhead costs)			
Less: overhead costs			
Profit (loss) on a full cost basis			

Answer. The contribution income statement would look as follows:

Item	Taxi 1	Taxi 2	Total
Revenue	$60,000	$30,000	$90,000
Less: variable costs	24,000	12,000	36,000
Margin (for fixed and overhead costs)	$36,000	$18,000	$54,000
Less: production center fixed costs (drivers)	10,000	10,000	20,000
Contribution (to overhead costs)	$26,000	$8,000	$34,000
Less: overhead costs			30,000
Profit (loss) on a full cost basis			$ 4,000

The key figures here are the contribution amounts, which show that each taxi is making a positive contribution, such that discontinuing it would leave the organization worse off than keeping it. Indeed, it is Taxi 2's $8,000 contribution that led to the change from a $4,000 loss to a $4,000 profit.

Problem: Quicky Legal Services' lawyers work in three departments. Each department is responsible for one of the case types: easy, hard, or extra hard. Each department also has some direct fixed costs. The firm's total fixed costs are as shown below, along with some other basic information:

	Fixed Costs	Fee/Case	Variable Cost/Case	Cases Served/Year
Regular Department	$ 500,000	$3,000	$1,800	1,000
Hard Department	700,000	4,000	2,200	400
Extra Hard Department	1,000,000	5,000	2,500	600
General (firm wide)	365,000			
Total	$2,565,000			2,000

Using the above mix of cases, structure Quicky's revenues and costs into a contribution income statement format.

Analysis. Using these data, a contribution income statement would look as follows:

	Regular	Hard	Extra Hard	Total
Revenue	$3,000,000	$1,600,000	$3,000,000	
Less: variable costs	1,800,000	880,000	1,500,000	
Margin	$1,200,000	$ 720,000	$1,500,000	$3,420,000
Less: department's fixed costs	500,000	700,000	1,000,000	2,200,000
Contribution	$ 700,000	$ 20,000	$500,000	$1,220,000
Less: overhead costs				365,000
Profit				$855,000

Note that we did not allocated overhead costs to case types. We could have, using some reasonable allocation basis, but doing so is not really necessary in an analysis of this sort. In fact, doing so would likely raise the same problem we saw with the Clearwater Taxi example. That is, the Hard cases, while making a contribution to overhead would be seen as losing money.

Problem: How would the contribution income statement look under the second mix of cases (Regular = 500; Hard = 200; Extra Hard = 1,300). As a member of the senior management team at Quicky, how might you respond to this change in the mix of cases?

Analysis. The revised contribution income statement would look as follows:

	Regular	Hard	Extra Hard	Total
Cases served per year	500	200	1,300	2,000
Revenue	$1,500,000	$800,000	$6,500,000	
Less: variable costs	900,000	440,000	3,250,000	
Margin	$ 600,000	$360,000	$3,250,000	$4,210,000
Less: fixed costs	500,000	700,000	1,000,000	2,200,000
Contribution	$ 100,000	$(340,000)	$2,250,000	$2,010,000
Less: overhead costs				365,000
Profit				$1,645,000

Senior management presumably would be pleased with the change in the mix of cases, since it has increased profits from $855,000 to $1,645,000. They might wish to look at the Hard cases to see if eliminating this category of cases would result in reducing the number of cases of the other two types. If not, profits could be improved by $340,000 by eliminating this category of cases. Moreover, if some of the overhead costs could be reduced with the elimination of the Hard category, profits could be improved even further. A key issue, of course, is that the firm no longer would be able to offer a "full line" of legal services, and this might lead to a decline in cases of the other two types.

You are now ready to work through the practice case at the end of the chapter. Casa Electrónica, S.A. allows you to perform a cost-volume-profit analysis, to compare the results to a full-cost analysis, and to consider the appropriate action to take. The solution is contained in the Appendix.

A CAUTION

Some people confuse fixed and variable costs by reasoning that, if the rate stays the same, the cost must be "fixed." This is incorrect. The easiest way to dispel this notion is to think about the cost of gasoline for an automobile.

Assume that gasoline sells for $3.00 a gallon and that your car gets 30 miles to the gallon. This means that your gasoline cost is $0.10 a mile. As long as the price of gasoline remains at $3.00 and you continue to get 30 miles per gallon, your gasoline cost per mile is fixed. This does not mean that gasoline is a fixed cost, however. Rather, it is a variable cost, that increases in a linear fashion with mileage at a rate of $0.10 per mile. Your total variable cost for gasoline will be the total miles driven times $0.10. If you do not drive for a day, you will not incur any gasoline costs.

PRACTICE CASE. CASA ELECTRÓNICA, S.A.

> I don't get it. We ran the numbers, and it all looked pretty good. Then we exceeded our sales projections, which should make things better. Yet the accountants tell us we're losing money. It just doesn't compute!

The speaker was Antonio García, manager of the Portable Communication Device (PCD) division of Casa Electrónica, S.A. (CESA), a a large retail electronic store located in downtown Santiago, Chile. He was discussing the poor financial performance of a new line of smart phones that the store had begun selling a month earlier. He continued:

> We ran a CVP [cost-volume-profit] analysis on the phones, and convinced senior management that it made sense to move ahead with them. Unless I can figure out what's going on, and find a way to explain it all, my head's going to be on the block at next week's meeting.

BACKGROUND

CESA imported large appliances and distributed them to retailers throughout Chile. It carried three broad lines of merchandise: audio equipment (such as stereo tuners, CD players, and radios), video equipment (including televisions and DVDs), and portable communication devices (such as smart phones and personal digital assistants).

Following a business trip in which he had seen widespread use of smart phones, and under pressure to improve his division's profits, Sr. García had decided to explore the idea of adding smart phones to the PCD division's offerings. He commented on the analysis that his staff had made:

> The numbers are pretty simple. The phones sell for $100. They cost us $40 each, which includes all insurance and freight charges to get them to the store. When we looked at the extra work involved in the warehouse, we found that we had to add some more employees, who cost us $10,000 a month including fringes.
>
> Our analysis even included the cost of some additional clerical staff. We figured that the extra paperwork would mean another 1/2 FTE [full-time equivalent] in the administrative offices, which translated into $2,000 a month including fringes. We knew we could sell at least 250 phones a month with no extra advertising, and, based on that, we convinced corporate that the phones were a good bet.

DATA

In the first month, CESA sold 300 phones. However, much to Sr. García's surprise, the accountants' Product-Line Report, shown in Exhibit 1, reported a $4,000 loss. It was this that led to his comment at the beginning of the case. In his view:

> This is lunacy! We did what we said we would do. The company hired some additional warehouse personnel whose salaries and fringes total $10,000, and the admin folks hired a new person, who divides his work about 50/50 between our division and the video division. Our fair share should be $2,000, just as we had projected. Yet both warehouse and admin are much bigger than this.
>
> I asked the accountants what was going on, and they told me that this [Exhibit 1] is their standard approach to computing product line profitability. So what do I do now?

Assignment

1. Using Sr. García's assumptions, what was the estimated breakeven volume for the smart phones? Based on his sales projections, how much before-tax profit did Sr. García expect the phones to earn for the company?
2. Assuming that all of Sr. García's price and cost figures were correct, how much should the company have earned before taxes from smart phone sales in the first month? How would you reconcile this figure with the accountants' analysis in Exhibit 1?
3. What should Sr. García do?

CASA ELECTRÓNICA, S.A.
Exhibit 1. Product Line Income Statement for August
Product Line: Smart Phones

Net sales revenues	$30,000	
Cost of goods sold (COGS)	12,000	
Gross margin		$18,000
Operating expenses:		
Warehouse personnel (1)	12,000	
Division manager's office (2)	5,000	
Rent and utilities (3)	200	
Insurance (4)	1,200	
Administrative and general costs (5)	3,600	
Total operating expenses		22,000
Income (loss) before taxes		$(4,000)

Notes:

(1) This amount was allocated to each product line on the basis of its share of total net sales revenues.

(2) This amount included the salaries of the department manager and his office staff, all of whom worked exclusively for the PCD division. They were allocated to product lines on the basis of number of units sold.

(3) The company's rent and utilities were allocated to each division on the basis of its share of total square footage. The accountants then reallocated these costs to product lines based on each product line's share of total shelf space.

(4) The insurance expense was based on the company's inventory. It was allocated to product lines based on the COGS amount.

(5) These were the costs of the company's central administration, such as the salary of the managing director, the salaries of her office staff, the company's accounting and legal departments, consulting fees, and other administrative items in the central office. Each department was allocated a share of these costs based on its share of total net sales revenues.