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MANAGERIAL AND COST ACCOUNTING



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Managerial and Cost Accounting

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Introduction to Managerial Accounting

Part 1

Your goals for this “managerial accounting introduction” chapter are to learn about:

- The distinguishing characteristics of managerial accounting.
- The role of managerial accounting in support of planning, directing, and controlling.
- Key production cost components: direct materials, direct labor, and factory overhead.
- Product costs versus period costs.
- Categories of inventory for manufacturers and related financial statement implications.

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1. Managerial Accounting

Early portions of this textbook dealt mostly with financial accounting. Financial accounting is concerned with reporting to external parties such as owners, analysts, and creditors. These external users rarely have access to the information that is internal to the organization, nor do they specify the exact information that will be presented. Instead, they must rely on the general reports presented by the company. Therefore, the reporting structure is well defined and standardized. The methods of preparation and the reports presented are governed by rules of various standard-setting organizations. Furthermore, the external users generally see only the summarized or aggregated data for an entity.

In contrast, managers of a specific business oftentimes need or desire far more detailed information. This information must be tailored to specific decision-making tasks of managers, and its structure becomes more “free formed.” Such managerial accounting information tends to be focused on products, departments, and activities. In this context, the management process is intended to be a broad reference to encompass marketing, finance, and other disciplines. Simply stated: managerial accounting is about providing information in support of the internal management processes. Many organizations refer to their internal accounting units as departments of strategic finance. This title is more reflective of their wide range and scope of duties.

Managerial accounting is quite different from financial accounting. External reporting rules are replaced by internal specifications as to how data are to be accumulated and presented. Hopefully, these internal specifications are sufficiently logical that they enable good economic decision making. For example, specific reporting periods may be replaced with access to real-time data that enable quick responses to changing conditions. And, forecasted outcomes become more critical for planning purposes. Likewise, cost information should be disseminated in a way that managers can focus on (and be held accountable for!) those business components (“segments”) under their locus of control.

In short, the remainder of this book is about the ideas and methods that can be used to provide accounting information in direct support of the “broadly defined” role of managing a business organization. If you aspire to work in strategic finance, the remainder of this book is your introductory primer. But, for most readers -- those who must manage some part of an organization -- the remainder of this book is your guide to knowing how and when the management accountant’s tools can be used to help you do your job better!

1.1 Professional Certifications in Management Accounting

You are no doubt familiar with the CPA (certified public accountant) designation; it is widely held and recognized. The certification is usually accompanied by a state issued license to practice public accounting. However, there are also CMA (certified management accountant) and CFM (certified financial manager) designations. These are not “licenses,” per se, but do represent significant competency in managerial accounting and financial management skills. These certifications are sponsored by the Institute of Management Accountants.

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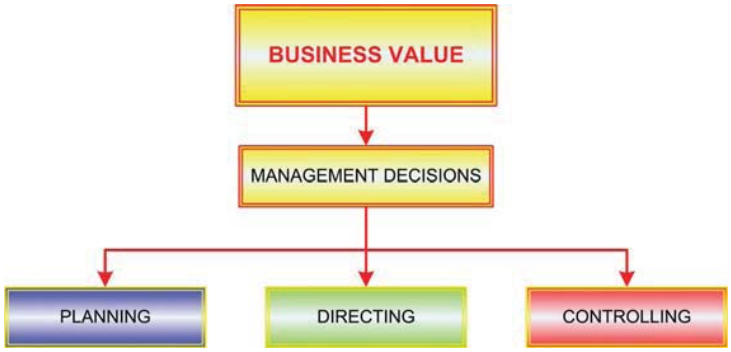
2. Planning, Directing, and Controlling

I once saw a clever sign hanging on the wall of a business establishment: “Managers are Paid to Manage -- If There Were No Problems We Wouldn’t Need Managers.” This suggested that all organizations have problems, and it is management’s responsibility to deal with them. While there is some truth to this characterization, it is perhaps more reflective of a “not so impressive” organization that is moving from one crisis to another. True managerial talent goes beyond just dealing with the problems at hand.

What does it mean to manage? Managing requires numerous skill sets. Among those skills are vision, leadership, and the ability to procure and mobilize financial and human resources. All of these tasks must be executed with an understanding of how actions influence human behavior within, and external to, the organization. Furthermore, good managers must have endurance to tolerate challenges and setbacks while trying to forge ahead. To successfully manage an operation also requires follow through and execution. But, each management action is predicated upon some specific decision. Thus, good decision making is crucial to being a successful manager.

2.1 Decision Making



Some managers seem to have an intuitive sense of good decision making. The reality is that good decision making is rarely done by intuition. Consistently good decisions can only result from diligent accumulation and evaluation of information. This is where managerial accounting comes in -- providing the information needed to fuel the decision making process. Managerial decisions can be categorized according to three interrelated business processes: planning, directing, and controlling. Correct execution of each of these activities culminates in the creation of business value. Conversely, failure to plan, direct, or control is a roadmap to business failure.

The central theme to focus on is this: (1) business value results from good management decisions, (2) decisions must occur across a spectrum of activities (planning, directing, and controlling), and (3) quality decision making can only consistently occur by reliance on information. Thus, I implore you to see the relevance of managerial accounting to your success as a business manager. Let’s now take a closer look at the components of planning, directing, and controlling.

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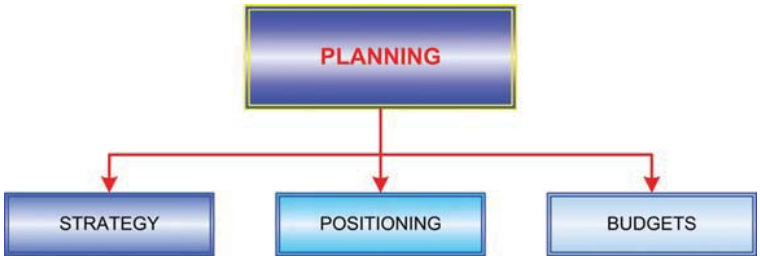
2.2 Planning



A business must plan for success. What does it mean to plan? It is about thinking ahead -- to decide on a course of action to reach desired outcomes. Planning must occur at all levels. First, it occurs at the high level of setting strategy. It then moves to broad-based thought about how to establish an optimum "position" to maximize the potential for realization of goals. Finally, planning must be undertaken from the perspective of thoughtful consideration of financial realities/constraints and anticipated monetary outcomes (budgets).

You have perhaps undergone similar planning endeavors. For example, you decided that you desired more knowledge in business to improve your stake in life, you positioned yourself in a program of study, and you developed a model of costs (and future benefits). So, you are quite familiar with the notion of planning! But, you are an individual; you have easily captured and contained your plan within your own mind. A business organization is made up of many individuals. And, these individuals must be orchestrated to work together in harmony. They must share and understand the organizational plans. In short, "everyone needs to be on the same page."

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2.3 Strategy

A business typically invests considerable time and money in developing its strategy. Employees, harried with day-to-day tasks, sometimes fail to see the need to take on strategic planning. It is difficult to see the linkage between strategic endeavors and the day-to-day corporate activities associated with delivering goods and services to customers. But, this strategic planning ultimately defines the organization. Specific strategy setting can take many forms, but generally, includes elements pertaining to the definition of core values, mission, and objectives.

Core Values -- An entity should clearly consider and define the rules by which it will play. Core values can cover a broad spectrum involving concepts of fair play, human dignity, ethics, employment/ promotion/compensation, quality, customer service, environmental awareness, and so forth. If an organization does not cause its members to understand and focus on these important elements, it will soon find participants becoming solely "profit-centric." This behavior inevitably leads to a short term focus and potentially illegal practices that provide the seeds of self destruction. Remember that management is to build business value by making the right decisions; and, decisions about core values are essential.

Mission -- Many companies attempt to prepare a pithy statement about their mission. For example:

> "At IBM, we strive to lead in the creation, development and manufacture of the industry's most advanced information technologies, including computer systems, software, networking systems, storage devices and microelectronics. We translate these advanced technologies into value for our customers through our professional solutions and services businesses worldwide."

Such mission statements provide a snapshot of the organization and provide a focal point against which to match ideas and actions. They provide an important planning element because they define the organization's purpose and direction. Interestingly, some organizations have avoided "missioning," in fear that it will limit opportunity for expansive thinking. For example, General Electric specifically states that it does not have a mission statement, per se. Instead, its operating philosophy and business objectives are clearly articulated each year in the Letter to Shareowners, Employees and Customers.

In some sense, though, GE's logo reflects its mission: "imagination at work". Perhaps the subliminal mission is to pursue opportunity wherever it can be found. As a result, GE is one of the world's most diversified entities in terms of the range of products and services it offers.

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Objectives -- An organization must also consider its specific objectives. In the case of GE:

> "Imagine, solve, build and lead - four bold verbs that express what it is to be part of GE. Their action-oriented nature says something about who we are - and should serve to energize ourselves and our teams around leading change and driving performance."

The objective of a business organization must include delivery of goods or services while providing a return (i.e., driving performance) for its investors. Without this objective, the organization serves no purpose and/or will cease to exist.

Overall, then, the strategic structure of an organization is established by how well it defines its values and purpose. But, how does the managerial accountant help in this process? At first glance, these strategic issues seem to be broad and without accounting context. But, information is needed about the "returns" that are being generated for investors; this accounting information is necessary to determine whether the profit objective is being achieved. Actually, though, managerial accounting goes much deeper. For example, how are core values policed? Consider that someone must monitor and provide information on environmental compliance. What is the most effective method for handling and properly disposing of hazardous waste? Are there alternative products that may cost more to acquire but cost less to dispose? What system must be established to record and track such material, etc.? All of these issues require "accountability." As another example, ethical codes likely deal with bidding procedures to obtain the best prices from capable suppliers. What controls are needed to monitor the purchasing process, provide for the best prices, and audit the quality of procured goods? All of these issues quickly evolve into internal accounting tasks. And, the managerial accountant will be heavily involved in providing input on all phases of corporate strategy.

2.4 Positioning

An important part of the planning process is positioning the organization to achieve its goals. Positioning is a broad concept and depends on gathering and evaluating accounting information.



Cost/Volume/Profit Analysis and Scalability -- In a subsequent chapter, you will learn about cost/volume/profit (CVP) analysis. It is imperative for managers to understand the nature of cost behavior and how changes in volume impact profitability. You will learn about calculating break-even points and how to manage to achieve target income levels. You will begin to think about business models and the ability (or inability) to bring them to profitability via increases in scale.

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Managers call upon their internal accounting staff to pull together information and make appropriate recommendations.

Global Trade and Transfer -- The management accountant frequently performs significant and complex analysis related to global business activities. This requires in-depth research into laws about tariffs, taxes, and shipping. In addition, global enterprises may transfer inventory and services between affiliated units in alternative countries. These transactions must be fairly and correctly measured to establish reasonable transfer prices (or potentially run afoul of tax and other rules of the various countries involved). Once again, the management accountant is called to the task.

Branding/Pricing/Sensitivity/Competition – In positioning a company's products and services, considerable thought must be given to branding and its impact on the business. To build a brand requires considerable investment with an uncertain payback. Frequently, the same product can be "positioned" as an elite brand via a large investment in up-front advertising, or as a basic consumer product that will depend upon low price to drive sales. What is the correct approach? Information is needed to make the decision, and management will likely enlist the internal accounting staff to prepare prospective information based upon alternative scenarios. Likewise, product pricing decisions must be balanced against costs and competitive market conditions. And, sensitivity analysis is needed to determine how sales and costs will respond to changes in market conditions.

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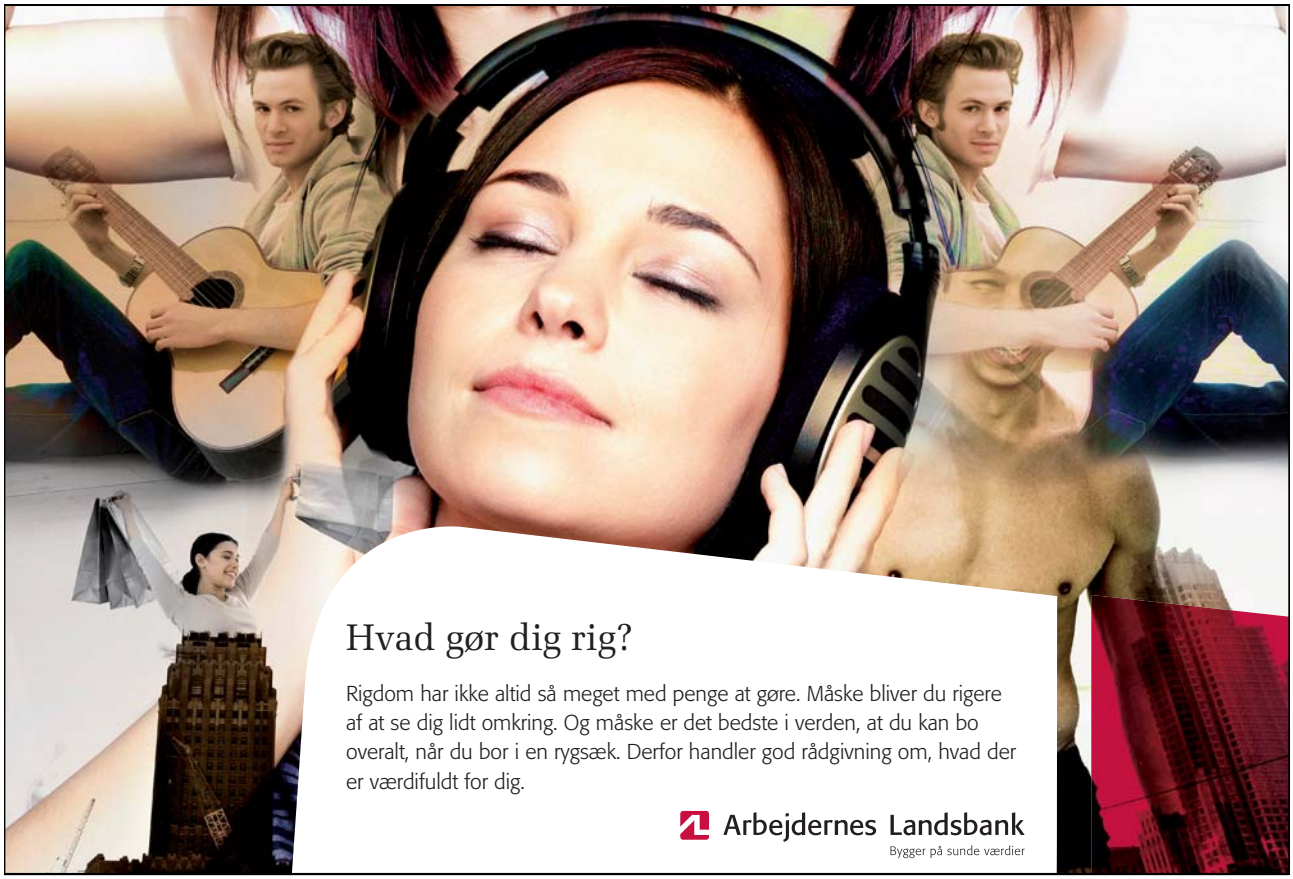

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As you can see, decisions about positioning a company's products and services are quite complex. The prudent manager will need considerable data to make good decisions. Management accountants will be directly involved in providing such data. They will usually work side-by-side with management in helping them correctly interpret and utilize the information. It behooves a good manager to study the basic principles of managerial accounting in order to better understand how information can be effectively utilized in the decision process. With these sorts of topics in play, it is no wonder that the term "strategic finance" is increasingly used to characterize this profession.

2.5 Budgets

A necessary planning component is budgeting. Budgets outline the financial plans for an organization. There are various types of budgets.

Operating Budgets -- A plan must provide definition of the anticipated revenues and expenses of an organization and more. These operating budgets can become fairly detailed, to the level of mapping specific inventory purchases, staffing plans, and so forth. The budgets, oftentimes, delineate allowable levels of expenditures for various departments.

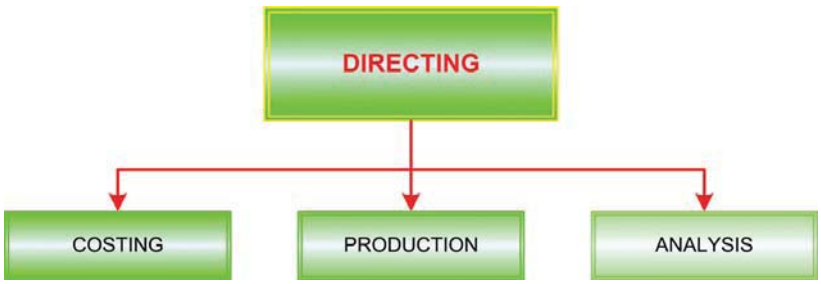
Capital Budgets – Operating budgets will also reveal the need for capital expenditures relating to new facilities and equipment. These longer term expenditure decisions must be evaluated logically to determine whether an investment can be justified and what rate and duration of payback is likely to occur.

Financial Budgets -- A company must assess financing needs, including an evaluation of potential cash shortages. These tools enable companies to meet with lenders and demonstrate why and when additional support may be needed.

The budget process is quite important (no matter how painful the process may seem) to the viability of an organization. Several of the subsequent chapters are devoted to helping you better understand the nature and elements of sound budgeting.

2.6 Directing

There are many good plans that are never realized. To realize a plan requires the initiation and



direction of numerous actions. Often, these actions must be well coordinated and timed. Resources must be ready, and authorizations need to be in place to enable persons to act according to the plan. By analogy, imagine that a composer has written a beautiful score of music -- the "plan." For it to

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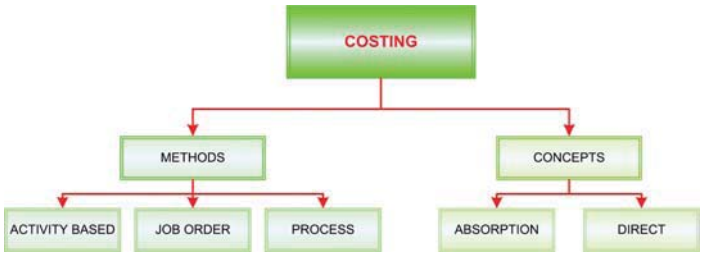
come to life requires all members of the orchestra, and a conductor who can bring the orchestra into synchronization and harmony. Likewise, the managerial accountant has a major role in putting business plans into action. Information systems must be developed to allow management to orchestrate the organization. Management must know that inventory is available when needed, productive resources (man and machine) are scheduled appropriately, transportation systems will be available to deliver output, and on and on. In addition, management must be ready to demonstrate compliance with contracts and regulations. These are complex tasks. They cannot occur without strong information resources. A major element of management accounting is to develop information systems to support the ongoing direction of the business effort.

Managerial accounting supports the "directing" function in many ways. Areas of support include costing, production management, and special analysis:

2.6.1 Costing



Cost accounting can be defined as the collection, assignment, and interpretation of cost. In subsequent chapters, you will learn about alternative costing methods. It is important to know what products and services cost to produce. The ideal approach to capturing costs is dependent on what is being produced.

Costing Methods -- In some settings, costs may be captured by the "job costing method." For example, a custom home builder would likely capture costs for each house constructed. The actual labor and material that goes into each house would be tracked and assigned to that specific home (along with some matching amount of overhead), and the cost of each home can be expected to vary considerably.

Some companies produce homogenous products in continuous processes. For example, consider the costing issues faced by the companies that produce the lumber, paint, bricks or other such homogenous components used in building a home. How much does each piece of lumber, bucket of paint, or stack of bricks cost? These types of items are produced in continuous processes where costs are pooled together during production, and output is measured in aggregate quantities. It is difficult to see specific costs attaching to each unit. Yet, it is important to make a cost assignment. To deal with these types of situations, accountants might utilize "process costing methods."

Now, let's think about the architectural firms that design homes. Such organizations need to have a sense of their costs for purposes of billing clients, but the firm's activities are very complex. An architectural firm must engage in many activities that drive costs but do not produce revenues. For

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example, substantial effort is required to train staff, develop clients, bill and collect, maintain the office, print plans, visit job sites, consult on problems identified during construction, and so forth. The individual architects are probably involved in multiple tasks and projects throughout the day; therefore, it becomes difficult to say exactly how much it costs to develop a set of blueprints for a specific client! The firm might consider tracing costs and assigning them to activities (e.g., training client development, etc.). Then, an allocation model can be used to attribute activities to jobs, enabling a reasonable cost assignment. Such "activity-based costing" (ABC) systems can be used in many settings, but are particularly well suited to situations where overhead is high, and/or a variety of products and services are produced.

Costing Concepts -- In addition to alternative methods of costing, a good manager will need to understand different theories or concepts about costing. In a general sense, the approaches can be described as "absorption" and "direct" costing concepts. Under the absorption concept, a product or service would be assigned its full cost, including amounts that are not easily identified with a particular item. Overhead items (sometimes called "burden") include facilities depreciation, utilities, maintenance, and many other similar shared costs. With absorption costing, this overhead is schematically allocated among all units of output. In other words, output absorbs the full cost of the productive process. Absorption costing is required for external reporting purposes under generally accepted accounting principles. But, some managers are aware that sole reliance on absorption costing numbers can lead to bad decisions.

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As a result, internal cost accounting processes in some organizations focus on a direct costing approach. With direct costing, a unit of output will be assigned only its direct cost of production (e.g., direct materials, direct labor, and overhead that occurs with each unit produced). You will study the differences between absorption and direct costing, and consider how they influence the management decision process. It is one of the more useful business decision elements to understand -- empowering you to make better decisions. Future chapters will build your understanding of these concepts. In review, to properly direct an organization requires a keen sense of the cost of products and services. Costing can occur under various methods and theories, and a manager must understand when and how these methods are best utilized to facilitate the decisions that must be made. Large portions of the following chapters will focus on these cost accounting issues.

2.6.2 Production

As you would suspect, successfully directing an organization requires prudent management of production. Because this is a hands-on process, and frequently entails dealing with the tangible portions of the business (inventory, fabrication, assembly, etc.), some managers are especially focused on this area of oversight. Managerial accounting provides numerous tools for managers to use in support of production and production logistics (moving goods through the production cycle to a customer). To generalize, production management is about running a “lean” business model. This means that costs must be minimized and efficiency maximized, while seeking to achieve enhanced output and quality standards. In the past few decades, advances in technology have greatly contributed to the ability to run a lean business. Product fabrication and assembly have been improved through virtually error free robotics. Accountability is handled via comprehensive software that tracks an array of data on a real-time basis. These enterprise resource packages (ERP) are extensive in their power to deliver specific query-based information for even the largest organizations. B2B (business to business) systems enable data interchange with sufficient power to enable one company’s information system to automatically initiate a product order on a vendor’s information system. Looking ahead, much is being said about the potential of RFID (radio frequency identification). Tiny micro processors are embedded in inventory and emit radio frequency signals that enable a computer to automatically track the quantity and location of inventory. M2M (machine to machine) enables connected devices to communicate necessary information (e.g., electric meters that no longer need to be read for billing, etc.) without requiring human engagement. These developments are exciting, sometimes frightening, but ultimately enhance organizational efficiency and the living standards of customers who benefit from better and cheaper products. But, despite their robust power, they do not replace human decision making. Managers must pay attention to the information being produced, and be ready to adjust business processes to respond. Production is a complex process requiring constant decision making. It is almost impossible to completely categorize and cover all of the decisions that will be required. But, many organizations will share similar production issues relating to inventory management and responsibility assignment tasks.

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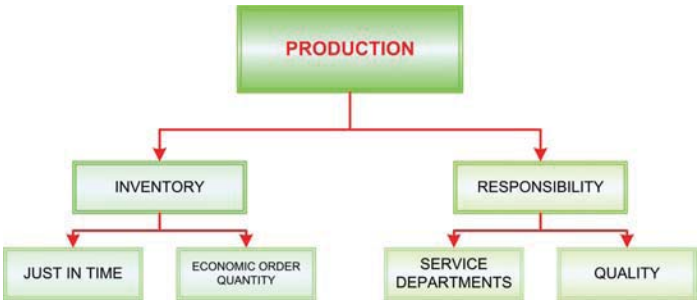

Inventory -- For a manufacturing company, managing inventory is vital. Inventory may consist of raw materials, work in process, and finished goods. The raw materials are the components and parts that are to be processed into a final product. Work in process consists of goods under production. Finished goods are the completed units awaiting sale to customers. Each category will require special consideration and control. Failure to properly manage any category of inventory can be disastrous to a business. Overstocking raw materials or overproduction of finished goods will increase costs and obsolescence. Conversely, out-of-stock situations for raw materials will silence the production line at potentially great cost. Failure to have finished goods on hand might result in lost sales and customers. Throughout subsequent chapters, you will learn about methods and goals for managing inventory. Some of these techniques carry popular acronyms like JIT (just-in-time inventory management) and EOQ (economic order quantity). It is imperative for a good manager to understand the techniques that are available to properly manage inventory.

Responsibility Considerations -- Enabling and motivating employees to work at peak performance is an important managerial role. For this to occur, employees must perceive that their productive efficiency and quality of output are fairly measured. A good manager will understand and be able to explain to others how such measures are determined. Your study of managerial accounting will lead you through various related measurement topics. For instance, direct productive processes must be supported by many “service departments” (maintenance, engineering, accounting, cafeterias, etc.). These service departments have nothing to sell to outsiders, but are essential components of operation. The costs of service departments must be recovered for a business to survive. It is easy for a production manager to focus solely on the area under direct control, and ignore the costs of support tasks. Yet, good management decisions require full consideration of the costs of support services. You will learn alternative techniques that managerial accountants use to allocate responsibility for organizational costs. A good manager will understand the need for such allocations, and be able to explain and justify them to employees who may not be fully cognizant of why profitability is more difficult to achieve than it would seem.

In addition, techniques must be utilized to capture the cost of quality -- or perhaps better said, the cost of a lack of quality. Finished goods that do not function as promised entail substantial warranty costs, including rework, shipping (back and forth!), and scrap. There is also an extreme long-run cost associated with a lack of customer satisfaction.

Understanding concepts of responsibility accounting will also require you to think about attaching inputs and outcomes to those responsible for their ultimate disposition. In other words, a manager must be held accountable, but to do this requires the ability to monitor costs incurred and

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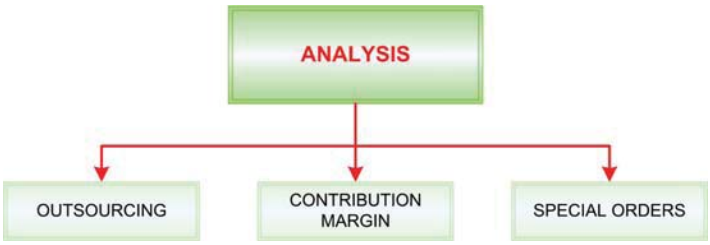
deliverables produced by circumscribed areas of accountability (centers of responsibility). This does not happen by accident and requires extensive systems development work, as well as training and explanation, on the part of management accountants.

2.6.3 Analysis

Certain business decisions have recurrent themes: whether to outsource production and/or support functions, what level of production and pricing to establish, whether to accept special orders with private label branding or special pricing, and so forth.



Managerial accounting provides theoretical models of calculations that are needed to support these types of decisions. Although such models are not perfect in every case, they certainly are effective in stimulating correct thought. The seemingly obvious answer may not always yield the truly correct or best decision. Therefore, subsequent chapters will provide insight into the logic and methods that need to be employed to manage these types of business decisions.

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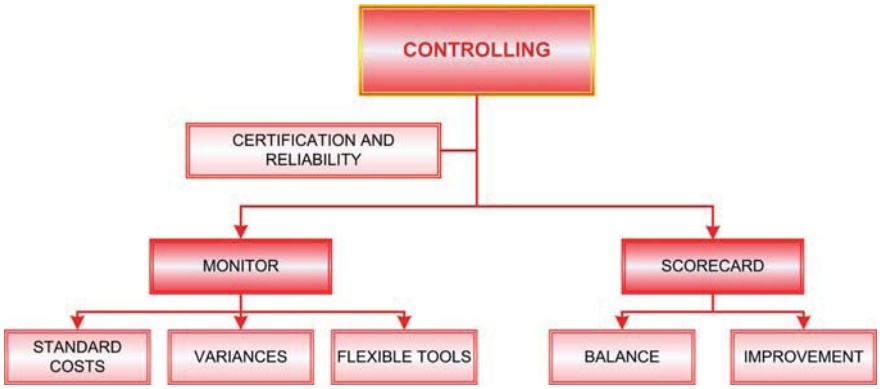
2.7 Controlling

Things rarely go exactly as planned, and management must make a concerted effort to monitor and adjust for deviations. The managerial accountant is a major facilitator of this control process, including exploration of alternative corrective strategies to remedy unfavorable situations. In addition, a recent trend (brought about in the USA by financial legislation most commonly known as Sarbanes-Oxley or SOX) is for enhanced internal controls and mandatory certifications by CEOs and CFOs as to the accuracy of financial reports. These certifications carry penalties of perjury, and have gotten the attention of corporate executives -- leading to greatly expanded emphasis on controls of the various internal and external reporting mechanisms.

Most large organizations have a person designated as “controller” (sometimes termed “comptroller”). The controller is an important and respected position within most larger organizations. The corporate control function is of sufficient complexity that a controller may have hundreds of support personnel to assist with all phases of the management accounting process. As this person’s title suggests, the controller is primarily responsible for the control task; providing leadership for the entire cost and managerial accounting functions. In contrast, the chief financial officer (CFO) is usually responsible for external reporting, the treasury function, and general cash flow and financing management. In some organizations, one person may serve a dual role as both the CFO and controller. Larger organizations may also have a separate internal audit group that reviews the work of the accounting and treasury units. Because internal auditors are reporting on the effectiveness and integrity of other units within a business organization, they usually report directly to the highest levels of corporate leadership. As you can see, “control” has many dimensions and is a large task!



2.7.1 Monitor

Let’s begin by having you think about controlling your car (aka “driving”)! Your steering, acceleration, and braking are not random; they are careful corrective responses to constant monitoring of many variables -- other traffic, road conditions, destination, and so forth. Clearly, each action on your part is in response to you having monitored conditions and adopted an adjusting response. Likewise, business managers must rely on systematic monitoring tools to maintain awareness of where the business is headed. Managerial accounting provides these monitoring tools, and establishes a logical basis for making adjustments to business operations.

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Standard Costs -- To assist in monitoring productive efficiency and cost control, managerial accountants may develop “standards.” These standards represent benchmarks against which actual productive activity is compared. Importantly, standards can be developed for labor costs and efficiency, materials cost and utilization, and more general assessments of the overall deployment of facilities and equipment (the overhead).

Variances -- Managers will focus on standards, keeping a particularly sharp eye out for significant deviations from the norm. These deviations, or “variances,” may provide warning signs of situations requiring corrective action by managers. Accountants help managers focus on the exceptions by providing the results of variance analysis. This process of focusing on variances is also known as “management by exception.”

Flexible tools -- Great care must be taken in monitoring variances. For instance, a business may have a large increase in customer demand. To meet demand, a manager may prudently authorize significant overtime. This overtime may result in higher than expected wage rates and hours. As a result, a variance analysis could result in certain unfavorable variances. However, this added cost was incurred because of higher customer demand and was perhaps a good business decision. Therefore, it would be unfortunate to interpret the variances in a negative light. To compensate for this type of potential misinterpretation of data, management accountants have developed various flexible budgeting and analysis tools. These evaluative tools “flex” or compensate for the operating environment in an attempt to sort out confusing signals. As a business manager, you will want to familiarize yourself with these more robust flexible tools, and they are covered in depth in subsequent chapters.

2.7.2 Scorecard

The traditional approach to monitoring organizational performance has focused on financial measures and outcomes. Increasingly, companies are realizing that such measures alone are not sufficient. For one thing, such measures report on what has occurred and may not provide timely data to respond aggressively to changing conditions. In addition, lower-level personnel may be too far removed from an organization’s financial outcomes to care. As a result, many companies have developed more involved scoring systems. These scorecards are custom tailored to each position, and draw focus on evaluating elements that are important to the organization and under the control of an employee holding that position. For instance, a fast food restaurant would want to evaluate response time, cleanliness, waste, and similar elements for the front-line employees. These are the elements for which the employee would be responsible; presumably, success on these points translates to eventual profitability.

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Balance -- When controlling via a scorecard approach, the process must be carefully balanced. The goal is to identify and focus on components of performance that can be measured and improved. In addition to financial outcomes, these components can be categorized as relating to business processes, customer development, and organizational betterment. Processes relate to items like delivery time, machinery utilization rates, percent of defect free products, and so forth. Customer issues include frequency of repeat customers, results of customer satisfaction surveys, customer referrals, and the like. Betterment pertains to items like employee turnover, hours of advanced training, mentoring, and other similar items. If these balanced scorecards are carefully developed and implemented, they can be useful in furthering the goals of an organization. Conversely, if the elements being evaluated do not lead to enhanced performance, employees will spend time and energy pursuing tasks that have no linkage to creating value for the business.

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Improvement -- TQM is the acronym for total quality management. The goal of TQM is continuous improvement by focusing on customer service and systematic problem solving via teams made up of front-line employees. These teams will benchmark against successful competitors and other businesses. Scientific methodology is used to study what works and does not work, and the best practices are implemented within the organization. Normally, TQM-based improvements represent incremental steps in shaping organizational improvement. More sweeping change can be implemented by a complete process reengineering. Under this approach, an entire process is mapped and studied with the goal of identifying any steps that are unnecessary or that do not add value. In addition, such comprehensive reevaluations will, oftentimes, identify bottlenecks that constrain the whole organization. Under the theory of constraints (TOC), efficiency is improved by seeking out and eliminating constraints within the organization. For example, an airport might find that it has adequate runways, security processing, luggage handling, etc., but it may not have enough gates. The entire airport could function more effectively with the addition of a few more gates. Likewise, most businesses will have one or more activities that can cause a slow down in the entire operation. TOC's goal is to find and eliminate the specific barriers.

So far, this chapter has provided snippets of how managerial accounting supports organizational planning, directing, and controlling. As you can tell, managerial accounting is surprisingly broad in its scope of involvement. Before looking at these topics in more detail in subsequent chapters, become familiar with some key managerial accounting jargon and concepts. The remainder of this chapter is devoted to that task.

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3. Cost Components

Companies that manufacture a product face an expanded set of accounting issues. In addition to the usual accounting matters associated with selling and administrative activities, a manufacturer must deal with accounting concerns related to acquiring and processing raw materials into a finished product. Cost accounting for this manufacturing process entails consideration of three key cost components that are necessary to produce finished goods:

1) *Direct materials* include the costs of all materials that are an integral part of a finished product and that have a physical presence that is readily traced to that finished product. Examples for a computer maker include the plastic housing of a computer, the face of the monitor screen, the circuit boards within the machine, and so forth. Minor materials such as solder, tiny strands of wire, and the like, while important to the production process, are not cost effective to trace to individual finished units. The cost of such items is termed “indirect materials.” These indirect materials are included with other components of manufacturing overhead, which is discussed below.

2) *Direct labor* costs consist of gross wages paid to those who physically and directly work on the goods being produced. For example, wages paid to a welder in a bicycle factory who is actually fabricating the frames of bicycles would be included in direct labor. On the other hand, the wages paid to a welder who is building an assembly line that will be used to produce a new line of bicycles is not direct labor. In general, indirect labor pertains to wages of other factory employees (e.g., maintenance personnel, supervisors, guards, etc.) who do not work directly on a product. Indirect labor is rolled into manufacturing overhead.

3) *Manufacturing overhead* includes all costs of manufacturing other than direct materials and direct labor. Examples include indirect materials, indirect labor, and factory related depreciation, repair, insurance, maintenance, utilities, property taxes, and so forth. Factory overhead is also known as indirect manufacturing cost, burden, or other synonymous terms. Factory overhead is difficult to trace to specific finished units, but its cost is important and must be allocated to those units. Normally, this allocation is applied to ongoing production based on estimated allocation rates, with subsequent adjustment processes for over- or under-applied overhead. This is quite important to product costing, and will be covered in depth later.

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Importantly, nonmanufacturing costs for selling and general/administrative purposes (SG&A) are not part of factory overhead. Selling costs relate to order procurement and fulfillment, and include advertising, commissions, warehousing, and shipping. Administrative costs arise from general management of the business, including items like executive salaries, accounting departments, public and human relations, and the like.

Accountants sometimes use a bit of jargon to describe certain "combinations" of direct materials, direct labor, and manufacturing overhead:

$$\text{Prime Costs} = \text{Direct Labor} + \text{Direct Material}$$
$$\text{Conversion Costs} = \text{Direct Labor} + \text{Manufacturing Overhead}$$

Prime costs are the components that are direct in nature. Conversion costs are the components to change raw materials to finished goods.

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4. Product Versus Period Costs

Now, another way to look at manufacturing costs is to think of them as attaching to a product. In other words, products result from the manufacturing process and “product costs” are the summation of direct materials, direct labor, and factory overhead. This is perhaps easy enough to understand. But, how are such costs handled in the accounting records?

To build your understanding of the answer to this question, think back to your prior studies about how a retailer accounts for its inventory costs. When inventory is purchased, it constitutes an asset on the balance sheet (i.e., “inventory”). This inventory remains as an asset until the goods are sold, at which point the inventory is gone, and the cost of the inventory is transferred to cost of goods sold on the income statement (to be matched with the revenue from the sale).

By analogy, a manufacturer pours money into direct materials, direct labor, and manufacturing overhead. Should this spent money be expensed on the income statement immediately? No! This collection of costs constitutes an asset on the balance sheet (“inventory”). This inventory remains as an asset until the goods are sold, at which point the inventory is gone, and the cost of the inventory is transferred to cost of goods sold on the income statement (to be matched with the revenue from the sale). There is little difference between a retailer and a manufacturer in this regard, except that the manufacturer is acquiring its inventory via a series of expenditures (for material, labor, etc.), rather than in one fell swoop. What is important to note about product costs is that they attach to inventory and are thus said to be “inventoriable” costs.

4.1 Period Costs

Some terms are hard to define. In one school of thought, period costs are any costs that are not product costs. But, such a definition is a stretch, because it fails to consider expenditures that will be of benefit for many years, like the cost of acquiring land, buildings, etc. It is best to relate period costs to presently incurred expenditures that relate to SG&A activities. These costs do not logically attach to inventory, and should be expensed in the period incurred.

It is fair to say that product costs are the inventoriable manufacturing costs, and period costs are the nonmanufacturing costs that should be expensed within the period incurred. This distinction is important, as it paves the way for relating to the financial statements of a product producing company. And, the relationship between these costs can vary considerably based upon the product produced. A soft drink manufacturer might spend very little on producing the product, but a lot on selling. Conversely, a steel mill may have high inventory costs, but low selling expenses. Managing a business will require you to be keenly aware of its cost structure.

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5. Financial Statement Issues that are Unique to Manufacturers

Unlike retailers, manufacturers have three unique inventory categories: Raw Materials, Work in Process, and Finished Goods. Below is the inventory section from the balance sheet of an actual company:

INVENTORIES	
RAW MATERIAL	11,736,735
WORK-IN-PROCESS	7,196,938
FINISHED GOODS	2,161,627

For this company, observe that the finished goods is just a small piece of the overall inventory. Finished goods represent the cost of completed products awaiting sale to a customer. But, this company has a more significant amount of raw materials (the components that will be used in manufacturing units that are not yet started) and work in process. Work in process is the account most in need of clarification. This account is for goods that are in production but not yet complete; it contains an accumulation of monies spent on direct material (i.e., the raw materials that have been put into production), direct labor, and applied manufacturing overhead.

Your earlier studies should have ingrained these formulations: Beginning Inventory + Purchases = Cost of Goods Available for Sale, and Cost of Goods Available for Sale - Ending Inventory = Cost of Goods Sold. If you need a refresher, look at the Current Assets book . Of course, these relations were necessary to calculate the cost of goods sold for a company with only one category of inventory.

For a manufacturer with three inventory categories, these “logical” formulations must take on a repetitive nature for each category of inventory. Typically, this entails a detailed set of calculations/ schedules for each of the respective inventory categories. Don’t be intimidated by the number of schedules, as they are all based on the same concept.

5.1 Schedule of Raw Materials

Focusing first on raw material, a company must determine how much of the available supply was transferred into production during the period. The schedule below illustrates this process for Katrina’s Trinkets, a fictitious manufacturer of inexpensive jewelry.

KATRINA'S TRINKETS Schedule of Raw Materials For the Year Ending December 31, 20X6	
Beginning raw materials inventory, Jan. 1	$ 135,000
Plus: Net purchases of raw materials	620,000
Raw materials available	$ 755,000
Less: Ending raw materials inventory, Dec. 31	160,000
Raw materials transferred to work in process (to schedule of work in process)	$ 595,000

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purchases determined from accounting records. Or, Katrina might utilize a sophisticated perpetual system that tracks the raw material as it is placed into production. Either way, the schedule summarizes the activity for the period and concludes with the dollar amount attributed to direct materials that have flowed into the production cycle. This material transferred to production appears in the schedule of work in process that follows.

5.2 Schedule of Work in Process

The following schedule presents calculations that pertain to work in process. Pay attention to its details, noting that (1) direct materials flow in from the schedule of raw materials, (2) the conversion costs (direct labor and overhead) are added into the mix, and (3) the cost of completed units to be transferred into finished goods is called cost of goods manufactured. The amounts are assumed, but would be derived from accounting records and/or by a physical counting process.

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KATRINA'S TRINKETS Schedule of Work in Process For the Year Ending December 31, 20X6			
Beginning work in process inventory, Jan. 1			$ 425,000
Plus: Additions to work in process			
Direct materials (from schedule of raw materials)		$ 595,000	
Direct labor		405,000	
Factory overhead			
Indirect material	$ 15,000		
Indirect labor	13,000		
Factory utilities	80,000		
Factory depreciation	70,000		
Factory insurance, maintenance, and taxes	22,000	200,000	$1,200,000
Total manufacturing costs			$1,625,000
Less: Ending work in process inventory, Dec. 31			625,000
Cost of goods manufactured (to schedule of cost of goods sold)			$1,000,000

5.3 Schedule of Cost of Goods Manufactured

The schedules of raw materials and work in process are often combined into a single schedule of cost of goods manufactured. This schedule contains no new information from that presented on the prior page; it is just a combination and slight rearrangement of the separate schedules.

KATRINA'S TRINKETS Schedule of Cost of Goods Manufactured For the Year Ending December 31, 20X6		
Direct materials:		
Beginning raw materials inventory, Jan. 1	$ 135,000	
Plus: Net purchases of raw materials	620,000	
Raw materials available	$ 755,000	
Less: Ending raw materials inventory, Dec. 31	160,000	
Raw materials transferred to production		$ 595,000
Direct labor		405,000
Factory overhead		
Indirect materials	$ 15,000	
Indirect labor	13,000	
Factory utilities	80,000	
Factory depreciation	70,000	
Factory insurance, maintenance, and taxes	22,000	200,000
Total manufacturing costs		$1,200,000
Beginning work in process inventory, Jan. 1		425,000
		$1,625,000
Less: Ending work in process inventory, Dec. 31		625,000
Cost of goods manufactured		$1,000,000

5.4 Schedule of Cost of Goods Sold

The determination of cost of goods sold is made via an examination of changes in finished goods:

KATRINA'S TRINKETS Schedule of Cost of Goods Sold For the Year Ending December 31, 20X6	
Beginning finished goods inventory, Jan. 1	$ 250,000
Plus: Cost of goods manufactured (from schedule of work in process)	1,000,000
Goods available for sale	$ 1,250,000
Less: Finished goods inventory, Dec. 31	190,000
Cost of goods sold (to income statement)	$ 1,060,000

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5.5 The Income Statement

An income statement for a manufacturer will appear quite similar to that of a merchandising company. The cost of goods sold number within the income statement is taken from the preceding schedules, and is found in the income statement below. All of the supporting schedules that were presented leading up to the income statement are ordinarily “internal use only” type documents. The details are rarely needed by external financial statement users who focus on the income statement. In fact, some trade secrets could be lost by publicly revealing the level of detail found in the schedules. For example, a competitor may be curious to know the labor cost incurred in producing a product, or a customer may think that the finished product price is too high relative to the raw material cost (e.g., have you ever wondered how much it really costs to produce a pair of $100+ shoes?).

KATRINA'S TRINKETS Income Statement For the Year Ending December 31, 20X6		
Sales		$ 1,980,000
Cost of goods sold		1,060,000
Gross profit		$ 920,000
Operating expenses		
Selling	$ 330,000	
General & administrative	270,000	600,000
Net income		$ 320,000

5.6 Reviewing Cost of Flow Concepts for a Manufacturer

Review the following diagram that summarizes the discussion thus far. Notice that costs are listed on the left -- the “product costs” have a blue drop shadow and the “period costs” have a pink drop shadow. Further, the “prime costs” of production have a back slash in the blue shadow, while the “conversion costs” have a forward slash in the blue shadow. Yes, the direct labor shadow has both forward and back slashes; remember that it is considered to be both a prime and a conversion cost!

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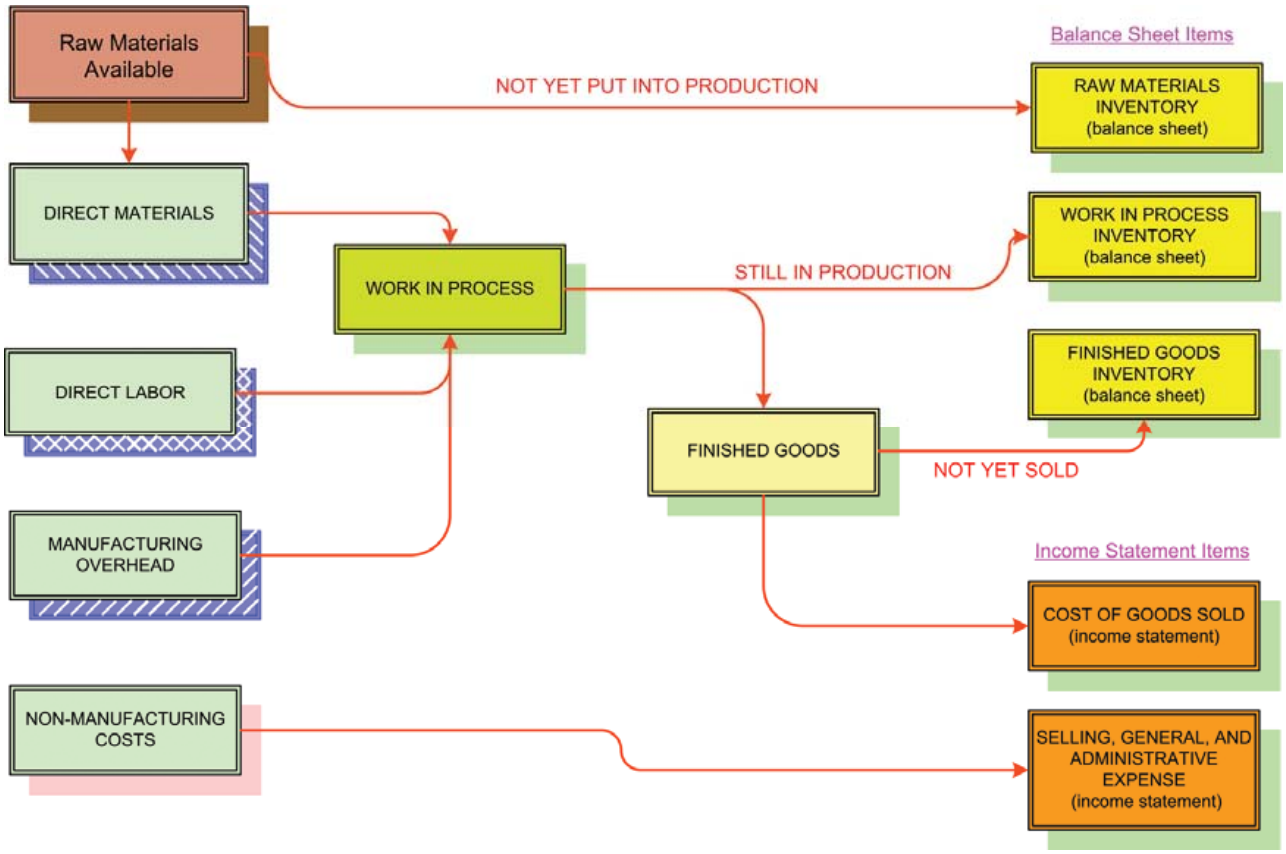

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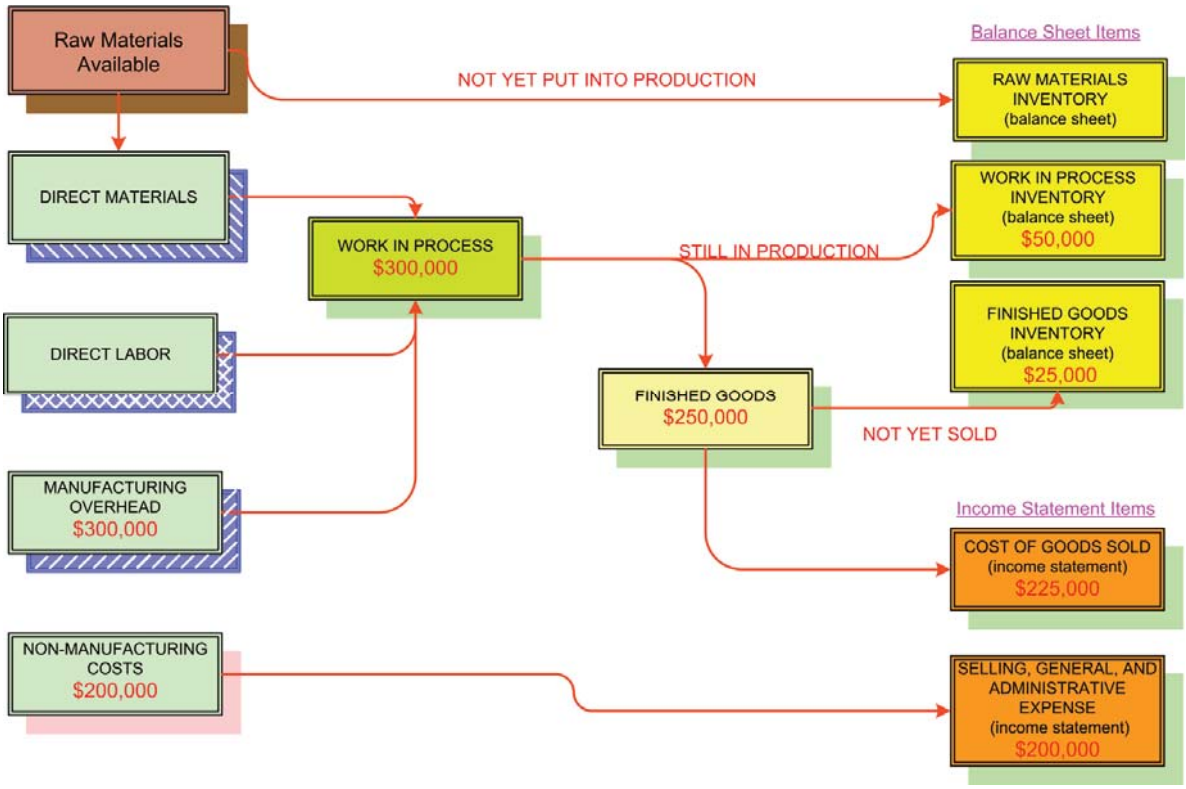
5.7 Critical Thinking About Cost Flow

It is easy to overlook an important aspect of cost flow within a manufacturing operation. Let's see if you have taken note of an important concept! Try to answer this seemingly simple question: Is depreciation an expense? You are probably inclined to say yes. But, the fact of the matter is that the answer depends! Let's think through this with an example. Suppose that Altec Corporation calculated deprecation of $500,000 for 20X1. 60% of this depreciation pertained to the manufacturing plant, and 40% related to the corporate offices. Further, Altec sold 75% of the goods put into production during the year. One third of the remaining goods placed in production were in finished goods awaiting resale, and the other portion was still being processed in the factory. So, what is the accounting implication? How does this all shake out? Let's reexamine the above diagram -- this time with the flow of the $500,000 of depreciation superimposed (for this illustration, we are ignoring all other costs and looking only at the depreciation piece):



First, notice that the $500,000 of depreciation cost enters the cost pool on the left; $300,000 attributable to manufacturing ($500,000 X 60%) and $200,000 to nonmanufacturing ($500,000 X 40%). The nonmanufacturing depreciation is a period cost and totally makes its way to expense on the right side of the graphic. But, the manufacturing depreciation follows a more protracted journey. It is assigned to work in process, and 75% of the goods put in process end up being completed and sold by the end of the year. Therefore, $225,000 of the $300,000 ($300,000 X 75%) is charged against income as cost of goods sold. The other $75,000 ($300,000 - $225,000 cost of goods sold) remains somewhere in inventory. In our fact situation, 1/3 of the $75,000 ($25,000) is attributable to completed goods and becomes part of finished goods inventory. The other $50,000 ($75,000 x 2/3) stays in work in process inventory since it is attributable to units still in production.

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Confusing enough? The bottom line here is that only $425,000 of the depreciation was charged against income. The other $75,000 was assigned to work in process and finished goods inventory. In short, $500,000 ($300,000 + $200,000) entered on the left, and $500,000 can be found on the right ($50,000 + $25,000 + $225,000 + $200,000). Returning to the seemingly simple question, we see that a cost is not always an expense in the same period. In a manufacturing business, much of the direct material, direct labor, and factory overhead can end up in inventory -- at least until that inventory is disposed.

How important are these cost flow concepts? Well, they are important enough that the FASB has specified external reporting rules requiring the allocation of production overhead to inventory. And, for tax purposes, the IRS has specific “uniform capitalization” rules. Under these rules, inventory must absorb direct labor, direct materials, and indirect costs including indirect labor, pensions, employee benefits, indirect materials, purchasing, handling, storage, depreciation, rent, taxes, insurance, utilities, repairs, design cost, tools, and a long list of other factory overhead items. A company’s results of operations are sensitive to proper cost assignment, and management accountants are focused on processes for correctly measuring and capturing this information. Subsequent chapters will better acquaint you with this aspect of accounting.

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Cost-Value-Profit and Business Scalability

Part 2

Your goals for this “cost-volume-profit analysis” chapter are to learn about:

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- Methods of cost behavior analysis.
- Break-even and target income analysis
- Cost and profit sensitivity analysis.
- Cost-volume-profit analysis for multiproduct scenarios.
- Critical assumptions of cost-volume-profit modeling.

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6. Cost Behavior

“Profitability is just around the corner.” This is a common expression in the business world; you may have heard or said this yourself. But, the reality is that many businesses don’t make it! Business is tough, profits are illusive, and competition has a habit of moving into areas where profits are available. And, sometimes, business owners become frustrated because revenue growth only seems to bring on waves of additional expenses, even to the point of going backwards.

How does one realistically assess the viability of a business? This is perhaps the most critical business assessment a manager must make. Most of us are taught from an early age to do our best and not give up, even in the face of adversity. And, there are countless stories of businesses that struggled to survive their infancy, but went on to become highly successful firms. But, it is equally important to note that some business models will not work. You likely have heard the tongue-in-cheek story about the car dealer who said he loses money on every sale but makes it up on volume. Of course, the math just won’t work. A good manager must learn to use information to make informed decisions about which business prospects to pursue. Managerial accounting methods provide techniques for evaluating the viability and ability to grow or “scale” a business. These techniques are called cost-volume-profit analysis (CVP).

6.1 The Nature of Costs

Before one can begin to understand how a business is going to perform over time and with shifts in volume, it is imperative to first consider the cost structure of the business. This requires drilling down into the specific types of costs that are to be incurred and trying to understand their unique attributes.

6.2 Variable Costs

Variable costs will vary in direct proportion to changes in the level of an activity. For example, direct material, direct labor, sales commissions, fuel cost for a trucking company, and so on, may be expected to increase with each additional unit of output.

Assume that GoSound produces portable digital music players. Each unit produced requires a printed circuit board (PCB) that costs $11. Below is a spreadsheet that reveals rising PCB costs with increases in unit production. For example, $1,650,000 is spent when 150,000 units are produced (150,000 X $11 = $1,650,000). The data are plotted on the graphs. The top graph reveals that total variable cost increases in a linear fashion as total production rises. The slope of the line is constant. Of course, when plotted on a “per unit” basis (the bottom graph), the variable cost is constant at $11 per unit. Increases in volume do not change the per unit cost. In summary, every additional unit produced brings another incremental unit of variable cost.

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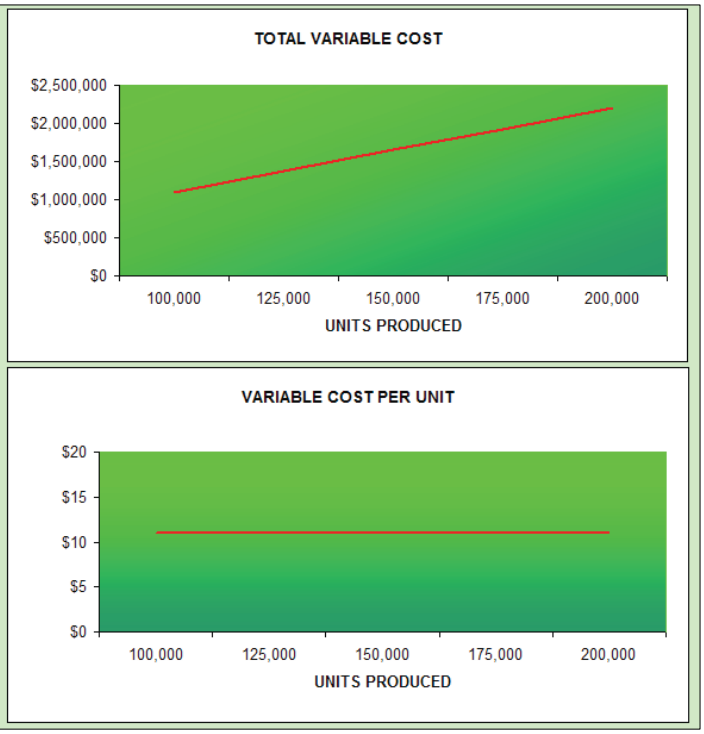
Units	PCB	PCB per unit (PCB/UNITS)
100,000	$1,100,000	$11
125,000	$1,375,000	$11
150,000	$1,650,000	$11
175,000	$1,925,000	$11
200,000	$2,200,000	$11



The activity base is the item or event that causes the incurrence of a variable cost. It is easy to think of the activity base in terms of units produced, but it can be more than that. Activity can relate to labor hours worked, units sold, customers processed, or other such “cost drivers.” For instance, a dentist uses a new pair of disposable gloves for each patient seen, no matter how many teeth are being filled. Therefore, disposable gloves are variable and key on patient count. But, the material used for fillings is a variable that is tied to the number of decayed teeth that are repaired. Some patients have none, some have one, and others have many. So, each variable cost must be considered independently and with careful attention to what activity drives the cost.

6.3 Fixed Costs

The opposite of variable costs are fixed costs. Fixed costs do not fluctuate with changes in the level of activity. Assume that GoSound leases the manufacturing facility where the portable digital music players are assembled. Assume that rent is $1,200,000 no matter the level of production. The rent is said to be a “fixed” cost, because total rent will not change as output rises and falls. The following spreadsheet reveals the factory rent incurred at different levels of production and the resulting “per unit” rent amount. Observe that the fixed cost per unit will decline with increases in production. This attribute of fixed costs is important to consider in assessing the scalability of a business proposition. There are numerous types of fixed costs. Examples include administrative salaries, rents, property taxes, security, networking infrastructure support, and so forth.

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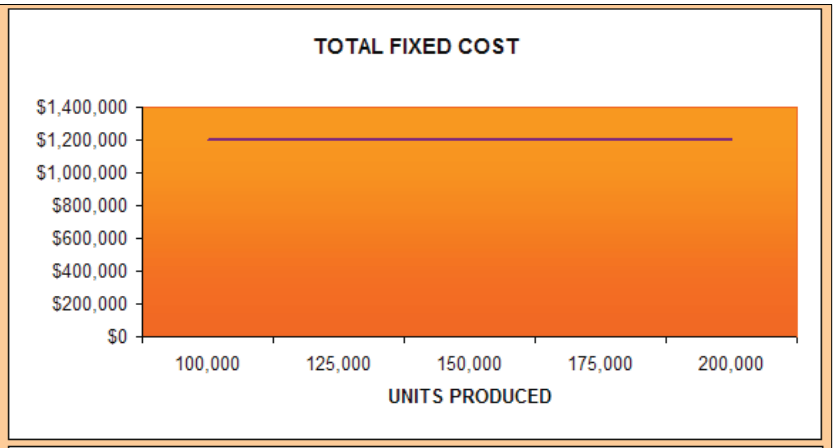
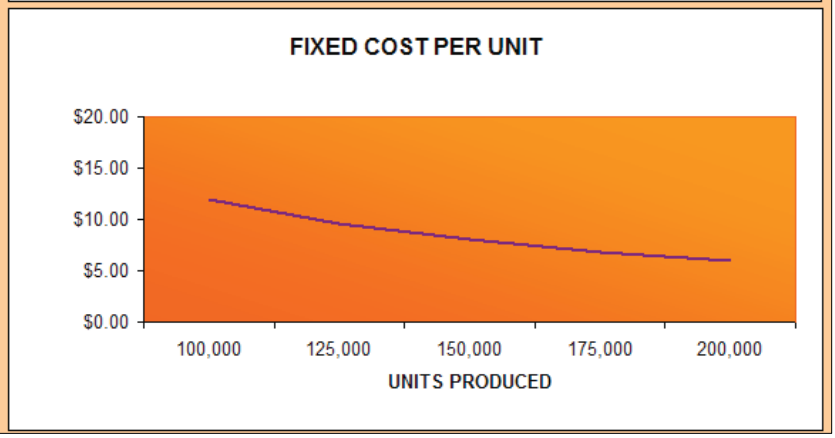
Units	Factory Rent	Rent per unit (RENT/UNITS)
100,000	$1,200,000	$12.00
125,000	$1,200,000	$9.60
150,000	$1,200,000	$8.00
175,000	$1,200,000	$6.86
200,000	$1,200,000	$6.00





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6.4 Business Implications of the Fixed Cost Structure

The nature of a specific business will have a lot to do with defining its inherent fixed cost structure. Airlines have historically been burdened with high fixed costs related to gates, maintenance, contractual labor agreements, computer reservation systems, aircraft, and the like. As you are aware, airlines have struggled during lean years because they are unable to cover fixed costs. During boom years, these same companies have been extremely profitable, because costs do not rise (much) with increases in volume. Basically, there is not much cost difference in flying a plane empty or full! Software companies have a big investment in product development, but very little cost in reproducing multiple electronic copies of the finished product. Their variable costs are low.

Other businesses have attempted to avoid fixed costs so that they can maintain a more stable stream of income relative to sales. For example, a computer company might outsource its tech support. Rather than having a fixed staff that is either idle or overloaded at any point in time, they pay an independent support company a per-call fee. The effect is to transform the organization's fixed costs to variable, and better insulate the bottom line from fluctuations brought about by the related ability to cover or not cover the fixed costs of operations.

Every business is unique, and a savvy business person will be careful to understand their cost structure. For a long time, the trend for many businesses was toward increased fixed costs. Some of this was the result of increased investment in robotics and technology. However, those components have become more affordable. And, we are now seeing more outsourcing, elimination of health insurance, conversion of pension plans, and so forth. These activities suggest attempts to structure businesses with a definitive margin (revenues minus variable costs) that scales up and down with changes in the level of business activity. No matter the specific example, a manager must understand their cost structure.

6.5 Economies of Sale

Economists speak of the concept of economies of scale. This means that certain efficiencies are achieved as production levels rise. This can take many forms. For starters, fixed costs can be spread over larger production runs, and this causes a decrease in the per unit fixed cost. In addition, enhanced buying power results (e.g., quantity discounts) as volume goes up, and this can reduce the per unit variable cost. These are valid considerations. The accountant is not blind to these issues and must take them into consideration in any business evaluation. However, care must also be exercised to limit one's analysis to a "relevant range" of activity.

Below is an excerpt from an online catalog (Digi-Key Corporation). This is a pricing table for surface mount Zener Diodes. Notice that they are $0.44 each, or $3.00 for ten units, or $20.80 for 100 units, or $92.00 per thousand. The bottom line here is that they range from $0.44 down to $0.092 each, depending on the quantity purchased. This is quite a remarkable spread.

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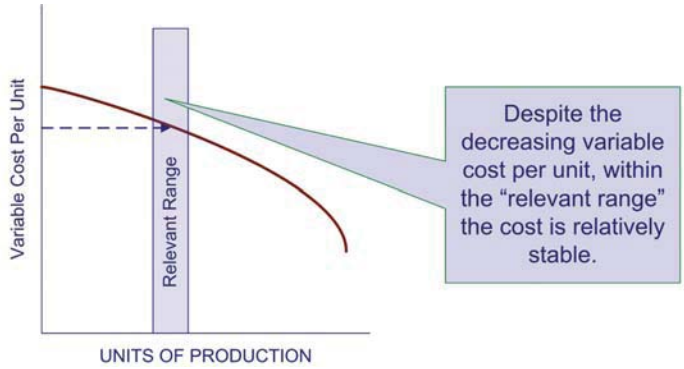
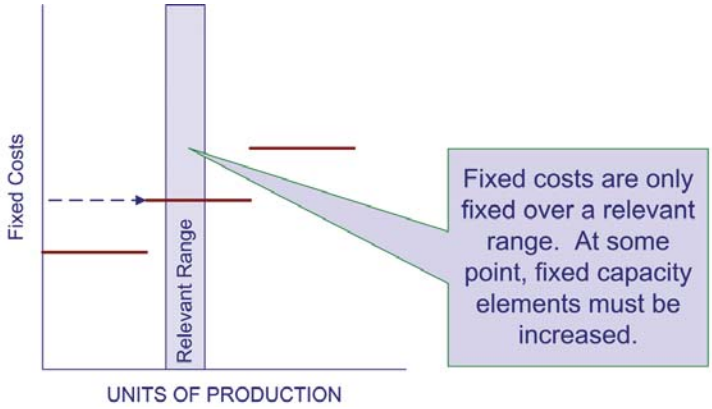
		Price Break	Unit Price	Price
Digi-Key Part Number	BZX84C36-FDICT-ND	1	0.44000	0.44
Manufacturer Part Number	BZX84C36-7-F	10	0.30000	3.00
Description	Diode Zener 300MW 36V SOT 23	100	0.20800	20.80
		250	0.15000	37.50
Quantity Available	2896	500	0.11200	56.00
		1000	0.09200	92.00

Despite the wild spread in pricing, if your business needed about 150 of these diodes in your production process, you would study the above table and determine that the best quantity for you to order would be priced at $20.80 per hundred. As a result, your per unit variable cost would be $0.208. The “relevant range” is the anticipated activity level at which you will perform. Any pricing data outside of this range is irrelevant and need not be considered. This enhanced concept of variable cost is portrayed in the following graphic:



The relevant range comes into play when considering fixed costs as well. Many fixed costs are only fixed for a certain level of production. For example, a machine or manufacturing plant can reach capacity. To increase production beyond a certain level, additional machinery (or a new plant, additional supervisors, etc.) must be deployed. This will cause a major step upward in the fixed cost. Fixed costs that behave in this fashion are also called step costs. These costs are illustrated by the following diagram. The key conceptual point is to note that fixed costs are only fixed over some particular range of activity, and moving outside that range can significantly alter the cost structure.



6.6 Dialing in Your Business Model

After grasping the concepts of variable and fixed costs, it is important to understand their full implications in managing a business. Let's first give added thought to fixed cost concepts. In an ideal setting, you would try to produce at the right-most edge of a fixed-cost step. This squeezes maximum productive output from a given level of expenditure. For a machine, it is as simple as running at full capacity. However, for a business with many fixed costs, it is more challenging to orchestrate operations so that each component is fully utilized.

Some fixed costs are committed fixed costs arising from an organization's commitment to engage in operations. These elements include such items as depreciation, rent, insurance, property taxes, and the like. These costs are not easily adjusted with changes in business activity. On the other hand, discretionary fixed costs originate from top management's yearly spending decisions; proper planning can result in avoidance of these costs if cutbacks become necessary or desirable. Examples of discretionary fixed costs include advertising, employee training, and so forth. Committed fixed costs relate to the desired long-run positioning of the firm; whereas, discretionary fixed costs have a short-term orientation. Committed fixed costs are important because they cannot be avoided in lean times; discretionary fixed costs can be altered with proper planning. Of course, a company should be careful to avoid incurring excessive committed fixed costs.

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Variable costs are also subject to adjustment. In the Digi-Key Corporation example, it was illustrated how such costs can vary based on quantities ordered. Perhaps it occurred to you that one might order and store large quantities of the diodes for use in future periods (after all, 1200 units at $.208 each > 3000 units at $0.08 each). In a subsequent chapter, you will learn how to calculate economic order quantities that take into account carrying and ordering costs in balancing these important considerations. Even direct labor cost can be subject to adjustment for overtime premiums, based on whether or not overtime is worked. It may or may not make sense to meet customer demand by ramping up production when overtime premiums kick in. Later in this book, you will learn how to perform incremental analysis for such decision tasks.

The interplay between all of the different costs emphasizes the importance of good planning. The trick is to synchronize operations so that the benefits of each fixed cost are maximized, and variable cost patterns are established in the most economic position. All of this must be weighed against revenue opportunities; you must be able to sell what you produce. Some advanced managerial accounting courses present sophisticated linear programming models that take into account constraints and opportunities and project the ideal firm positioning. Those models are beyond the scope of an introductory class, but a number of simpler tools are available, and will be covered next.

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7. Cost Behavior Analysis

Good managers must not only be able to understand the conceptual underpinnings of cost behavior, but they must also be able to apply those concepts to real world data that do not always behave in the expected manner. Cost data are impacted by complex interactions. Consider for instance the costs of operating a vehicle. Conceptually, fuel usage is a variable cost that is driven by miles. But, the efficiency of fuel usage can fluctuate based on highway miles versus city miles. Beyond that, tires wear faster at higher speeds, brakes suffer more from city driving, and on and on. Vehicle insurance is seen as a fixed cost; but portions are required (liability coverage) and some portions are not (collision coverage). Furthermore, if you have a wreck or get a ticket, your cost of coverage can rise. Now, the point is that assessing the actual character of cost behavior can be more daunting than you might first suspect. Nevertheless, management must understand cost behavior, and this sometimes takes a bit of forensic accounting work. Let's begin by considering the case of "mixed costs."

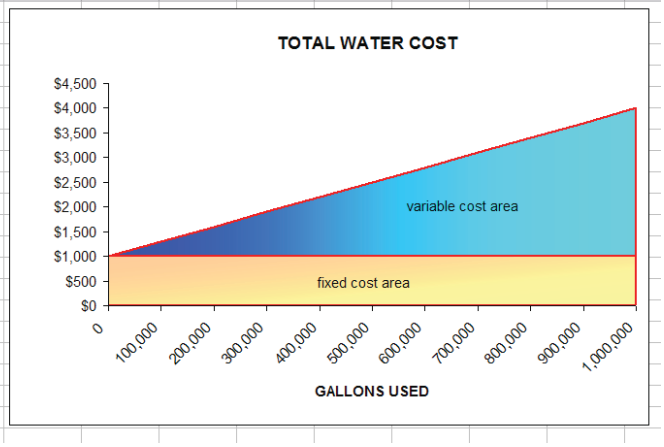
7.1 Mixed Costs

Many costs contain both variable and fixed components. These costs are called mixed or semi variable. If you have a cell phone, you probably know more than you wish about such items. Cell phone agreements usually provide for a monthly fee plus usage charges for excess minutes, text messages, and so forth. With a mixed cost, there is some fixed amount plus a variable component tied to an activity. Mixed costs are harder to evaluate, because they change in response to fluctuations in volume. But, the fixed cost element means the overall change is not directly proportional to the change in activity.

To illustrate, assume that Butler's Car Wash has a contract for its water supply that provides for a flat monthly meter charge of $1,000, plus $3 per thousand gallons of usage. This is a classic example of a mixed cost. Below is a graphic portraying Butler's potential water bill, keyed to gallons used:

B12 =(A12/1000)*3

	A	B	C	D
3	Gallons	Variable	Fixed	Total
5	0	$0	$1,000	$1,000
6	100,000	$300	$1,000	$1,300
7	200,000	$600	$1,000	$1,600
8	300,000	$900	$1,000	$1,900
9	400,000	$1,200	$1,000	$2,200
10	500,000	$1,500	$1,000	$2,500
11	600,000	$1,800	$1,000	$2,800
12	700,000	$2,100	$1,000	$3,100
13	800,000	$2,400	$1,000	$3,400
14	900,000	$2,700	$1,000	$3,700
15	1,000,000	$3,000	$1,000	$4,000



Look closely at the data in the spreadsheet, and notice that the "variable" portion of the water cost is $3 per thousand gallons. For example, spreadsheet cell B12 is $2,100 (700 thousand gallons at $3

per thousand); observe the formula for cell B12 in the upper bar of the spreadsheet (=(A12/1000)*3). In addition, the "fixed" cost is $1,000, regardless of the gallons used. The total in column D is the summation of columns B and C. The cost components are mapped in the diagram at the right.

Hopefully, the preceding illustration is clear enough. But, what if you were not given the "formula" by which the water bill is calculated? Instead, all you had was the information from a handful of past water bills. How hard would it be to to sort it out? Could you estimate how much the water bill should be for a particular level of usage? This type of problem is frequently encountered in business, as many expenses (individually and by category) contain both fixed and variable components.

7.2 High-Low Method

April	450,000 gallons	$2,350
May	340,000 gallons	$2,020
June	850,000 gallons	$3,550
July	500,000 gallons	$2,500

One approach to sorting out mixed costs is the high-low method. It is perhaps the simplest technique for separating a mixed cost into fixed and variable portions. However, beware that it can return an imprecise answer if the data set under analysis has a number of rogue data points. But, it will work fine in other cases, as with the water bills for Butler's Car Wash. Information from Butler's actual water bills is shown at above right. Butler is curious to know how much the August water bill will be if 650,000 gallons are used. Assume that the only data available are from the aforementioned four water bills.

With the high-low technique, the highest and lowest levels of activity are identified for a period of time. The highest water bill is $3,550, and the lowest is $2,020. The difference in cost between the highest and lowest level of activity represents the variable cost ($3,550 - $2,020 = $1,530) associated with the change in activity (850,000 gallons on the high end and 340,000 gallons on the low end yields a 510,000 gallon difference). The cost difference is divided by the activity difference to determine the variable cost for each additional unit of activity ($1,530/510 thousand gallons = $3 per thousand).

	USAGE (in thousands of gallons)	COST
Highest level	850	$ 3,550
Lowest level	340	2,020
Difference	510	$ 1,530
Variable Cost per unit: ($1,530/510)	$3	
	HIGH	LOW
Total cost	$ 3,550	$ 2,020
Less: Variable cost ($3 per unit X usage)	2,550	1,020
Fixed cost	$ 1,000	$ 1,000

The fixed cost can be calculated by subtracting variable cost (per-unit variable cost multiplied by the activity level) from total cost. The table at above right reveals the application of the high-low method. An electronic spreadsheet can be used to simplify the high-low calculations. The website includes a link to an illustrative spreadsheet for Butler.

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7.3 Method of Least Squares

As cautioned, the high-low method can be quite misleading. The reason is that cost data are rarely as linear as presented in the preceding illustration, and inferences are based on only two observations (either of which could be a statistical anomaly or "outlier"). For most cases, a more precise analysis tool should be used. If you have studied statistical methods, recall "regression analysis" or the "method of least squares." This tool is ideally suited to cost behavior analysis. This method appears to be imposingly complex, but it is not nearly so complex as it seems. Let's start by considering the objective of this calculation.

The goal of least squares is to define a line so that it fits through a set of points on a graph, where the cumulative sum of the squared distances between the points and the line is minimized (hence, the name "least squares"). Simply, if you were laying out a straight train track between a lot of cities, least squares would define a straight-line route between all of the cities, so that the cumulative distances (squared) from each city to the track is minimized.

Let's dissect this method, beginning with the definition of a line. A line on a graph can be defined by its intercept with the vertical (Y) axis and the slope along the horizontal (X) axis. In the following diagram, observe a red line starting on the Y axis (at the value of "2"), and rising gently upward as it moves out along the X axis. The rate of rise is called the slope of the line; in this case, the slope is 0.8, because the line "rises" 8 units on the Y axis for every 10 units of "run" along the X axis.

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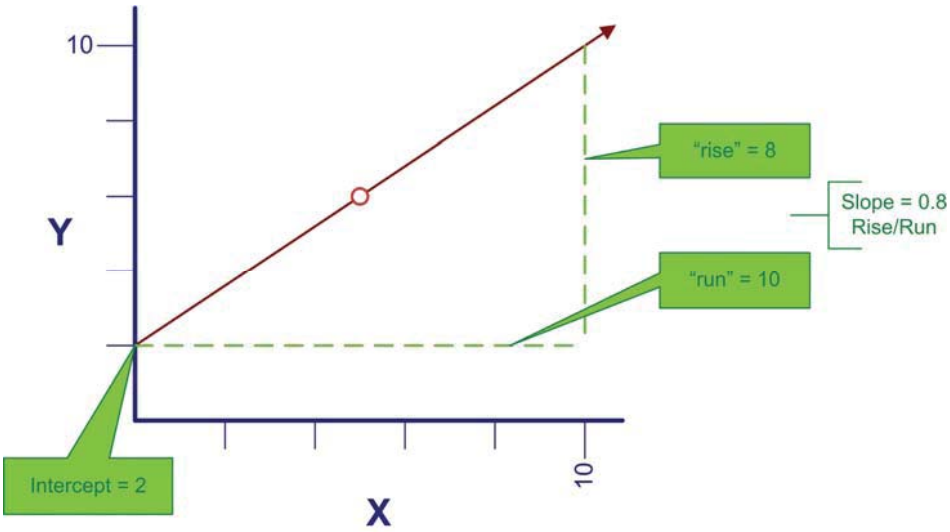

In general, a straight line can be defined by this formula:

$$Y = a + bX$$

where:

a = the intercept on the Y axis
b = the slope of the line
X = the position on the X axis

For the line drawn on the previous page, the formula would be:

$$Y = 2 + 0.8X$$

And, if you wished to know the value of Y, when X is 5 (see the red circle on the line), you perform the following calculation:

$$Y = 2 + (0.8 * 5) = 6$$

Now, lets move on to fitting a line through a set of points. On the next page is a table of data showing monthly unit production and the associated cost (sorted from low to high). These data are plotted on the graph to the right. Through the middle of the data points is drawn a line, and the line has a formula of:

$$Y = \$138{,}533 + \$10.34X$$

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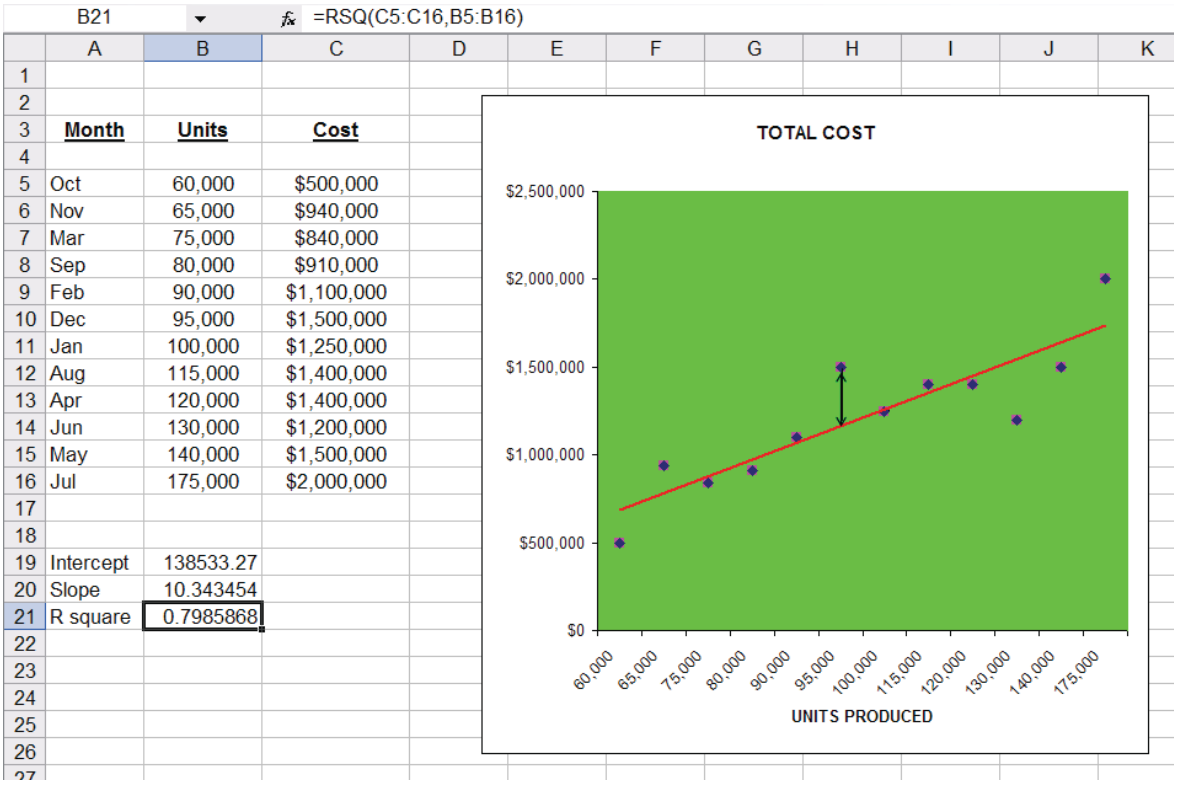
This formula suggests that fixed costs are $138,533, and variable costs are $10.34 per unit. For example, how much would it cost to produce about 110,000 units? The answer is about $1,275,000 ($138,533 + ($10.34 * 110,000)).

How was the formula derived? One approach would be to “eyeball the points” and draw a line through them. You would then estimate the slope of the line and the Y intercept. This approach is known as the scatter graph method, but it would not be precise. A more accurate approach, and the one used to derive the above formula, would be the least squares technique. With least squares, the vertical distance between each point and resulting line (e.g., as illustrated by an arrow at the $1,500,000 point) is squared, and all of the squared values are summed. Importantly, the defined line is the one that minimizes the summed squared values! This line is deemed to be the best fit line, hopefully giving the clearest indication of the fixed portion (the intercept) and the variable portion (the slope) of the observed data.

One can always fit a line to data, but how reliable or accurate is that resulting line? The R-Square value is a statistical calculation that characterizes how well a particular line fits a set of data. For the illustration, note (in cell B21) an R2 of .798; meaning that almost 80% of the variation in cost can be explained by volume fluctuations. As a general rule, the closer R2 is to 1.00 the better; as this would represent a perfect fit where every point fell exactly on the resulting line.



	Month	Units	Cost
5	Oct	60,000	$500,000
6	Nov	65,000	$940,000
7	Mar	75,000	$840,000
8	Sep	80,000	$910,000
9	Feb	90,000	$1,100,000
10	Dec	95,000	$1,500,000
11	Jan	100,000	$1,250,000
12	Aug	115,000	$1,400,000
13	Apr	120,000	$1,400,000
14	Jun	130,000	$1,200,000
15	May	140,000	$1,500,000
16	Jul	175,000	$2,000,000
19	Intercept	138533.27	
20	Slope	10.343454	
21	R square	0.7985868	

The R-Square method is good in theory. But, how does one go about finding the line that results in a minimization of the cumulative squared distances from the points to the line? One way is to utilize built-in tools in spreadsheet programs, as illustrated above. Notice that the formula for cell B21 (as noted at the top of spreadsheet) contains the function RSQ(C5:C16,B5:B16). This tells the

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spreadsheet to calculate the R2 value for the data in the indicated ranges. Likewise, cell B20 is based on the function SLOPE (C5:C16,B5:B16). Cell B19 is INTERCEPT(C5:C16,B5:B16). Most spreadsheets provide intuitive pop-up windows with prompts for setting up these statistical functions.

Spreadsheets have not always been available. You may be curious to know the underlying mechanics for the least squares method. If so, you can check out the link on the website.

7.4 Recap

Before moving on, let's review a few key points. A good manager must understand an organization's cost structure. This requires careful consideration of variable and fixed cost components. However, it is sometimes difficult to discern the exact cost structure. As a result, various methods can be employed to analyze cost behavior. Once an organization's cost structure is understood, it then becomes possible to perform important diagnostic calculations which are the subject of the next sections of this chapter.

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8. Break-Even and Target Income

CVP analysis is imperative for management. It is used to build an understanding of the relationship between costs, business volume, and profitability. The analysis focuses on the interplay of pricing, volume, variable and fixed costs, and product mix. This analysis will drive decisions about what products to offer, how to price them, and how to manage an organization's cost structure. CVP is at the heart of techniques that are useful for calculating the break-even point, volume levels necessary to achieve targeted income levels, and similar computations. The starting point for these calculations is to consider the contribution margin.

8.1 Contribution Margin

The contribution margin is revenues minus variable expenses. Do not confuse the contribution margin with gross profit as discussed in the previous chapter (revenues minus cost of sales). Gross profit would be calculated after deducting all manufacturing costs associated with sold units, whether fixed or variable. Instead, the contribution margin is a conceptual number reflecting the amount available from each sale, after deducting all variable costs associated with the units sold. Some of these variable costs are product costs, and some are selling and administrative in nature. The contribution margin is generally a number calculated for internal use and analysis; it does not ordinarily become a part of the externally reported data set.

8.2 Contribution Margin: Aggregated, per Unit, or Ratio?

When speaking of the contribution margin, one might be referring to aggregated data, per unit data, or ratios. This point is illustrated below for Leyland Sports, a manufacturer of score board signs. The production cost is $500 per sign, and Leyland pays its sales representatives $300 per sign sold. Thus, variable costs are $800 per sign. Each sign sells for $2,000. Leyland's contribution margin is $1,200 ($2,000 - ($500 + $300)) per sign. In addition, assume that Leyland incurs $1,200,000 of fixed costs, regardless of the level of activity. Below is a schedule with contribution margin information, assuming 1,000 units are produced and sold:

	Total	Per Unit	Ratio
Sales (1,000 X $2,000)	$2,000,000	$2,000	100%
Variable costs (1,000 X $800)	800,000	800	40%
Contribution margin	$1,200,000	$1,200	60%
Fixed costs	1,200,000		
Net income	-		

What would happen if Leyland sold 2,000 units?

	Total	Per Unit	Ratio
Sales (2,000 X $2,000)	$4,000,000	$2,000	100%
Variable costs (2,000 X $800)	1,600,000	800	40%
Contribution margin	$2,400,000	$1,200	60%
Fixed costs	1,200,000		
Net income	$1,200,000		

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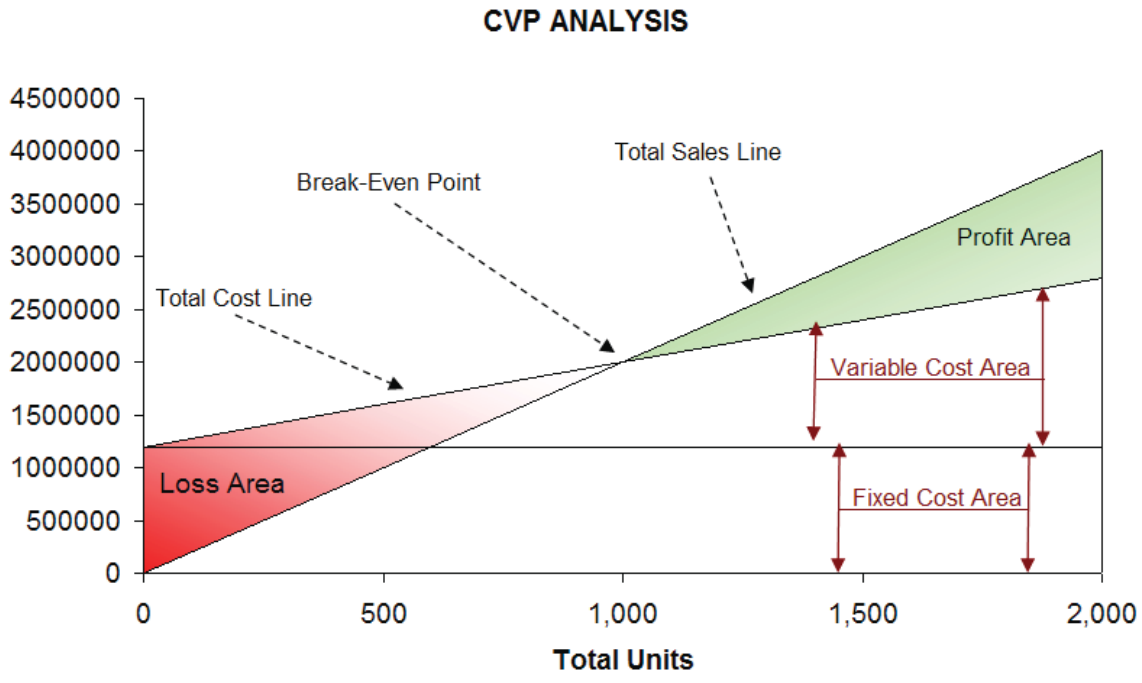
What would happen if Leyland sold only 500 units?

	Total	Per Unit	Ratio
Sales (500 X $2,000)	$1,000,000	$2,000	100%
Variable costs (500 X $800)	400,000	800	40%
Contribution margin	$ 600,000	$1,200	60%
Fixed costs	1,200,000		
Net income	$ (600,000)		

Notice that changes in volume only impact certain amounts within the “total column.” Volume changes did not impact fixed costs, or change the per unit or ratio calculations. By reviewing the data on the previous page, also note that 1,000 units achieved breakeven net income. At 2,000 units, Leyland managed to achieve a $1,200,000 net income. Conversely, 500 units resulted in a $600,000 loss.

8.3 Graphic Presentation

Leyland’s management would probably find the following chart very handy. Dollars are represented on the vertical axis and units on the horizontal:



Be sure to examine this chart, taking note of the following items: The total sales line starts at “0” and rises $2,000 for each additional unit. The total cost line starts at $1,200,000 (reflecting the fixed cost), and rises $800 for each additional unit (reflecting the addition of variable cost). “Break-even” results where sales equal total costs. At any given point, the width of the loss area (in red) or profit area (in green) is the difference between sales and total costs.

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8.4 Break-Even Calculations

As they say, a picture is worth a thousand words, and that is certainly true for the CVP graphic just presented. However, everyone is not an artist, and you may find it more precise to do a little algebra to calculate the break-even point. Consider that:

Break-even results when:
Sales = Total Variable Costs + Total Fixed Costs

For Leyland, the math turns out this way:

(Units X $2,000) = (Units X $800) + $1,200,000

Solving:

Step a: (Units X $2,000) = (Units X $800) + $1,200,000
Step b: (Units X $1,200) = $1,200,000
Step c: Units = 1,000

Now, it is possible to "jump to step b" above by dividing the fixed costs by the contribution margin per unit. Thus, a break-even short cut is:

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Break-Even Point in Units = Total Fixed Costs / Contribution Margin Per Unit
1,000 Units = $1,200,000 / $1,200

Sometimes, you may want to know the break-even point in dollars of sales (rather than units). This approach is especially useful for companies with more than one product, where those products all have a similar contribution margin ratio:

Break-Even Point in Sales = Total Fixed Costs / Contribution Margin Ratio
$2,000,000 = $1,200,000 / 0.60

8.5 Target Income Calculations

Breaking even is not a bad thing, but hardly a satisfactory outcome for most businesses. Instead, a manager may be more interested in learning the necessary sales level to achieve a targeted profit. The approach to solving this problem is to treat the "target income" like an added increment of fixed costs. In other words, the margin must cover the fixed costs and the desired profit:

Target Income results when:
Sales = Total Variable Costs + Total Fixed Costs + Target Income

Assume Leyland wants to know the level of sales to reach a $600,000 income:

(Units X $2,000) = (Units X $800) + $1,200,000 + $600,000

Solving:

Step a: (Units X $2,000) = (Units X $800) + $1,200,000 + $600,000
Step b: (Units X $1,200) = $1,800,000
Step c: Units = 1,500

Again, it is possible to "jump to step b" by dividing the fixed costs and target income by the per unit contribution margin:

Units to Achieve a Target Income
=
(Total Fixed Costs + Target Income) / Contribution Margin Per Unit
1,500 Units = $1,800,000 / $1,200

If you want to know the dollar level of sales to achieve a target net income:

Sales to Achieve a Target Income
=
(Total Fixed Costs + Target Income) / Contribution Margin Ratio
$3,000,000 = $1,800,000 / 0.60

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8.6 Critical Thinking About CVP

CVP is more than just a mathematical tool to calculate values like the break-even point. It can be used for critical evaluations about business viability.

For instance, a manager should be aware of the "margin of safety." The margin of safety is the degree to which sales exceed the break-even point. For Leyland, the degree to which sales exceed $2,000,000 (its break-even point) is the margin of safety. This will give a manager valuable information as they plan for inevitable business cycles.

A manager should also understand the scalability of the business. This refers to the ability to grow profits with increases in volume. Compare the income analysis for Leaping Lemming Corporation and Leaping Leopard Corporation:

LEAPING LEMMING CORPORATION Contribution-based Income Analysis for 20X1			LEAPING LEOPARD CORPORATION Contribution-based Income Analysis for 20X1		
Sales (5000 X $1,000)	$5,000,000	100%	Sales (5000 X $1,000)	$5,000,000	100%
Variable costs (5,000 X $900)	4,500,000	90%	Variable costs (5,000 X $400)	2,000,000	40%
Contribution margin	$ 500,000	10%	Contribution margin	$3,000,000	60%
Fixed costs	500,000		Fixed costs	3,000,000	
Net income	$ -		Net income	$ -	

Both companies "broke even" in 20X1. Which company would you rather own? If you knew that each company was growing rapidly and expected to double sales each year (without any change in cost structure), which company would you prefer? With the added information, you would expect the following outcomes for 20X2:

LEAPING LEMMING CORPORATION Contribution-based Income Analysis for 20X2			LEAPING LEOPARD CORPORATION Contribution-based Income Analysis for 20X2		
Sales (10,000 X $1,000)	$10,000,000	100%	Sales (10,000 X $1,000)	$10,000,000	100%
Variable costs (10,000 X $900)	9,000,000	90%	Variable costs (10,000 X $400)	4,000,000	40%
Contribution margin	$ 1,000,000	10%	Contribution margin	6,000,000	60%
Fixed costs	500,000		Fixed costs	3,000,000	
Net income	$ 500,000		Net income	$ 3,000,000	

This analysis reveals that Leopard has a more scalable business model. Its contribution margin is high and once it clears its fixed cost hurdle, it will turn very profitable. Lemming is fighting a never ending battle; sales increases are met with significant increases in variable costs. Be aware that scalability can be a double-edged sword. Pull backs in volume can be devastating to companies like Leopard because the fixed cost burden can be consuming. Whatever the situation, managers need to be fully cognizant of the effects of changes in scale on the bottom-line performance.

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9. Sensitivity Analysis

The only sure thing is that nothing is a sure thing. Cost structures can be anticipated to change over time. Management must carefully analyze these changes to manage profitability. CVP is useful for studying sensitivity of profit for shifts in fixed costs, variable costs, sales volume, and sales price.

9.1 Changing Fixed Costs

Changes in fixed costs are perhaps the easiest to analyze. To determine a revised break-even level requires that the new total fixed cost be divided by the contribution margin. Let's return to the example for Leyland Sports. Recall one of the original break-even calculations:

Break-Even Point in Sales = Total Fixed Costs / Contribution Margin Ratio
$2,000,000 = $1,200,000 / 0.60

If Leyland added a sales manager at a fixed salary of $120,000, the revised break-even would be:

$2,200,000 = $1,320,000 / 0.60

In this case, the fixed cost increased from $1,200,000 to $1,320,000, and sales must reach $2,200,000 to break even. This increase in break-even means that the manager needs to produce at least $200,000 of additional sales to justify their post.

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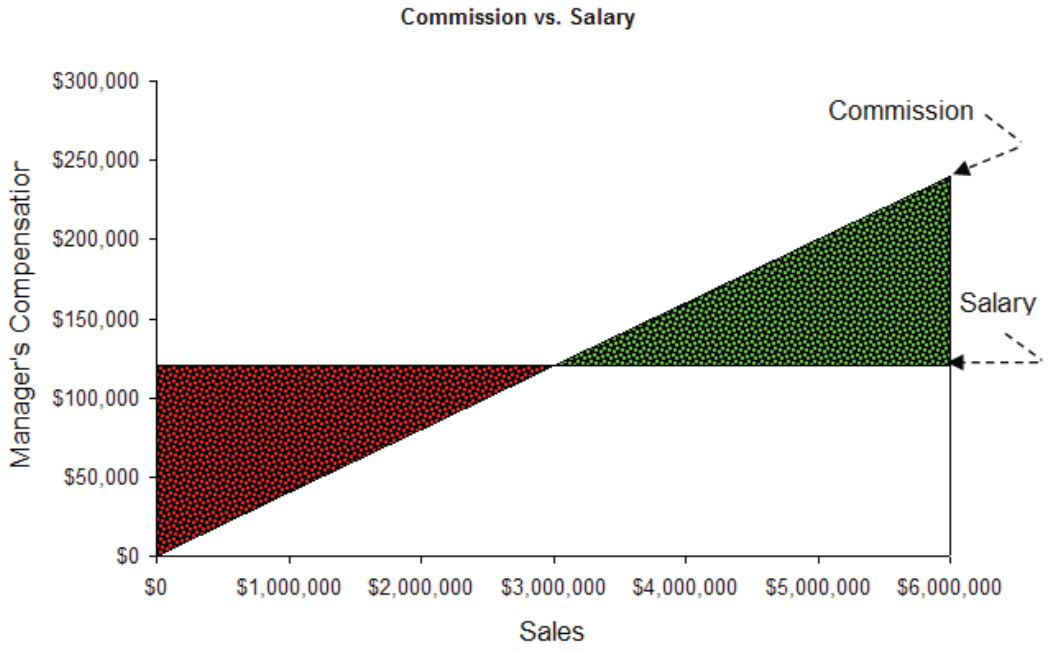
9.2 Changing Variable Costs

In recruiting the new sales manager, Leyland became interested in an aggressive individual who was willing to take the post on a “4% of sales” commission-only basis. Let’s see how this would change the breakeven point:

Break-Even Point in Sales = Total Fixed Costs / Contribution Margin Ratio
$2,142,857 = $1,200,000 / 0.56

This calculation uses the revised contribution margin ratio (60% - 4% = 56%), and produces a lower break-even point than with the fixed salary ($2,142,857 vs. $2,200,000). But, do not assume that a lower break-even defines the better choice! Consider that the lower contribution margin will “stick” no matter how high sales go. At the upper extremes, the total compensation cost will be much higher with the commission-based scheme. Following is a graph of commission cost versus salary cost at different levels of sales. You can see that the commission begins to exceed the fixed salary at any point above $3,000,000 in sales. In fact, at $6,000,000 of sales, the manager’s compensation is twice as high if commissions are paid in lieu of the salary!



What this analysis cannot tell you is how an individual will behave. The sales manager has more incentive to perform, and the added commission may be just the ticket. For example, the company will make more at $6,000,000 in sales than at $3,000,000 in sales, even if the sales manger is paid twice as much. At a fixed salary, it is hard to predict how well the manager will perform, since pay is not tied to performance.

You have probably marveled at the salaries of some movie stars and professional athletes. Rest assured that some serious CVP analysis has gone into the contract negotiations for these celebrities. For example, how much additional revenue must be generated by a movie to justify casting a high

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dollar movie star (versus using a low-cost unknown actor)? And, you have probably read about deals where musicians get a percentage of the revenue from ticket sales and concessions at a concert. These arrangements are likely based on detailed calculations; what may seem foolish is actually quite logical in terms of a comprehensive CVP analysis.

9.3 Blended Cost Shifts

Sometimes, a business will contemplate changes in fixed and variable costs. For example, an airline is considering the acquisition of a new jet. The new jet entails a higher fixed cost for the equipment, but is more fuel efficient. The proper CVP analysis requires that the new fixed cost be divided by the new unit contribution margin to determine the new break-even level. Such analysis is important to evaluate whether an increase in fixed costs is justified.

To illustrate, assume Flynn Flying Service currently has a jet with a fixed operating cost of $3,000,000 per year, and a contribution margin of 30%. Flynn is offered an exchange for a new jet that will cost $4,000,000 per year to operate, but produce a 50% contribution margin. Flynn is expecting to produce $9,000,000 in revenue each year. Should Flynn make the deal? The answer is yes. The break-even point on the old jet is $10,000,000 of revenue ($3,000,000/0.30), while the new jet has an $8,000,000 break-even ($4,000,000/0.50). At $9,000,000 of revenue, the new jet is profitable while continuing to use the old jet will result in a loss.

9.4 Per Unit Revenue Shifts

Thus far, the discussion has focused on cost structure and changes to that structure. Another approach to changing the contribution margin is via changes in per unit selling prices. So long as these adjustments are made without impacting fixed costs, the results can be dramatic. Let's return to Leaping Lemming, and see how a 10% increase in sales price would impact the contribution margin and profitability for 20X2.

LEAPING LEMMING CORPORATION
Income Analysis for 20X2 at Alternative Pricing

	$1,000 per unit scenario	$1,100 per unit scenario
Sales (10,000 units)	$10,000,000	$11,000,000
Variable costs (10,000 X $900)	9,000,000	9,000,000
Contribution margin	$ 1,000,000	$ 2,000,000
Fixed costs	500,000	500,000
Net income	$ 500,000	$ 1,500,000

Notice that this 10% increase in price results in a doubling of the contribution margin and a tripling of the net income. Bingo: the solution to increasing profits is to raise prices while maintaining the existing cost structure -- if it were only this easy! Customers are sensitive to pricing and even a small increase can drive customers to competitors. Before raising prices, a company must consider the "price elasticity" of demand for its product. This is fancy jargon to describe the simple reality that demand for a product will drop as its price rises.

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So, the real question for Leaping Lemming is to assess how much volume drop can be absorbed when prices are increased. The appropriate analysis requires dividing the continuing fixed costs (plus target or current net income) by the revised unit contribution margin; this results in the required sales (in units) to maintain the current level of profitability. For Lemming to achieve a $500,000 profit level at the revised pricing level, it would need to sell 5,000 units:

Units to Achieve a Target Income
=
(Total Fixed Costs + Target Income) / Contribution Margin Per Unit
5,000 Units = ($500,000 + $500,000) / $200

If Lemming sells at least 5,000 units at $1,100 per unit, it will make at least as much as it would by selling 10,000 units at $1,000 per unit. The unknown is what customer response will be to the $1,100 pricing decision. Many a business has fallen prey to the presumption that they could raise prices with impunity; others have scored homeruns by getting away with such increases.

9.5 Margin Beware

Some contracts provide for "cost plus" pricing, or similar arrangements that seek to provide the seller with an assured margin. These agreements are intended to allow the seller a normal and fair profit margin, and no more. However, they can have unintended consequences. Let's evaluate an example. Pioneer Plastics sells trash bags to Heap Compacting Service. Heap and Pioneer have entered into an agreement that provides Pioneer with a contribution margin of 20% on 1,000,000 bags.

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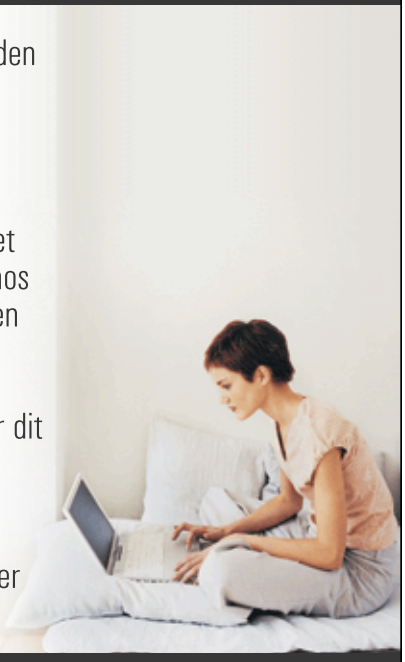

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Originally, the bags were anticipated to cost Pioneer $1 each to produce, plus a fixed cost of $100,000. However, increases in petroleum products necessary to produce the bags skyrocketed, and Pioneer's variable production cost was actually $3 per unit. Let's see how Pioneer faired under their agreement:

	$1 Scenario	$3 scenario
Sales	$ 1,250,000	$ 3,750,000
Variable costs (1,000,000 X $1 vs. $3)	1,000,000	3,000,000
Contribution margin (20% of sales)	$ 250,000	$ 750,000
Fixed costs	100,000	100,000
Net income	$ 150,000	$ 650,000

Notice the astounding change in Pioneer's net income - $150,000 versus $650,000. Such "cost plus" agreements must be carefully constructed, else the seller has little incentive to do anything but let costs creep up. Sometimes you will hear a company complain about cost increases negatively affecting their "margins;" before you assume the worst, take a closer look to see how the bottom line is being impacted. Even if Pioneer agreed to cut Heap a break and reduce their margin in half, their bottom line profit would still soar in the illustration.

9.6 Margin Mathematics

In the preceding illustration, the contribution margin was 20% of sales. Accordingly, variable costs are 80% of sales. If total variable costs are $1,000,000, then sales would be $1,250,000 ($1,000,000 divided by 0.80).

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10. CVP for Multiple Products

How many businesses sell only one product? The reality is that firms usually offer a diverse product line, and the individual products will have different selling prices, contribution margins, and contribution margin ratios. Yet, the firm's total fixed cost picture may be the same, no matter the mix of products sold. This can cloud the ability to perform simple CVP analysis. To lift this cloud requires some knowledge of the product mix.

Let's assume Hummingbird Feeders produces and sells a brightly colored feeding container for $15 (variable cost of production is $10, and contribution margin is $5) and a nectar formula for $3 per packet ($1 variable cost to produce, resulting in a $2 contribution margin). Hummingbird Feeders sells 10 packets of nectar for every feeder sold. Its fixed cost is $100,000. How many feeders and packets must be sold to break even? To answer this question requires a redefinition of the "unit." If we assume the "unit" is 1 feeder and 10 packets, we would then see that each "unit" would have a contribution margin of $25, as shown below.

	Contribution Margin		
Feeder	1 item @ $5	=	$5.00
Nectar Packets	10 items @ $2 each	=	20.00
"Unit" contribution			$25.00

To recover $100,000 of fixed cost, at $25 of contribution per "unit," would require selling 4,000 "units" ($100,000/$25). To be clear, this translates into 4,000 feeders and 40,000 packets of nectar. Total breakeven sales would be $180,000 (($15 X 4,000 feeders) + ($3 X 40,000 packets)). Of course, the validity of this analysis depends upon actual sales occurring in the predicted ratio. Changes in product mix will result in changes in break-even levels. If Hummingbird Feeders sold $180,000 in feeders, and no packets of nectar, they would come no where near breakeven (because the contribution margin ratio on feeders is much lower than on the packets of nectar).

Note that one could also get the $180,000 result by dividing the fixed cost by the weighted-average contribution margin ($100,000/0.555 = $180,000). The weighted-average contribution margin of 0.555 is calculated as follows:

	Product Sales to Total Sales Ratio (mix)		Product Contribution Margin Ratio		Weighted Average Ratio
Feeder (1 @ $15)	$15/$45	X	$5/$15	=	0.1111
Nectar Packets (10 @ $3)	$30/$45	X	$2/$3	=	0.4444
					0.5555

Businesses must be mindful of the product mix. Automobile manufacturers have a broad range of products, some at high margin and some at lower levels. If customers unexpectedly substitute economy cars for sport utility vehicles, basic models for luxury models, etc., the resulting bottom

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line impacts can be significant. Product mix can also be important for companies that sell a base product and a related disposable. For example, a printer manufacturer may sell "unprofitable" printers along with large quantities of high margin ink cartridges. Managers of such businesses need to watch not only total sales, but also keep a keen eye on the product mix.

10.1 Multiple Products, Selling Costs, and Margin Management

Selling expenses are oftentimes variable. For example, a salesperson may be paid a designated percentage of total sales. Such schemes have the potential to be counterproductive in a multiple product setting. For example, assume that a company sells two products. Product A has a per unit sales price of $120, and Product B has a per unit sales price of $100.

A salesperson, earning a commission calculated as 5% of total sales, would prefer to sell product A. However, the company is better off when Product B is sold, because it has a higher contribution impact ($30 vs. $20). As a result, when a business manager considers its program of compensation for its sales staff, care should be given to align the interests of the sales force and the company. For the preceding example, it may make better sense to tie the commission to the contribution effects rather than the sales price.

	Sales Price	Variable Production Cost
PRODUCT A	$120	$100
PRODUCT B	$100	$70

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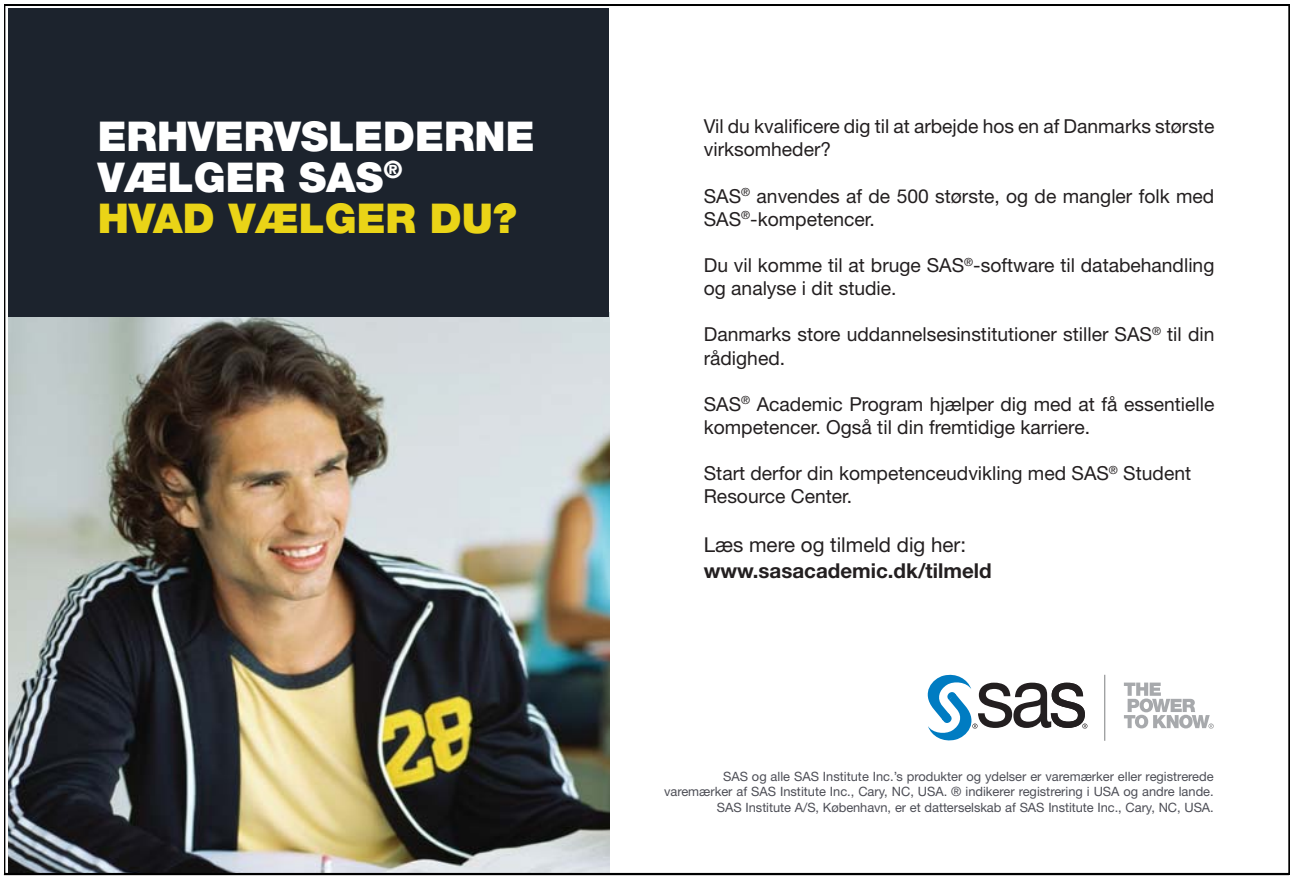

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11. Assumptions of CVP

This chapter has presented information on how to apply CVP for business analysis. Most of this analysis is keyed to a model of how profitability is impacted by changes in business volume. Like most models, there are certain inherent assumptions. Violating the assumptions has the potential to undermine the conclusions of the model. Some of these assumptions have been touched on throughout the chapter:

1. Costs can be segregated into fixed and variable portions
2. The linearity of costs is preserved over a relevant range (i.e., variable cost is constant per unit, and fixed cost is constant in total)
3. Revenues are constant per unit and multiple-product firms meet the expected product mix ratios

One additional assumption is that inventory levels are fairly constant, with the number of units produced equaling the number of units sold. If inventory levels fluctuate, some of the variable and fixed product costs may flow into or out of inventory, with a variety of potential impacts on profitability.

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Job Costing and Modern Cost Management Systems

Part 3

Your goals for this “job order costing system” chapter are to learn about:

- Basic concepts in job costing.
- Information systems for job costing environments.
- Tracking job costs in the corporate ledger.
- Accounting for actual and applied overhead.
- Job costing in service, not-for-profit, and governmental environments.
- Modern management of costs and quality.

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12. Basic Job Casting Concepts

The previous chapters provided an introduction to product costing. You were exposed to the schedule of cost of goods manufactured and the basic cost flow of a manufacturer. In that preliminary presentation, most cost data (e.g., ending work in process inventory, etc.) were "given." In addition, the chapters showed how cost data are used in making important business decisions.

12.1 Cost Data Determination

How does one determine the cost data for products and services that are the end result of productive processes? The answer to this question is more complex than you might suspect. Multiple persons, parts, and processes may be needed to bring about a deliverable output. Think about an automobile manufacturer; what is the dollar amount of "cost" for the hundreds of cars that are in various stages of completion at the end of a month? After studying this chapter, and the next, you will have a better sense of how business information systems are used to generate these important cost data.

This chapter focuses on the job costing technique, and the next chapter will look more closely at process costing and other options. At the outset, note that job costing is best suited to those situations where goods and services are produced upon receipt of a customer order, according to customer specifications, or in separate batches (as a result, many companies will refer to this costing method as the job order costing method). For example, a ship builder would likely accumulate costs for each ship produced. An aircraft manufacturer would find this method logical. Construction companies and home builders would naturally gravitate to a job costing approach. Each job is somewhat unique. Materials and labor can be readily traced to each job, and the cost assignment logically follows.

12.2 Conceptualizing Job Costing

Begin to develop an understanding of job costing by thinking about a simple illustration. Jack Castle owns an electrical contracting company, Castle Electric. Jack provides a variety of products and services to clientele. Jack has four employees, maintains a neat (rented) shop, a broad inventory of parts and equipment, and a fleet of five service trucks. On a typical day, Jack will arrive at the shop early and line out the day's work assignments for his four electricians. Around 8:00 a.m., his electricians begin to arrive, and he gives them their assignments, as well as the necessary parts and equipment they will need. They are then dispatched to the various job sites.

One of Jack's electricians is Donnie Odom. On July 14, Donnie arrived at the shop at 8:00 a.m. He first spent thirty minutes getting his assignments and loading a service truck with necessary items to complete the day's work. His three tasks for the day included:

- Job A: Cleaning and reconnecting the electrical connections and replacing a flood light atop a billboard (materials required include one lamp at $150).

- Job B: Replacing the breakers on an old electrical distribution panel at an office building (materials required include 20 breakers at $20 each).

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- Job C: Pulling wire for a new residence under construction (materials required include 500 feet of wire at $0.14 per foot).

Donnie successfully completed all three tasks on July 14. He spent 1 hour on the billboard, 2 hours on the electrical panel, and 3 hours on the residential installation. The other 2 hours of his 8-hour day were spent on indirect job administration and travel. During the day, Donnie also used a roll of electrical tape ($3) and a box of wire nuts (60 nuts at $0.05 each). Donnie is paid $18 per hour. Donnie drove the truck 100 miles on July 14, and he used a variety of tools, ladders, and other specialized equipment. Jack is paid $25 per hour, and he does not usually work on any specific job. Instead, his time is spent doing spot inspections of work, getting permits, managing inventory, and tending to the various other tasks associated with these jobs.

The "job costing" question is: How much did it "cost" to change the light on the billboard, etc.?

Obviously, the job cost included the direct costs of the job; specifically, Donnie's direct labor time (1 hour) and the direct material (one lamp at $150). But, the job could not have gotten done without the shop, equipment, trucks, indirect labor time, Jack's efforts, tape and wire nuts, and so forth. These latter items constitute the indirect costs, or overhead, for the job. How then, are we to assign costs to a specific job?

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12.3 Tracking Direct Labor

A logical starting point for job costing is to track the direct labor to specific jobs. Donnie, and the other electricians, fill out a time report documenting time spent on each job, as well as the time spent on tasks that cannot be traced to a specific job:

Castle Electric — Daily Time Sheet

Employee: Donnie Odom
Date: 7/14/X5

Start/Stop Time		Job Name	Task	Client	Admin Hours	Direct Labor Hours
8:00	8:30	Admin	Assignment and load	n/a	0.50	
8:30	8:45	Travel		n/a	0.25	
8:45	9:45	Job A	Service and replace bulb	Image Advertising		1.00
9:45	10:15	Travel		n/a	0.50	
10:15	12:15	Job B	Replace breakers	TechWay Office Park		2.00
12:15	1:00	Lunch	n/a	n/a		
1:00	4:00	Job C	Pull wiring	Mr./Mrs. Lybrand Home		3.00
4:00	4:45	Travel and Admin	Return to shop and unload	n/a	0.75	
				Total Hours	2.00	6.00

Not only will this time sheet form the basis for payroll, but it will also allow cost assignment to specific jobs. The direct labor for the billboard task (Job A) was one hour of Donnie's time (at $18 per hour). The "direct labor" for Job A will be compiled by reference to the time sheet on the previous page.

12.4 Tracking Direct Materials

Jack keeps detailed records of the material released to each job. When Donnie gathered up the light bulbs, breakers, wire, tape, and wire nuts on the morning of the 14th, some system needed to be in place to "check out" this material. The document that is used for this process is called a "materials request" or "materials requisition" form. This form will show what material is leaving the available raw materials stock and being put into production. Sometimes a separate form is prepared for each item, and sometimes a running list similar to the following is used:

Castle Electric — Materials Requisition

Employee: Donnie Odom
Date: 7/14/X5

Material	Job Name	Quantity	Per Unit Cost	Extended Cost
Light Bulbs	Job A	1 Unit	$150	$150
Breakers	Job B	20 Units	$20 each	$400
Wire	Job C	500 feet	$0.14 per foot	$70
Electrical Tape	Indirect Material	1 Roll	$3 per roll	$3
Wire Nuts	Indirect Material	60 Nuts	$0.05 each	$3

This form provides essential documentation to safeguard and track inventory; a manager that fails to control and monitor inventory does so at great peril! It also reveals that the "direct material" for the billboard task (Job A) was $150 (the light bulb). The wire nuts and tape that might have been used on the billboard will be dealt with as overhead which is discussed later.

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Before moving on to overhead, you need to know one more thing about a “materials requisition” form; although the illustrated form lists the material cost, that will not always be the case. Sometimes, a business will not be particularly interested in letting employees see cost information, or cost information may not be readily available. In either case, the form will instead include a part or serial number. A subsequent clerical task will be to identify the cost of the particular parts that were put into production. Great care must always be taken to match the right cost to the right item, and in the right quantity. For example, the 500 feet of wire may be on one roll, but it is priced by the foot, and the quantity should be 500 feet, not 1 roll; the job cost calculation would be incorrect if only $0.14 were assigned to one roll of wire!

12.5 Tracking Overhead

Jack would have a huge task at hand if he tried to daily trace all items of overhead. For instance:

- How hard would it be to track the “indirect material”? How many wire nuts were used on the billboard? How many inches of electrical tape were used? What was the cost of these items?

- What about indirect labor? Donnie spent two hours on job-related administration and travel issues for the six hours of direct labor time on the 14th. Should the cost of the 2 hours be spread over the three jobs equally, pro-rata based on hours, or some other basis? On the 15th, Donnie may spend the entire day on the residential wiring job and have little administrative and travel time. How does this impact the cost per hour of output on the 15th versus the 14th? What about Jack’s time? He is supervising 4 electricians. Should the cost of his time be allocated 1/4 to each, or based on some other formula?

- Then, one must consider the cost of rent, equipment, trucks, and so forth. Donnie needed a ladder to scale the billboard. A ladder will eventually wear out -- but how much is the “ladder cost” for one trip up and down a billboard? Now, repeat this question for every item of cost incurred in running Castle Electric.

Tracking overhead is tricky. One way this is done is by using a predetermined overhead rate. Assume Jack sat down at the beginning of the year with his accountant. Together they carefully considered all of the production overhead that was anticipated during the year -- the cost of Jack’s time, the rent, the cost of vehicles, insurance, taxes, utilities, indirect labor, indirect materials, depreciation of long-lived assets, and so forth. The expected total came to about $150,000. Jack figures that his four electricians will work a total of about 7,500 direct labor hours during the year. By comparing these two numbers ($150,000 and 7,500 hours), it is now possible to “model” that overhead is $20 per direct labor hour. The “overhead application rate” is thus determined.

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Now, two things should be made clear. First, overhead application is arbitrary. Jack decided to apply overhead based on direct labor hours; this is a common choice, but not the only choice. Some other systematic and rational approach could have been developed. Ordinarily, one would try to establish some correlation between the application base and overall cost incurrence. For instance, feet of wire used (instead of direct labor hours) could have been selected as the application base; but, feet of wire would be hard to defend since two of Donnie's three jobs did not use any wire and would not be assigned any of the business overhead! The point is that some logical method needs to be used to attach overhead costs to output, but no single choice is absolute. Cost allocation necessarily involves some degree of arbitrary methodology; this is neither bad nor good, it is just reality. In some ways, costing is more of an "art" than "science" -- despite its outward appearance of mathematical precision.

Second, expect differences between the actual overhead and the amount applied to production. For instance, Jack will likely discover that actual overhead is more or less than $150,000. Jack will also find that his electricians will probably work more or less than the anticipated 7,500 hours. When all is said and done, Jack will need to deal with the actual cost. The difference between the amount of overhead applied to production (i.e., direct labor hours X the $20 per hour rate) and the actual amount spent must be accounted for! We will see how to deal with this later in the chapter.

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12.6 Job Cost Sheets

The preceding information can be logically transferred to a job cost sheet that is a compilation of cost data for a specific job:

Castle Electric
Job: Job A - Image Advertising

Job Cost Sheet

	Form Reference	Direct Labor			Direct Material			Applied Overhead				Total
		Hours	Rate	Total	Qty.	Unit Cost	Total	Basis	Qty.	Rate	Total	
July 14, 20X5												
Donnie Odom	DTS.07.14.X5.DO	1.00	$18	$18.00								$ 18.00
Light Bulb	MR.07.14.X5.DO				1.00	$150	$150.00					150.00
Applied Overhead								Labor Hours	1.00	$20	$20.00	20.00
		1.00		$18.00			$150.00				$20.00	$188.00

The direct labor information found on the job cost sheet is taken from Donnie Odom's daily time sheet (a cross-reference is created of "DTS.07.14.X5.DO" to indicate "daily time sheet of July 14, 20X5, for Donnie Odom"). In similar fashion, Donnie's material requisition form was used as the source document for compiling the direct material information. Some type of cross-referencing system needs to be developed to allow one to trace specific cost allocations to their source documents. Overhead was applied directly to the job cost sheet based upon the predetermined overhead application scheme of $20 per direct labor hour.

12.7 Expanding the Illustration

The next graphic shows separate job cost sheets for all three of Donnie's jobs. All direct material and direct labor must be transferred to specific jobs. As alluded to earlier, the indirect labor (admin hours) and indirect material is not directly transferred to a specific job; its cost is instead represented through the applied overhead.

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Castle Electric — Daily Time Sheet

Employee: Donnie Odom
Date: 7/14/X5

Start/Stop Time		Job Name	Task	Client	Admin Hours	Direct Labor Hours
8:00	8:30	Admin	Assignment and load	n/a	0.50	
8:30	8:45	Travel		n/a	0.25	
8:45	9:45	Job A	Service and replace bulb	Image Advertising		1.00
9:45	10:15	Travel		n/a	0.50	
10:15	12:15	Job B	Replace breakers	TechWay Office Park		2.00
12:15	1:00	Lunch	n/a	n/a		
1:00	4:00	Job C	Pull wiring	Mr./Mrs. Lybrand Home		3.00
4:00	4:45	Travel and Admin	Return to shop and unload	n/a	0.75	
				Total Hours	2.00	6.00

Castle Electric — Materials Requisition

Employee: Donnie Odom
Date: 7/14/X5

Material	Job Name	Quantity	Per Unit Cost	Extended Cost
Light Bulbs	Job A	1 Unit	$150	$150
Breakers	Job B	20 Units	$20 each	$400
Wire	Job C	500 feet	$0.14 per foot	$70
Electrical Tape	Indirect Material	1 Roll	$3 per roll	$3
Wire Nuts	Indirect Material	60 Nuts	$0.05 each	$3

Castle Electric — Job Cost Sheet

Job: Job A - Image Advertising

	Form Reference	Direct Labor			Direct Material			Applied Overhead				Total
		Hours	Rate	Total	Qty.	Unit Cost	Total	Basis	Qty.	Rate	Total	
July 14, 20X5												
Donnie Odom	DTS.07.14.X5.DO	1.00	$18	$18.00								$ 18.00
Light Bulb	MR.07.14.X5.DO				1.00	$150	$150.00					150.00
Applied Overhead								Labor Hours	1.00	$20	$20.00	20.00
		1.00		$18.00			$150.00				$20.00	$188.00

Castle Electric — Job Cost Sheet

Job: Job B - TechWay Office Park

	Form Reference	Direct Labor			Direct Material			Applied Overhead				Total
		Hours	Rate	Total	Qty.	Unit Cost	Total	Basis	Qty.	Rate	Total	
July 14, 20X5												
Donnie Odom	DTS.07.14.X5.DO	2.00	$18	$36.00								$ 36.00
Breakers	MR.07.14.X5.DO				20	$20	$400.00					400.00
Applied Overhead								Labor Hours	2.00	$20	$40.00	40.00
		2.00		$36.00			$400.00				$40.00	$476.00

Castle Electric — Job Cost Sheet

Job: Job C - Lybrand Home

	Form Reference	Direct Labor			Direct Material			Applied Overhead				Total
		Hours	Rate	Total	Qty.	Unit Cost	Total	Basis	Qty.	Rate	Total	
July 14, 20X5												
Donnie Odom	DTS.07.14.X5.DO	3.00	$18	$54.00								$ 54.00
Wire	MR.07.14.X5.DO				500	$.14	$70.00					70.00
Applied Overhead								Labor Hours	3.00	$20	$60.00	60.00
		3.00		$54.00			$70.00				$60.00	$184.00

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12.8 Another Expansion of the Illustration

Thus far, the illustration has focused only on Donnie's activities. He had relatively simple assignments on the 14th and was able to complete three separate jobs by himself. But, remember that Jack has three other electricians and many other jobs. Some of these jobs may require multiple employees and extend over days and weeks. One such job was the new home of Aba Obekie. This job took two electricians (Andy Axom and Bev Bentson) three full days to complete. The resulting job cost sheet appeared as follows:

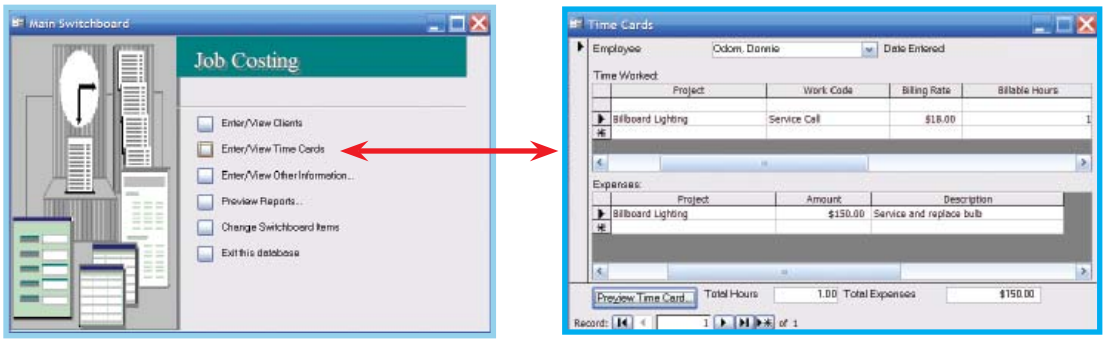
Castle Electric — Job Cost Sheet

Job: Job A - Obekie Home

	Form Reference	Direct Labor			Direct Material			Applied Overhead				Total
		Hours	Rate	Total	Qty.	Unit Cost	Total	Basis	Qty.	Rate	Total	
July 14, 20X5												
Andy Axon	DTS.07.14.X5.AA	7	$10	$ 70.00								$ 70.00
Bev Bentson	DTS.07.14.X5.BB	7	$22	154.00								154.00
Wire	MR.07.14.X5.BB				2000	$.14	$280.00					280.00
Junction Boxes	MR.07.14.X5.BB				50	$2	100.00					100.00
July 15, 20X5												
Andy Axon	DTS.07.15.X5.AA	8	$10	80.00								80.00
Bev Bentson	DTS.07.15.X5.BB	8	$22	176.00								176.00
July 16, 20X5												
Andy Axon	DTS.07.16.X5.AA	6	$10	60.00								60.00
Bev Bentson	DTS.07.16.X5.BB	8	$22	176.00								176.00
Can Lights	MR.07.16.X5.AA				25	$15	375.00					375.00
Applied Overhead								Labor Hours	44	$20	$880.00	880.00
		44		$716.00			$755.00				$880.00	$2,351.00

12.9 Database Versus Spreadsheets

Jack could maintain some or all of his job costing system manually. Or, he could use an electronic spreadsheet to prepare reports similar to those just illustrated. However, there is another more powerful tool -- the electronic database. A number of commercial packages are available. Generalizing, data are entered via a user friendly input form that includes a number of predetermined "slots" for entering desired information. For instance, below is a data entry form for entering Donnie's time and material for the 14th:



The benefit of the database approach is that information is only entered once; it need not be transferred to other forms. The computer files can be queried in many ways -- beyond just preparing a job cost report. For instance, Jack could use the customized reports feature to find all jobs on which billboard light bulbs were used during the past 18 months, determine the total direct labor hours of any employee for a selected time interval, identify how many jobs were performed for a selected client, and on and on! Such databases provide a powerful management tool.

12.10 Moving Beyond the Conceptual Level

Thus far, we have looked at a simple and understandable illustration of job costing. What this illustration fails to show is:

- The sophistication of the information systems that are used to track job costs in a larger organization.
- The debits and credits that are needed to track the accumulation and application of costs within a company's general ledger system.
- The ultimate disposition of the difference between applied and actual overhead.

Each of these issues will be dealt with in the following sections of this chapter. As you proceed to study this material, you may find yourself becoming consumed by the details. If so, think again about Jack Castle; consider that we are applying Jack's costing model to a more robust business environment.

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13. Information Systems for the Job Costing Environment

Jump on an internet search engine, and look for “factory automation”, “bar code scanners”, or “RFID”. Spend some time at the websites of companies like Oracle or SAP. It is an eye opening experience! There is a revolution in manufacturing technology, where robots and machines have resulted in quantum leaps in productivity and quality. What your tour of the internet will reveal is a similar revolution in the deployment of technology to enable job costing for those same environments.

13.1 Direct Material

Give some thought to the computer that you used to examine the suggested websites. It was likely produced as the direct result of someone’s specific order. If you have ordered a computer, you know that you must choose components relating to memory, hard drives, monitors, sound systems, and on and on. Literally hundreds of combinations are possible. Therefore, each computer represents a unique job, and it will have a unique cost depending on the installed options. You may have seen a video of a computer factory where the units are zipping along an assembly line at an amazing rate. How can cost data be captured for each unit? It would be impractical to deploy the basic system introduced for Jack Castle. How many people would it take to track all of the components, and how could they avoid errors? The key is to utilize the logic within Jack’s system, but deploy it in a cost-effective and accurate way. As a result, companies are increasingly reliant on devices that capture identification data for each significant part that goes into a manufactured product. If you were to open up the housing on your computer, you would quickly note that many of the expensive parts within have serial numbers, barcodes, or other unique identifiers attached to them. These ID’s were probably mechanically scanned into a database that matches them with the serial number of the finished computer unit. As a result, a computer manufacturer can probably tell you exactly which memory chips, hard drives, etc. are installed in the computer you are using. This is helpful for warranty processing, product recalls, and other inventory management issues. But, that same data can be matched with raw materials purchase records to produce a listing of direct material cost for each unit produced. This is exactly what Donnie’s material requisition process did earlier in this chapter, but at warp speed, with great precision, and little human intervention.

13.2 Direct Labor

Technology is also used to track and log time to specific jobs via various forms of “login clocks.” Note that the information being tracked is essentially the same as what Donnie was providing to Jack via the daily time sheet, but with added efficiency, accuracy, and control. In addition to monitoring job cost, a manager must also safeguard corporate resources. Here, technology can play a key role. Newer systems require biometric validation (like finger print IDs and logging) of employees working on a project. These tools are used to make sure that employees who claim time working on a job are in fact present and working on the job! Such systems can also be used to limit access to direct material inventory. Rather than allowing free access to an inventory storage area, or providing a human “guard,” technology can control who comes and goes, and what they take with them when they leave.

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Some products are produced via an assembly line approach where each worker performs a specific task. Only a certain amount of time is available for each task, as the line keeps moving. Depending on the product, each employee might perform the same operation on 50, 100, or more units per hour. It would take more time to measure and record the labor for each job than it takes to perform the labor task itself. In this type of environment, cost is usually assigned to jobs based on the average or standard time for each activity. In essence, if an employee is expected to work on 60 units per hour, one minute of direct labor time/cost would be assigned to each unit for the employee's specific task. In a subsequent chapter, you will learn more about standards and managing variances from those standards.

13.3 Overhead and Cost Drivers

The application of overhead to specific jobs is mostly an exercise in algebra. Jack applied overhead at the rate of $20 for each hour of direct labor. A similar mathematical exercise is used to apply overhead in the highly automated factory environment. Some predetermined scheme is used to apply the overhead to production.

However, in a highly mechanized environment, one must give careful thought to the "cost driver." The cost driver is the factor that is viewed as causing costs to be incurred within an organization; it is best viewed only in an abstract context, as there are too many individual variables for any single factor to fully explain all cost incurrence. For Jack Castle's business, direct labor hours were viewed as the primary cost driver and the basis for assigning overhead. Labor hours may not be the most significant cost driver in a mechanized setting. Machine hours, number of direct material bar code scans, fuel consumption, spot-welds, or number of assembly steps could each provide a potentially logical base for allocating overhead. This choice must be logical, as it will govern the allocation of total overhead costs to individual products.

It is a bit frightening to consider that product pricing, CVP analysis, inventory values, decisions to discontinue a product, and so forth are dependent upon costing information that is driven by arbitrary overhead allocation choices. This underscores the importance of careful methodology in correctly identifying cost drivers. To do otherwise could result in costing some products too high and others too low. This might lead to overproduction of unprofitable products and discontinuance of profitable lines. How is this possible? Suppose a computer manufacturer allocated overhead based on the installation of RAM memory chips. As a result, a machine with 2 GB of memory would absorb twice as much overhead as a machine with 1 GB. This is probably not a good idea; there is little difference in the production process needed to manufacture the two machines (save and except the difference in direct material cost for memory chips). The faulty overhead allocation could cause management to conclude that the 2 GB machines were too costly to produce, while the 1 GB machines seem a relative bargain. In short, the amount of memory is probably not the leading cost driver.

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Management accountants have long fretted about the overhead allocation problem. With so much at stake, quite a lot of thought has been put into ways to improve this effort. In the next chapter, you will discover "activity-based costing." ABC seeks to overcome some of the issues just described by dividing production into its component processes ("activities") and more closely associating overhead with each unique process. But, ABC has its own limitations, so do not be too quick to dismiss the merits of the overhead allocation approach introduced in this chapter.

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14. Tracking Job Cost Within the Corporate Ledger

Thus far, the illustrations of job costing have focused on forms, spreadsheets, databases, and technology to accumulate job cost information. In a sophisticated electronic environment, that information can be seamlessly transferred to a company's general ledger system. In the alternative, one may still need to transcribe the cost flow information via a series of entries. Either way, it is imperative to not only understand how job cost data are measured, but also how they impact a company's general ledger and resulting financial statements.

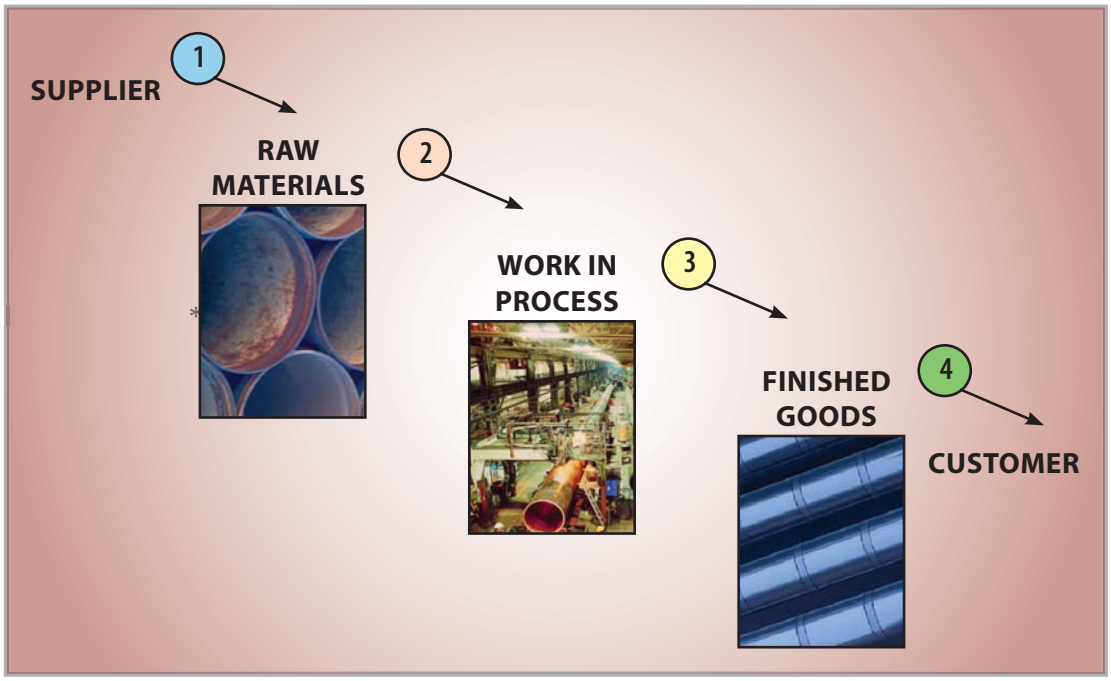
14.1 Direct Material

Begin by considering how a job cost travels through the accounting system by focusing on direct materials. Below is an illustration for a company that buys unfinished pipe from a steel mill. The manufacturing process entails a specialized heat treating, welding, and polishing process that readies the pipe for intense use by gas pipeline transmission companies.

The flow of direct materials occurs in the following four steps:

- Raw material is purchased from a supplier and placed in the raw materials inventory.
- Raw material is transferred to the production process.
- Upon completion of processing, the material is transferred to finished goods inventory.
- A customer takes delivery of the product, and it is removed from finished goods inventory.

Below is an illustration of the flow of material from supplier, through production, to the customer:



For purposes of this illustration, assume the stack of pipe in the first picture cost $10,000. This expenditure must be captured in inventory and eventually transferred to cost of goods sold when the product is delivered to an end customer.

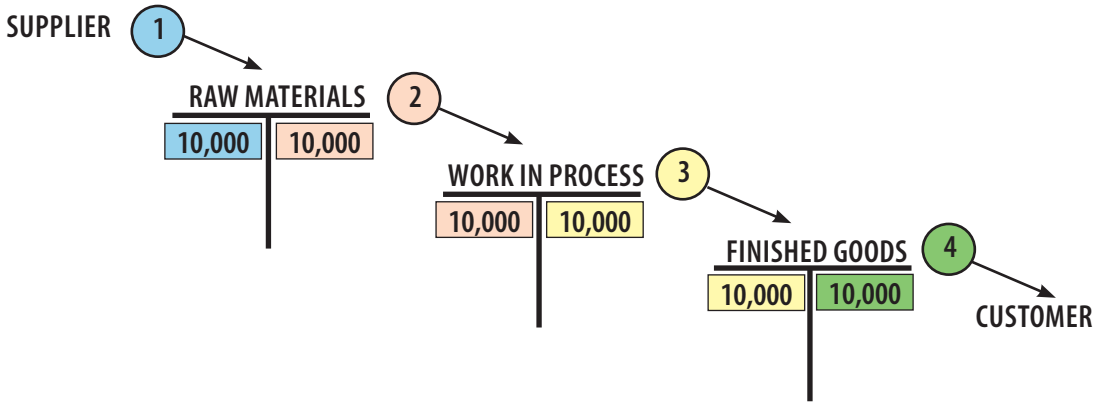
Raw Materials:
At the time it is acquired, the Raw Materials Inventory needs to be increased by $10,000, as shown in the T-Account below.

Work in Process:
The second step will result in a reduction in the Raw Materials Inventory and a corresponding increase in the Work in Process Inventory.

Finished Goods:
Upon completion, that cost is transferred from Work in Process Inventory to Finished Goods Inventory.

Cost of Goods:
When the product is sold, the cost moves out of Finished Goods Inventory.

At this point, only the cost flow of direct materials is being illustrated; shortly, you will see how to weave in the direct labor and overhead costs.



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In general journal form, the preceding flow of costs is:

1	Raw Materials Inventory	10,000	
	Accounts Payable		10,000
	Purchased pipe from steel mill		
2	Work in Process Inventory	10,000	
	Raw Materials Inventory		10,000
	Transferred pipe to production		
3	Finished Goods Inventory	10,000	
	Work in Process Inventory		10,000
	Transferred processed pipe to finished goods		
4	Cost of Goods Sold	10,000	
	Finished Goods Inventory		10,000
	Delivered finished goods to customer		

Carefully review the above set of entries, and focus on the fact that $10,000 of cost was incurred when the raw material was purchased in Step 1. And, that cost eventually became a cost of goods sold at the end of the process when the goods were delivered to the customer in Step 4 (remember, only the direct material is being shown here; labor and overhead costs are yet to be considered).

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Concurrent with recording the 4th entry, another entry would be made to record the sale (debit. Accounts Receivable and credit Sales). The difference between Sales and Cost of Sales would be the gross profit. These entries assume a perpetual inventory system; the same result could be achieved with a periodic system like that illustrated earlier in the book.

14.2 Direct Labor

Now focus exclusively on the direct labor cost, ignoring materials and overhead. Notice that laborers were present in the middle picture from the pipe plant. This suggests the introduction of direct labor into the costing equation. Like the cost of raw materials, the salaries payable for direct labor are added to Work in Process Inventory (at "stage 2" of the diagram). The following entries assume that the pipe required 200 hours of direct labor at $15 per hour:

2	Work in Process Inventory	3,000	
	Salaries Payable		3,000
	Incurred direct labor to process pipe (200 hrs @$15)		
3	Finished Goods Inventory	3,000	
	Work in Process Inventory		3,000
	Transferred processed pipe to finished goods		
4	Cost of Goods Sold	3,000	
	Finished Goods Inventory		3,000
	Delivered finished goods to customer		

Notice that the accounts used in these entries are identical to those for direct material, except that the credit in the first entry is to Salaries Payable. This reflects that the cost is attributable to an obligation to pay employees for their time.

14.3 Applied Factory Overhead

Take one more look at the "work in process" factory floor picture, and think about the factory overhead that is being "used" to process the pipe. What components can you identify or contemplate? Likely, your list will include utilities costs, insurance, factory maintenance, depreciation on the equipment, some supplies, and similar items. As discussed earlier in the chapter, these costs must be attached to the products. But, the method of attachment is by applying overhead based on a predetermined estimated rate -- again, because it is virtually impossible to associate or match the incurrence of actual overhead with each job actually produced.

Assume the pipe factory applies overhead at the rate of $25 per direct labor hour. Remember that 200 hours were needed for the job in question. Thus, $5,000 ($25 x 200) is the amount of applied factory overhead. The following entries are similar to those that were used to record the direct labor; compare them, and pick out the account that differs:

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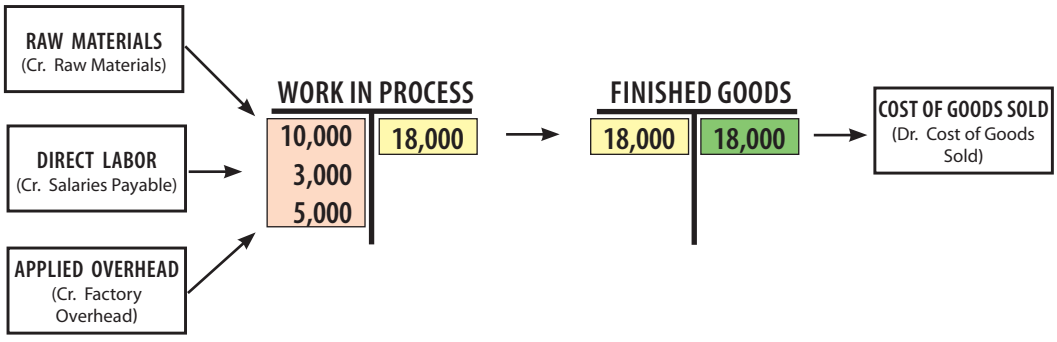
2	Work in Process Inventory	5,000	
	Factory Overhead		5,000
	Applied factory overhead to production (200 hours @$25)		
3	Finished Goods Inventory	5,000	
	Work in Process Inventory		5,000
	Transferred processed pipe to finished goods		
4	Cost of Goods Sold	5,000	
	Finished Goods Inventory		5,000
	Delivered finished goods to customer		

An account entitled “Factory Overhead” was uniquely credited in the first of the above entries. What does this credit really represent? This account is one of the more confusing to explain; it is challenging for students to grasp. As a result, there is a separate section later in this chapter (Accounting for Actual and Applied Overhead). But, for the moment, accept this truncated explanation: The credit to Factory Overhead is the allocation tool used to pass out the actual overhead costs to jobs in progress; the actual overhead costs are captured via debits to this account through a separate process described later in this chapter.

14.4 Overview

The preceding information can be combined and summarized as follows:



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This graphic illustrates how the total job cost was measured as $18,000. The general journal would include the following entries:

6-15-X3	Raw Materials Inventory		10,000	
	Accounts Payable			10,000
	To record purchase of raw materials			
6-20-X3	Work in Process Inventory		18,000	
	Raw Materials Inventory			10,000
	Salaries Payable			3,000
	Factory Overhead			5,000
	To transfer raw materials to production, record direct labor costs on job, and apply overhead at the predetermined rate			
6-21-X3	Finished Goods Inventory		18,000	
	Work in Process Inventory			18,000
	To transfer completed units to finished goods inventory			
6-25-X3	Accounts Receivable		25,000	
	Sales			25,000
	To record sale of finished pipe for $25,000			
	Cost of Goods Sold		18,000	
	Finished Goods Inventory			18,000
	To transfer finished goods to cost of goods sold			

14.5 Financial Statement Impact Scenarios

How job cost data appears on the financial statements depends on its condition at the financial statement date. Considering the pipe illustration:

- If the raw pipe had not yet started into production, its $10,000 cost would appear in the raw materials inventory category on the balance sheet:

INVENTORIES	
RAW MATERIAL	$ 10,000
WORK-IN-PROCESS	
FINISHED GOODS	

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- If the pipe was in production but not complete, the total cost in the Work in Process account as of the balance sheet date would be aggregated and presented as work in process inventory on the balance sheet. For example, assume all of the raw material was in process, but only half of the necessary labor tasks had been performed; in this case, the Work in Process Inventory account would include $14,000 ($10,000 direct material + $1,500 labor + $2,500 applied overhead):

INVENTORIES	
RAW MATERIAL	
WORK-IN-PROCESS	$ 14,000
FINISHED GOODS	

- If the drill pipe was completed but unsold, the finished goods inventory would be carried at $18,000 on the balance sheet:

INVENTORIES	
RAW MATERIAL	
WORK-IN-PROCESS	
FINISHED GOODS	$ 18,000

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- If the drill pipe was sold for $25,000, the income statement would include sales ($25,000) and cost of goods sold ($18,000), netting to the $7,000 gross profit:

Sales	$ 25,000
Cost of goods sold	18,000
Gross profit	$ 7,000
. . . . .	

14.6 Cost Flows to the Financial Statements

If you are unclear about the flow of production costs into the financial statements, review the cost flow graphic presented in the Introduction to Managerial Accounting chapter.. In so doing, remember that the nonmanufacturing "period" costs are charged directly to expense in the period incurred; they do not enter into the determination of inventory or cost of goods sold.

14.7 Subsidiary Accounts

You learned earlier in the book about subsidiary accounts. For example, a company's general ledger will reveal the total accounts receivable, total accounts payable, total equipment, etc. But, there is also need to know subsidiary details about each of these accounts. In other words, you must be able to identify the specific customers who owe money, how much is due to each vendor, how much depreciation to record for each asset, and so forth. The same is true for the Work in Process account. While it is imperative to know the total dollar value of all jobs, a company must also be able to pinpoint the amount attributable to each job. This is accomplished via an account numbering scheme where each job is given a unique number. This enables ease of data mining. The chart of accounts typically includes a number where the leading digits indicate the control account, and the trailing digits indicate the subsidiary account. For work in process, this numbering could go as illustrated below.

	Account Number	
Job A	600.0100	$ 35,000
Job B	600.0101	25,000
.		.
.		.
.		.
.		.
Job Z	600.0125	12,000
Total for all jobs	600	$290,000

While the exact mechanics of maintaining subsidiary account balance information can vary, what is important is that you could inspect the general ledger and financial statements, and find $290,000 in work in process. The subsidiary account information should be sufficient to allow you to find that Job A represents $35,000 of the total, Job B represents $25,000, and so forth.

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14.8 Global Trade and Transfers

Companies engaged in international commerce often establish separate operating units around the globe. For instance, a company may establish a manufacturing facility in a country with lower wages and costs of production. This trend has introduced a myriad of complex costing issues which generally fall under the heading of “transfer pricing.”

The heart of the issue is how to assess costs and set prices for goods produced in one venue and transferred to an affiliate in another. The governments of each country have a keen interest in taxing activities within their domain (whether it be by a value added tax, income tax, tariff system, custom duties, etc.). And, companies will envision an opportunity to shift profits from high tax jurisdictions to low tax jurisdictions by shuffling costs and prices between entities.

This is a fertile area of tax dispute, and one that keeps many managerial accountants quite busy. In the main, the applicable rules attempt to require the use of fair and equitable job costing, and require that transfers be based on “arms length” transaction pricing. But, the devil is in the details of implementation. A recent look on an internet search engine turned up almost five million hits for “transfer pricing rules!”

The above transfer pricing issues are not limited to global companies. Similar issues can arise when products are shipped between affiliated companies in different states or provinces. Also, affiliated companies may have divisional profit sharing, causing managers working for the same corporate parent to debate the costs assigned to products produced by their respective unit. As you can see, there is a lot more to job costing than just adding up costs!

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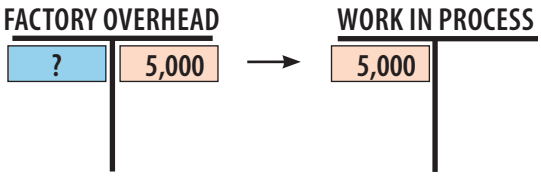
15. Accounting for Actual and Applied Overhead

A lot of this chapter has been devoted to discussing the application of overhead to production. Overhead is applied based on a predetermined formula, and considerable thought needs to be put into the appropriate basis (cost drivers) for making this allocation. An account called “Factory Overhead” is credited to reflect this overhead application to work in process.

But, what is the source of the debits to Factory Overhead?



15.1 The Factory Overhead Account

The Factory Overhead account is not a typical account. It does not represent an asset, liability, expense, or any other element of financial statements. Instead, it is a “suspense” or “clearing” account. Amounts go into the account and are then transferred out to other accounts. In this case, actual overhead goes in, and applied overhead goes out! The credits to this account are generated when overhead is applied to production; now focus on the debits which represent the actual amounts being spent on overhead.

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15.2 Actual Overhead

As the cost components of overhead are actually incurred, the Factory Overhead account is debited, and the logically offsetting accounts are credited. The table below provides representative examples of factory overhead items.

EXAMPLE OVERHEAD ITEM	DEBIT	CREDIT
Indirect labor	Factory Overhead	Salaries Payable
Indirect material	Factory Overhead	Inventory or Supplies
Insurance	Factory Overhead	Prepaid Insurance
Factory depreciation	Factory Overhead	Accumulated Depreciation
Taxes	Factory Overhead	Taxes Payable
Utilities	Factory Overhead	Utilities Payable

The indirect labor would relate to the cost of factory staff not directly involved in production. This can include break-time of line workers, shop managers, maintenance, guards, and so forth. The indirect materials relates to supplies and components that are not a significant cost item. Importantly, selling and administrative costs not related to production (e.g., advertising, salaries for non-production related staff, sales commissions, rent of the corporate offices, etc.) are separately expensed, and are not part of factory overhead. A typical entry to record factory overhead costs would be as follows:

6-30-X3	Factory Overhead		100,000	
	Salaries Payable			50,000
	Supplies			15,000
	Prepaid Insurance			5,000
	Accumulated Depreciation			11,000
	Taxes Payable			9,000
	Utilities Payable			10,000
	To record various factory overhead costs			

15.3 The Balance of Factory Overhead

Since the Factory Overhead account is debited for actual overhead incurred and credited for allocated overhead, the general ledger account would appear as follows (the job costs are newly assumed for this illustration):

ACCOUNT: Factory Overhead

Date	Description	Debit	Credit	Balance
June 5, 20X3	Allocated overhead to Job A		$ 15,000	$ 15,000
June 7, 20X3	Allocated overhead to Job B		10,000	25,000
June 8 to 30	Allocated overhead to Job C, D, etc.		75,000	100,000
June 30, 20X3	Recorded actual overhead (see entry)	$ 100,000		-

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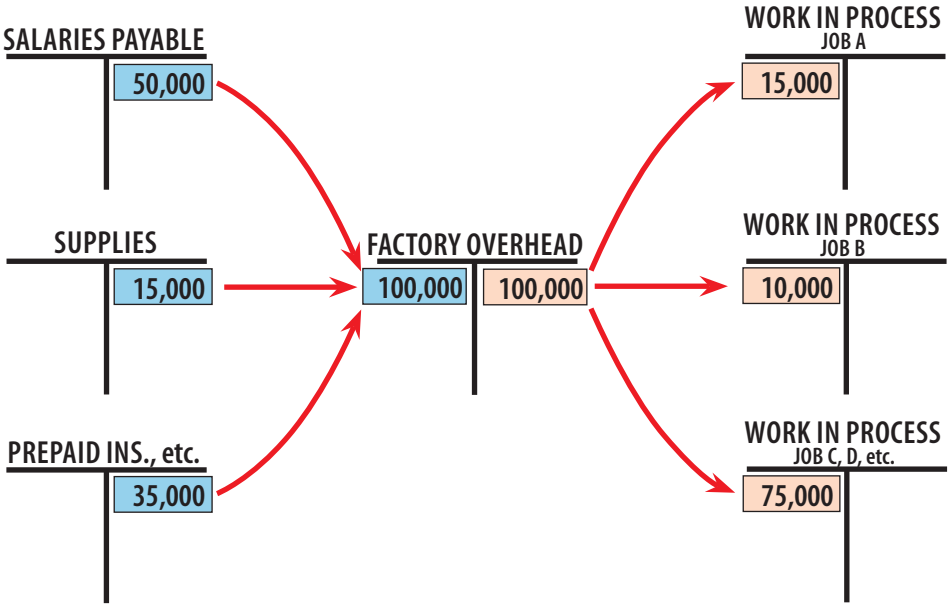
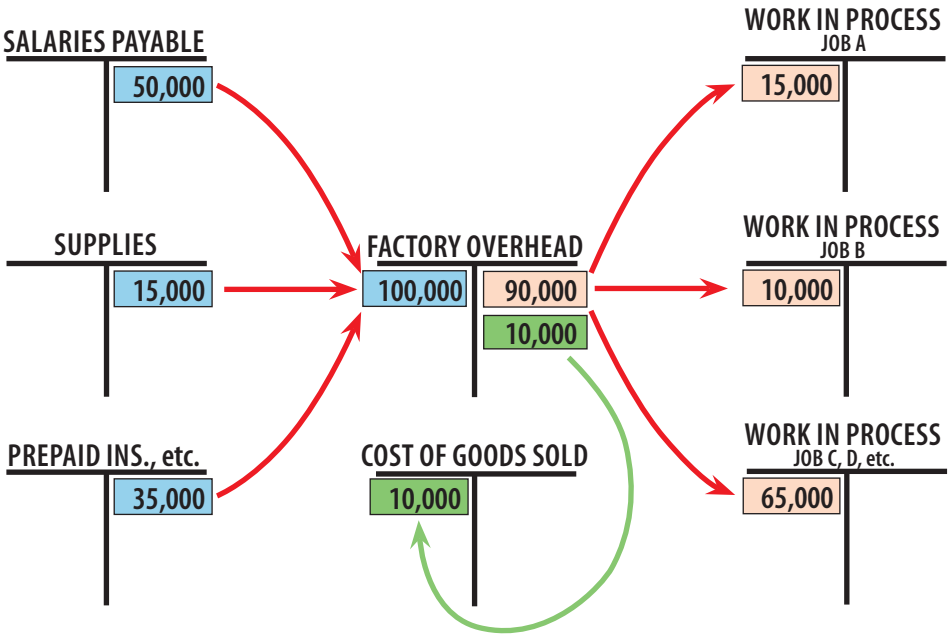
The next graphic provides a visual representation of the cost flow associated with the Factory Overhead account. In this case, the applied overhead equaled the actual overhead, leaving a zero balance. This means that the predetermined allocation rate was exactly what was incurred during the period. More often than not, this level of perfection will not result.



15.4 Underapplied Overhead

A more likely outcome is that the applied overhead will not equal the actual overhead. The following graphic shows a case where $100,000 of overhead was actually incurred, but only $90,000 was applied.



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This situation is called "underapplied" overhead. It is said to be an "unfavorable" outcome, because not enough jobs were produced to absorb all of the overhead incurred. This might result from below normal levels of output, or overspending. In any event, the fact remains that more was spent than allocated. Because the Factory Overhead account is just a clearing account (not a financial statement account), the remaining balance must be transferred out. Several options are available for disposing of this amount, but one approach is to remove (credit) the underapplied amount and charge (debit) Cost of Goods Sold:

6-30-X3	Cost of Goods Sold		10,000	
	Factory Overhead			10,000
	To transfer underapplied overhead to cost of goods sold			

This entry has the effect of reducing income for the excessive overhead.

15.5 Overapplied Overhead

If the applied overhead exceeds the actual amount incurred, overhead is said to be "overapplied." This is usually viewed as a favorable outcome, because less has been spent than anticipated for the level of achieved production.

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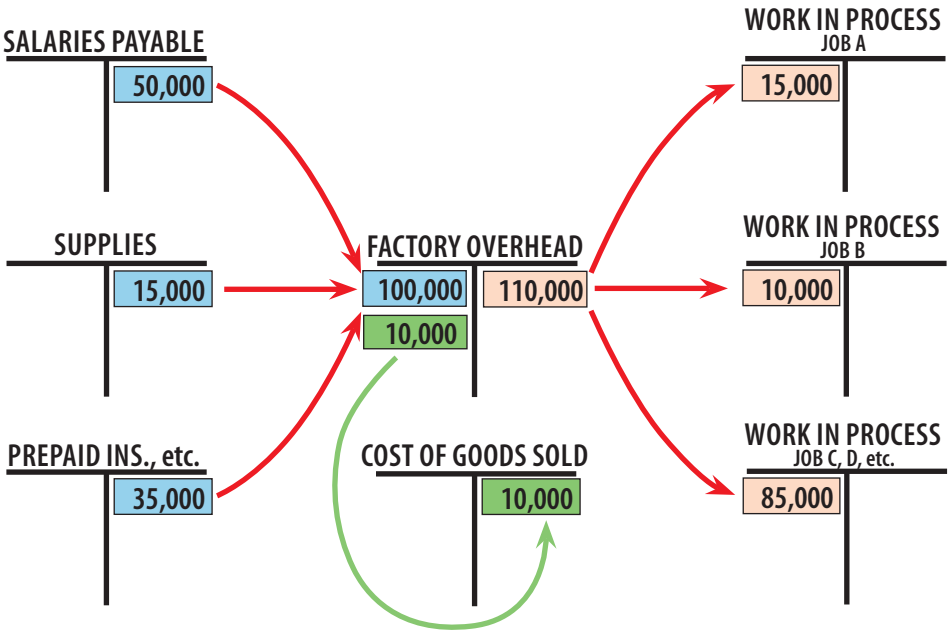

The next journal entry shows the reduction of cost of goods sold to offset the amount of overapplied overhead:

6-30-X3	Factory Overhead		10,000	
	Cost of Goods Sold			10,000
	To reduce cost of goods sold for the overapplied overhead			

Always keep in mind that the goal is to "zero out" the Factory Overhead account and measure the actual cost incurred. In this last example, $100,000 was actually spent and accounted for: $110,000 charged to specific jobs and $10,000 offset as a reduction in cost of goods sold.

These illustrations of the disposition of under- and overapplied overhead are typical, but not the only available solution. A more theoretically correct approach would be to reduce cost of goods sold, work in process inventory, and finished goods inventory on a pro-rata basis. However, this approach is clearly more cumbersome and can sometimes run afoul of the specific accounting rules discussed in the next paragraph. In a subsequent chapter, you will learn more about how to handle the "variances" arising from underapplied overhead.

15.6 Influence of GAAP

Although managerial accounting information is generally viewed as for internal use only, be mindful that many manufacturing companies do prepare external financial statements. And, generally accepted accounting principles dictate the form and content of those reports. For example, a specific Statement of the Financial Accounting Standards Board (SFAS No. 151) requires that underapplied overhead relating to idle facilities, wasted material, the allocation of fixed production overhead, and so forth, be charged to current period income by means similar to those just illustrated.

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16. Job Costing in Service, Not For-Profit, And Governmental Environments

The last hundred-plus years have been remarkable. A primarily agriculture-based world economy gave way to the industrial revolution. This revolution took root and continues to sweep around the globe. Following the growth in manufacturing has been an even greater proliferation of support and service roles. Perhaps as few as 10% of workforce members are now actively producing a tangible end product.

16.1 The Service Sector

Most employees in the private sector are engaged in nonmanufacturing activities like accounting, sales, computing, and administration. New businesses have developed in the areas of law, healthcare, food services, electronic information delivery, transportation, entertainment, and others. The not-for-profit sector is increasing; consider the size and scope of educational institutions, hospitals, foundations, and so forth. And, not to be forgotten, is the size and scope of governmental entities. Cities provide services like municipal infrastructure, fire, police, water utilities, and code enforcement. State and provincial governments may provide for the educational system, highways, and prisons. At the federal level, governments may provide military, welfare, transportation, and countless other services. It is no wonder that most people work in a nonmanufacturing role.

The job costing model presented in this chapter is generally suggestive of the idea that a “job” can be identified as some tangible product. But, that is not necessarily the case. This chapter opened with an illustration for Castle Electric. If you think deeper about that example, you will realize that most of what Jack Castle provided to his customers was a “service.” But, the utilization of job costing methodologies was still highly relevant. The cost of services, whether provided in the private sector, not-for-profit, or governmental arenas, must be determined with some reasonable degree of accuracy. The growth, indeed dominance, of these sectors of the economy underscores the need to extend costing methods beyond the traditional manufacturing setting.

The concept of a “job” gives way to more abstract connotations: “client,” “surgical procedure,” “seat mile,” “student credit hour,” “fire call,” or other measure of output. Clearly, direct materials become a less significant part of the overall picture. But, overhead can take on heightened levels of importance. Perhaps you have experienced a costly hospital stay. The itemized billing that follows usually includes some shocking components (e.g., $5 for an aspirin). These prices cannot be justified based on direct material cost alone. Clearly, the hospital has tremendous and costly overhead. In addition, you don’t just pop an aspirin in the hospital as you would at home. The pill must be administered, documented, and billed; efforts which consume expensive labor time.

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If costing methods are not employed correctly, the organization may find that it has underestimated its costs of services. This can lead to financial failure. On the other hand, many will question the cost drivers and methods of allocations that are used in service type activities. For instance, a city may determine that the full cost of a fire department is several hundred thousand dollars per residential house fire. This type of job costing could lead one to conclude that a fire department is not cost effective. The problem with this approach is that it ignores that one fire would quickly spread to an entire city without a suppression action by the fire department. And, firefighters save countless lives for which there can be no rational economic measure. So, what is the actual "job" and how are costs to be assigned to that "job?" This measurement problem is pervasive and challenging in the service sector.

16.2 Capacity Utilization

The root of the problem is that traditional job costing allocates overhead based on the expected output. In contrast, it may sometimes make more sense to charge individual jobs based on full capacity utilization, provided a plan is in place to maintain the financial viability of the organization. Capacity utilization refers to the degree to which an organization's output capabilities are being deployed or utilized.

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To illustrate this concept, assume that a local ambulance service was capable of providing 30,000 calls per year, but only expected to make 10,000 actual calls. If the overhead of the ambulance company was $30,000,000, the overhead allocation would be either $3,000 per call (based on estimated activity) or $1,000 per call (based on full capacity utilization). If the entity set customer charges based on the $3,000 amount, it might soon find that it generates fewer calls, because people opt not to utilize the service. In essence, a handful of actual patients are put in the position of paying for the ambulance service that is available to everyone. A more logical approach might be to cost the service based on the $1,000 figure, and then recover the additional cost by some form of tax or fee that falls on all potential patrons of the ambulance service (whether they use it or not during a given time period).

These capacity utilization and costing considerations are in play for all organizations, but they seem to present a particularly vexing problem for the service sector. As a general rule, when overhead is allocated based on full capacity rather than expected output, one can expect considerable underapplied overhead. Managers need to be keenly aware of this as they plot their ultimate financial strategies. Great care must be taken to avoid dysfunctional decisions based on erroneously high or low costing. There are many theories and methods, but none of them replace a savvy decision made by a well informed manager who understands the nuances of job costing.

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17. Modern Management of Costs and Quality

Accountants have a reputation for being focused on cost control. Perhaps this reputation can be traced back to the 1843 book by Charles Dickens entitled A Christmas Carol. In that tale, Ebenezer Scrooge is a penny-pinching miser who cares nothing for the people around him. His sole purpose is making money, and his trusted but suffering accountant is Bob Cratchit who painstakingly tracks every penny. Fear not, Mr. Scrooge eventually sees the light when visited by the ghost of his former partner, but that's another story.

Today's accountants still focus on measuring and controlling the costs of a business. And, this pursuit sometimes earns them the scorn of their associates who may be more interested in engineering, product development, marketing, and other facets of the business. The accountants, and their numbers, are sometimes seen as profit obsessed and, therefore, limiting the potential to achieve other objectives.

But, modern managerial accounting techniques are causing a shift in this reputation. Technologically advanced information systems mean less time needs to be spent on data capture, and more time can be devoted to analyzing data and making sound business decisions. As you will see, modern evaluative techniques are looking beyond the bottom line.

17.1 Global Competition

One result of the rise in global competition has been a cross-pollination of best business practices. Interestingly, many profitable businesses come out of environments where profit is not the primary motivation. What has been learned from this is that business success can be driven by a fixation on issues such as quality, employee involvement, customer satisfaction, and the like; profit is the result not the objective. Let's focus on several contemporary trends where management accountants play an important implementation role.

17.2 Kaizen

Kaizen is a Japanese term used to describe a blitz like approach to study processes and install efficiency within an organization. This approach relies on frontline employee input for "quick fix" suggestions relating to business processes. Essentially, focus sessions are conducted in search of the obvious areas of operational improvement. These sessions are usually "observed" or "moderated" by members of the strategic finance/managerial accounting/industrial engineering teams. But, these "experts" are supposed to listen and learn, not suggest or lead the discussions. What is sought are simple and common sense solutions for issues that may not have even been seen as problems for the business. In one setting, for example, a production facility manufactured metal shelving to be used in refrigeration equipment. Essentially, the product required sheet metal to be stamped and shaped in a series of operations. The facility was cramped, and the product flowed down the three production lines like this:

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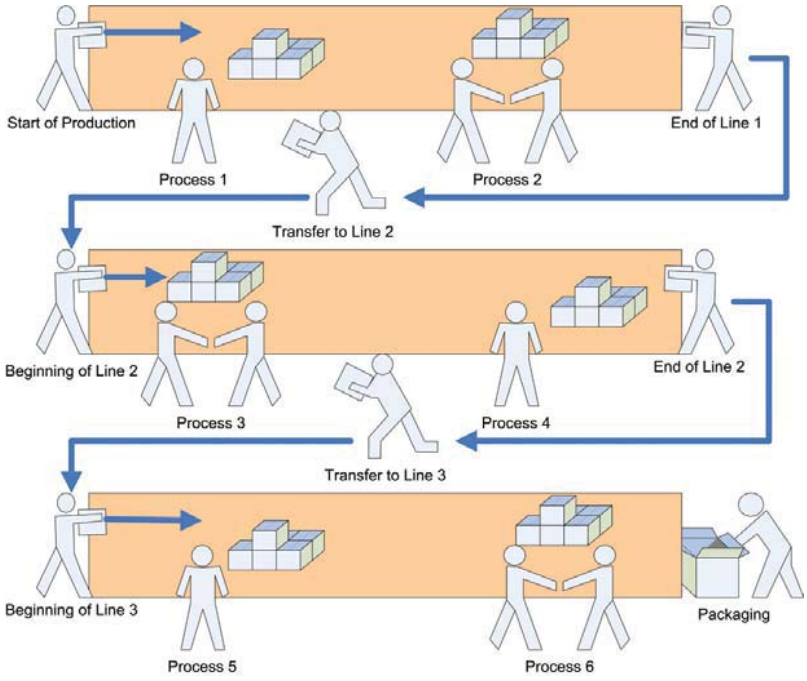

The business was not profitable, and was acquired by an entrepreneur who immediately conducted a Kaizen session. The workers pointed out that they were bumping into each other and disrupting the manufacturing activity as they moved the work in process between the three production lines. The simple fix was to reverse the middle line as follows:

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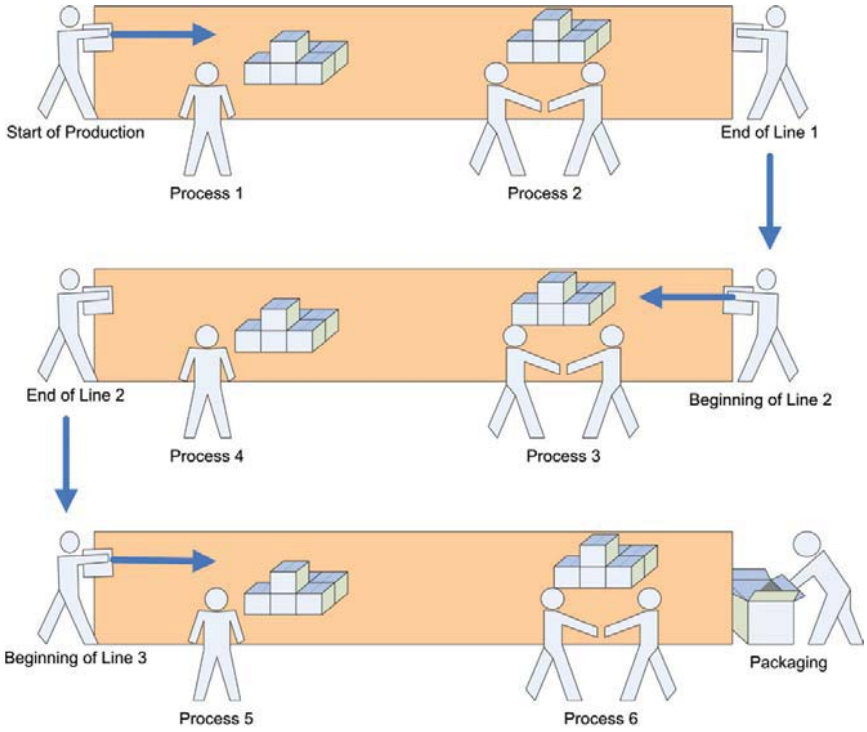

This was a simple, and in retrospect obvious, corrective measure. The savings were huge from this and other Kaizen event fixes! The entrepreneur sold the business at a greatly increased price within just a few years after buying it. There are few businesses that cannot benefit by taking time to listen to employees in search of operational suggestions that make sense. The cost and efficiency savings can be enormous. These Kaizen sessions are also useful in helping employees understand business cost control and its importance to the entire business team.

17.3 Lean Manufacturing

A term popularized in recent years has been “lean manufacturing.” This descriptive term is indicative of an environment where waste has been trimmed. But, it also entails a focus on speed and quality. Another benchmark of lean manufacturing is the pursuit of standardization for as many processes as possible, without compromising responsiveness to customer demand.

The development of a lean manufacturing facility is not a quick fix like Kaizen. Accountants and others will conduct an extensive and in-depth study of each process with the goal of bringing efficiency to the business. Often, consultants and experts are engaged; these outsiders can bring a fresh perspective and valuable insight gained by their service to a variety of other businesses.

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To illustrate, there was a time when automakers had many options for each car produced, and the customers spent considerable time deciding which options they preferred and could afford. This, in turn, complicated the manufacturer's production and inventory management. In time, they discovered that the manufacturing process, inventory management, and customer buying experience could be improved by bundling options into two or three packages. The "leaning" process resulted in a more standardized/streamlined production effort, and produced a better customer experience. The point is that making a lean manufacturing operation does not mean simply cutting, cutting, and cutting some more. It is the result of an intensive effort to streamline and standardize production, without disappointing the customer!

17.4 Just in Time Inventory

Inventory management often benefits from studies into the development of a lean manufacturing environment. Maintaining raw materials inventory entails not only a considerable upfront investment, but the potential for costly damage and obsolescence. Lean companies will attempt to minimize their raw materials inventory. One method is adopting "just in time" (JIT) inventory systems. In an ideal application, raw materials are received from suppliers just as they are needed in the production process. This approach requires a complete and reliable logistics system, as any disruption in the flow of materials can bring the whole production process to a devastating stop. Such systems are usually dependent upon a strong information system that often links the manufacturer directly to the supplier with automated procurement procedures. A Japanese term that is associated with JIT is "Kanban," which means some form of signal that a particular inventory is ready for replenishment.

A popular modification of the JIT system is for suppliers to "store" their inventory at the manufacturer's physical location. This enables the manufacturer to "buy" raw materials directly from the supplier's stock located within the same physical location. Finally, look carefully as you travel through industrial areas, and notice that "compatible" businesses are located in close proximity. For example, a beverage bottler's neighbor is apt to be an aluminum can manufacturer. All of these measures evolve from significant endeavors to develop lean manufacturing processes, and are usually based upon detailed job cost studies.

17.5 Total Quality Management

Total quality management (TQM) is a key driver of customer satisfaction and business success. Globalization increases the level of competition and drive toward higher product quality. This is often achieved by incorporating detailed standards into the management and productive processes. There is now a globally recognized organization, The International Organization for Standardization, that provides standards and guidelines relating to processes that drive the production of quality outputs. An "ISO 9000" certification suggests that a company, no matter where operating around the world, is able to demonstrate that it has successfully implemented quality management standards. This becomes increasingly important in selecting global trading partners.

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17.6 Six Sigma

An important part of TQM is to stress quality by comparing products and processes to other "worldclass" firms. This comparative process is commonly known as benchmarking. Motorola developed a quality-focused management approach that is responsible for billions of dollars in savings. So popular is the approach, that it has been trademarked by Motorola. The company now offers training into their quality management processes. Those processes are known as Six Sigma, and they are being deployed by many other companies. GE is a fan of the approach, and its website notes: "Six Sigma is a highly disciplined process that helps us focus on developing and delivering near-perfect products and services."

"Sigma" is a term learned in statistics. It is a measure of deviation from a norm. In the case of production management the "norm" is perfection. With Six Sigma, the organization tracks and monitors "defects" in a process. Then, methods are sought to systematically eliminate the opportunity for such defects. The goal is to achieve nearly "zero defects" -- a defect rate that is at least six standard deviations from the norm (hence the name "six sigma"). Such a distribution would have only 3.4 defects per million observations. Importantly, the defects relate not only to final products, but to all business processes, whether they be in manufacturing, record keeping, or whatever!

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Six Sigma revolves around the definition, measurement, and analysis of defects. The management accounting group will be heavily involved in this process. And, it is often the management accounting unit's responsibility to suggest improvements and provide controls necessary to drive an organization toward the near-zero defect goal. But, how does this result in cost savings? Companies have learned that quality defects are very costly. The costs come about directly in terms of the of corrective actions like warranty work, and indirectly through lost customer satisfaction that can adversely impact future sales. Significant savings are realized via the reduction in the cost of poor quality.

17.7 Reflection on Modern Cost Management

This chapter should serve to highlight an important message: The modern managerial accountant is increasingly deploying technology to deal with the mundane data capture, thereby freeing resources to study and analyze techniques needed to drive business success. While penny-pinching is an important part of building a financially successful business, it is also true that one can be penny-wise and pound foolish. Thus, the management accountant is not solely focused on cost cutting, but must also be mindful of measuring and instituting controls that drive an efficiently produced product of high quality.

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Process Costing and Activity-Based Costing

Part 4

Your goals for this “process costing and activity-based costing” chapter are to learn about:

- The purpose and functioning of a process cost accounting system.
- The concept of equivalent units of production.
- Assigning total cost to completed units and units in process.
- Activity-based costing systems.

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18. Process Costing

Oftentimes the production of manufactured products is easily divisible into specific jobs, and the job costing method illustrated in the previous chapter is appropriate. However, the job costing method does not work well when the production cycle involves a continuous flow of raw materials through various processing departments, and the finished output is characterized as homogenous units, each displaying the same basic characteristics. Examples of such “processes” are numerous. Wood pulp is “processed” into giant rolls of paper, refineries “process” crude oil to gasoline, iron ore is “processed” into steel, sand is “processed” into glass, and on and on. The physical nature of these “processes” makes it hard to identify and associate specific units of direct labor and direct material with the final output. For example, do you suppose anyone really knows which barrel of oil was used to produce the last tank of gasoline you purchased for your vehicle? Obviously, the crude oil was pumped from the ground, transported, put through a refinery, transported to a storage tank, etc. The molecules of oil were stirred, cracked, blended, and converted many times so that it is no longer possible to trace your tank of gasoline back to any specific barrel of oil. The gasoline was not produced as a specific job; it was the result of a “process.”

18.1 Process Costing

Now, if you were in charge of a refinery, how would you associate the cost of the barrels of crude oil with the gallons of finished gasoline? Logic would tell you to develop a mathematical approach that would divide the total cost of all oil and allocate it in some proportion to all the gallons of gasoline. This is the essence of “process costing.” Process costing is methodology used to allocate the total costs of production to homogenous units produced via a continuous process that usually involves multiple steps or departments.

If you are comfortable with the cost flow concepts from the prior chapter, you are already well on your way to understanding process costing. The reason is that the same cost flow concepts and accounts will be evident. That is, material, labor, and factory overhead will still occur and still be assigned to work in process. And, amounts assigned to work in process will in turn make their way to finished goods. The debits/credits and financial statement outcomes are going to look the same.

The big difference between job costing and process costing arises in the work in process “units.” Remember, under job costing we captured costs for each job (recall the discussion about job cost sheets and subsidiary amounts for each job). Under process costing, we will instead capture the costs for each process or department. Let’s think about a steel production factory. The basic processes for producing steel are to (1) melt iron ore (along with perhaps processed coal/coke and limestone), then (2) skim the material while adding alloys to adjust for tensile strength and flexibility, and finally (3) oxygen blast and extrude the material into its finished form (I-Beams, sheet steel, coils, etc.). Below is a representative graphic:

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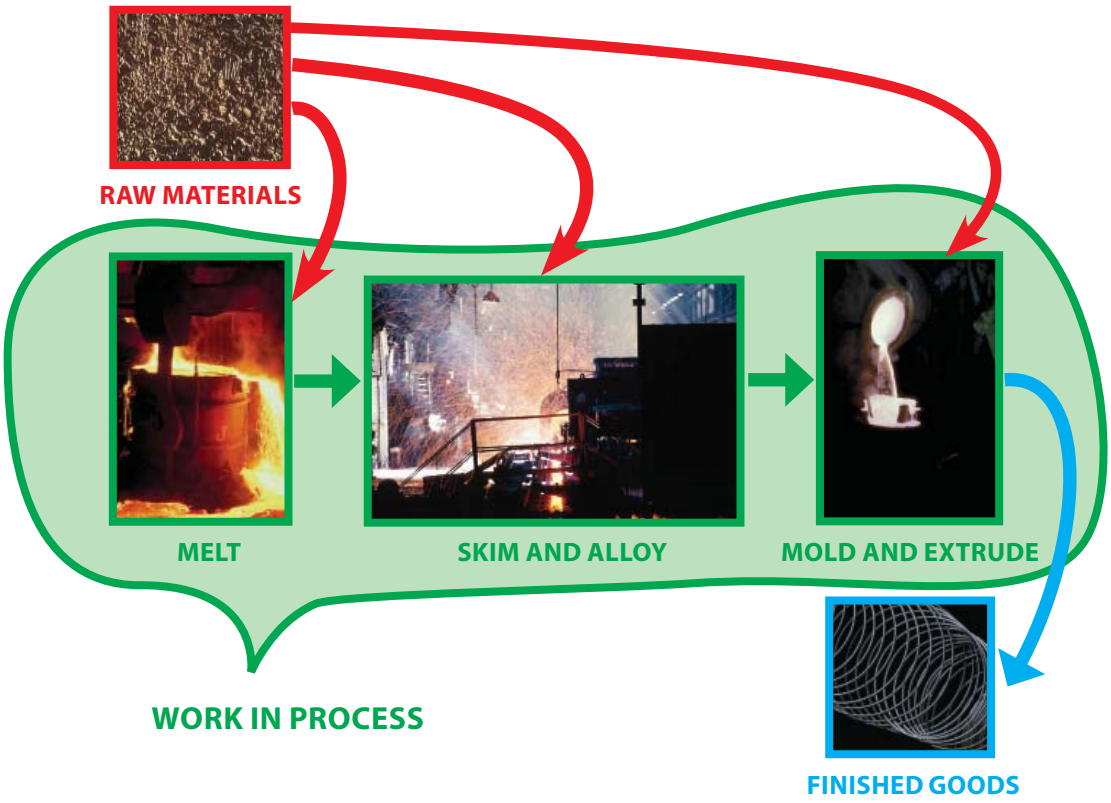

18.2 Comparing Job and Process Costing

The first thing you should note in the above graphic are familiar inventory categories relating to raw materials, work in process, and finished goods. However, rather than observing work in process as being made up of many individual/discrete jobs, you now begin to see that it consists of individual/discrete processes - melt, skim/alloy, mold/extrude. You will also note that material can be introduced into each process - ore in the melt stage, alloys in the skim/alloy stage, etc. (this is equally true for labor and overhead). This necessitates the employment of a separate Work in Process account for each major manufacturing activity. Examine the graphic on the top of the next page that compares job and process costing, noting in particular the difference in how costs are shifted out of work in process. Process costing entails handing off accumulated costs from one department to the next.

18.3 Introduction to the Cost of Production Report

With a job costing system, the costs of each job were tabulated on some form of job cost sheet. A similar tabulation of costs is needed for process costing, but with emphasis on costs by department. The cost report that is prepared for each department is termed a cost of production report. The graphic on next page illustrates this important comparative distinction.

The cost of production report provides comprehensive information on the material, labor, and overhead incurred within each department during a period. It is the primary source document for determining how those costs are allocated to actual production. Soon, we will look more closely at the specific content of a production cost report. But, first, it is necessary to introduce a new concept called “equivalent units” of production.

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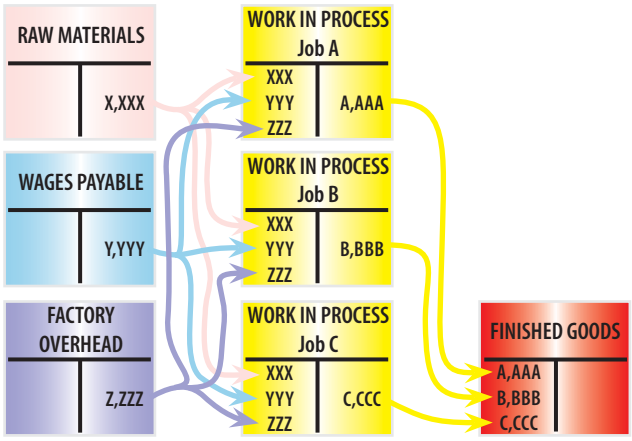
18.4 Job Costing Flows



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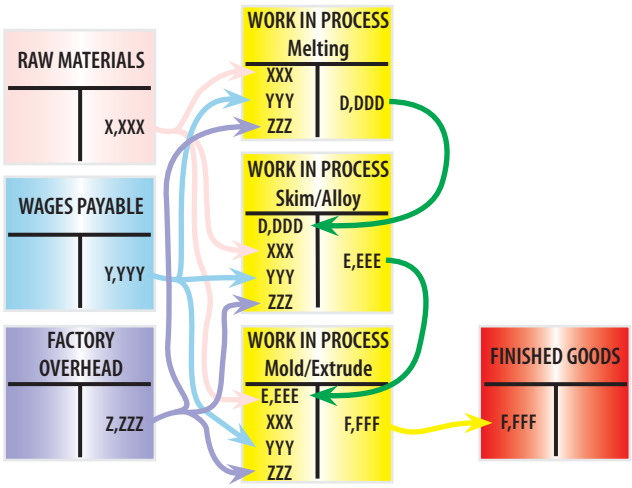
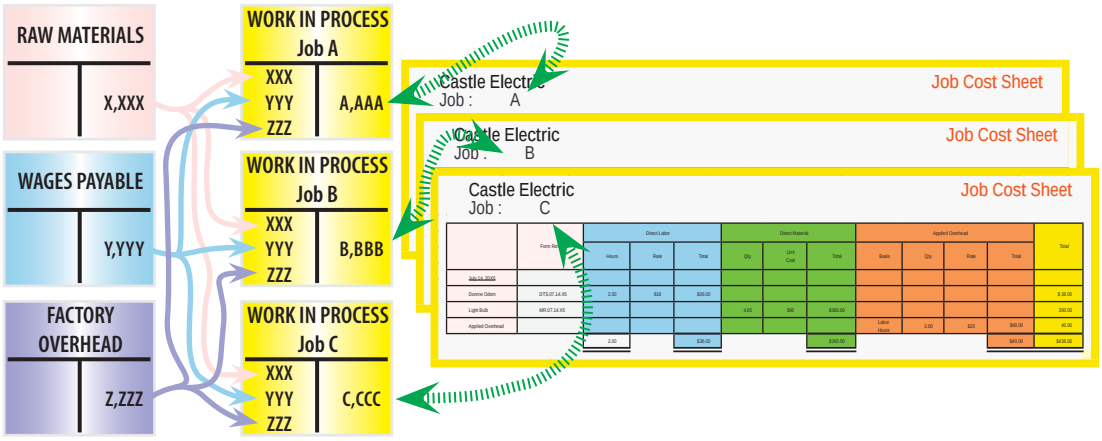
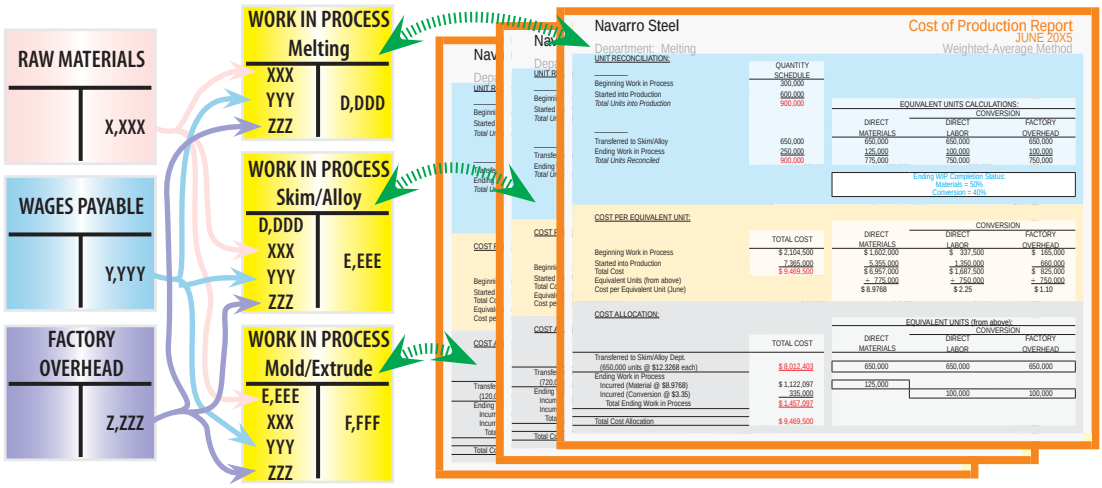
18.5 Process Costing Flows



18.6 Job Costing Flows on Job Cost Sheets



18.7 Process Costing Flows on Cost of Production Reports



19. Equivalent Units

One feature of process costing scenarios is that inventory is usually produced in a continuous process. Production does not start and stop just because a calendar page is being flipped. It is very likely that goods will be in various stages of production within each department at the end of each accounting period. For example, at the end of each month, Navarro Steel may have vats of iron ore that are in the process of being melted, other pools of material may have been skimmed but not yet laced with the requisite alloys, and partially cooled material may be awaiting the extrusion process. How are the costs incurred to be allocated between work in process versus finished goods?

To deal with the aforementioned question, accountants have devised the concept of an equivalent unit. An equivalent unit is a physical unit expressed in terms of a finished unit. As a simple example, ten units in process that are 30% complete equates to three equivalent units of output. None of the ten units is complete; merely the equivalent amount of work necessary to complete three units is said to be performed. As you might suspect, this determination of equivalent units is a bit abstract.

19.1 Factors of Production

For starters, it is necessary to consider equivalent units relative to each of the factors of production. In other words, 80% of necessary direct material may be in process, but only 60% of the direct labor and factory overhead (i.e., conversion cost) has been incurred. Therefore, proper costing methodology for 100 units in process would require us to state that 80 equivalent units have been produced based on material, while 60 equivalent units based on conversion have been produced.

To assess the equivalent units of production requires careful reasoning about the amount of direct material injected into production for each department, relative to the total amount of direct material that will ultimately be needed to complete the process within that department. This type of assessment must be repeated for direct labor and overhead (i.e., conversion costs). If overhead is applied based on labor, the process is simplified because the “percent complete” would the same for labor and overhead. However, if overhead is applied on some other basis (like machine hours) then a separate determination of equivalency would be needed for labor and for overhead (note: the illustrations within this chapter will assume overhead is applied based on labor, and the equivalent units for labor and overhead are therefore shown to be the same -- but be aware that such is not always the case).

19.2 An Illustration of Equivalent Units Calculations

To better understand equivalent units, let’s focus on an example for Navarro Steel. To begin, one needs to identify the total units that are to be considered, no matter their stage of completion at the beginning and end of the month.

The first stage in Navarro’s production process is the Melting Department. Navarro started the month of June with 300,000 tons of iron ore in process in the Melting Department. During June, an additional 600,000 tons were introduced into the melting vats. This means 900,000 total units must be “reconciled.” The quantity schedule below provides this reconciliation. It shows that 650,000

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units were transferred on to the Skim/Alloy Department, leaving 250,000 tons still in process. You should not proceed to try to calculate equivalent units until you have done this reconciliation.

UNIT RECONCILIATION:

	QUANTITY SCHEDULE
Beginning Work in Process	300,000
Started into Production	600,000
Total Units into Production	900,000
Transferred to Skim/Alloy	650,000
Ending Work in Process	250,000
Total Units Reconciled	900,000

In reconciling total units into production with the total units transferred out/still in process, it is not uncommon to come up short; many processes may involve scrap, waste, or spoilage (e.g., evaporation, spilling, etc.). Such units would be "identified" as the missing amount needed to balance the quantity schedule column. Advanced managerial accounting courses usually demonstrate the mechanics of handling the cost of spoilage within a process cost system. However, for now you should simply know that the cost of "normal" spoilage is allocated to the inventory of good units, while the cost of excessive waste is charged off as a loss on the income statement. The remaining details are left for subsequent courses.

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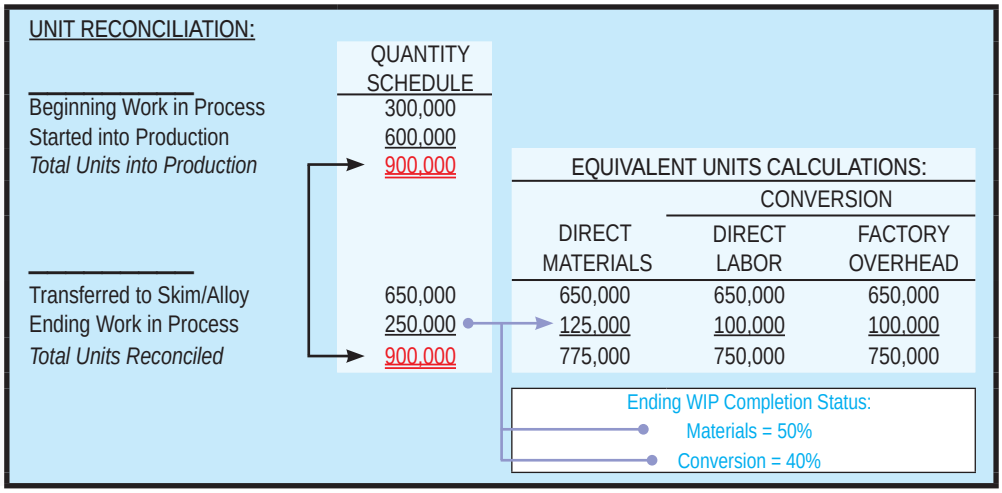
Once the total units have been reconciled, the equivalent units are computed. The correct manipulation of the data will depend on the inventory method in use. In this illustration, Navarro is assumed to use the weighted-average costing method (first-in, first-out is illustrated later). This simplifies the process because the beginning inventory and current period production can be combined or "averaged" together; thus, the 650,000 units that were completed are counted as 650,000 equivalent units of output (a 1:1 correspondence for material, labor, and factory overhead) -- no matter their origin from beginning inventory or otherwise. However, the units in ending work in process require more thoughtful consideration. Let's assume that the 250,000 tons in ending work in process are 50% complete with respect to material (i.e., 125,000 equivalent units) and 40% complete with respect to conversion (i.e., 100,000 equivalent units of direct labor and factory overhead). The right-hand side of the following schedule shows how the total units are translated into equivalent units:



19.3 Cost per Equivalent Unit

The equivalent units, as determined in the blue schedule above, are carried forward into the tan schedule below (see the small arrow on the right-hand edge). This "cost per equivalent unit" schedule shows how the combined costs from beginning work in process (assumed at $2,104,500 for Navarro, broken down between materials, labor, and overhead as shown) and current period production (assumed at $7,365,000, again broken down as shown) are divided by the equivalent units. The result is the weighted-average cost per equivalent unit for each factor of production: direct material, direct labor, and factory overhead. The individual cost factors can be combined to identify conversion cost per equivalent unit, and overall cost per equivalent unit. It can be very important to extend the decimals beyond the "cent" level (avoid rounding) because the per unit cost may ultimately be multiplied times millions of units!

COST PER EQUIVALENT UNIT:

	TOTAL COST	DIRECT MATERIALS	CONVERSION	
			DIRECT LABOR	FACTORY OVERHEAD
Beginning Work in Process	$ 2,104,500	$ 1,602,000	$ 337,500	$ 165,000
Started into Production	7,365,000	5,355,000	1,350,000	660,000
Total Cost	$ 9,469,500	$ 6,957,000	$ 1,687,500	$ 825,000
Equivalent Units (from above)		÷ 775,000	÷ 750,000	÷ 750,000
Cost per Equivalent Unit (June)		$ 8.9768	$ 2.25	$ 1.10
			$ 3.35	
		$ 12.3268		

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20. Cost Allocation to Completed Units and Units in Process

Thus far, we know that Navarro's Melting Department incurred total cost of $9,469,500 in producing output that entailed 775,000 equivalent units of material and 750,000 units of conversion. We also know the average cost per equivalent unit. Of course, the end objective is to allocate the total costs between work in process at the end of the month and units that were completed and transferred out during the month. This causes us to revisit the equivalent units calculations, this time applying the per unit cost to the proportion of equivalent units completed and those still in process:

COST ALLOCATION:

		EQUIVALENT UNITS (from above):		
			CONVERSION	
	TOTAL COST	DIRECT MATERIALS	DIRECT LABOR	FACTORY OVERHEAD
Transferred to Skim/Alloy Dept. (650,000 units @ $12.3268 each)	$ 8,012,403	650,000	650,000	650,000
Ending Work in Process				
Incurred (Material @ $8.9768)	$ 1,122,097	125,000		
Incurred (Conversion @ $3.35)	335,000		100,000	100,000
Total Ending Work in Process	$ 1,457,097			
√Total Cost Allocation	$ 9,469,500			

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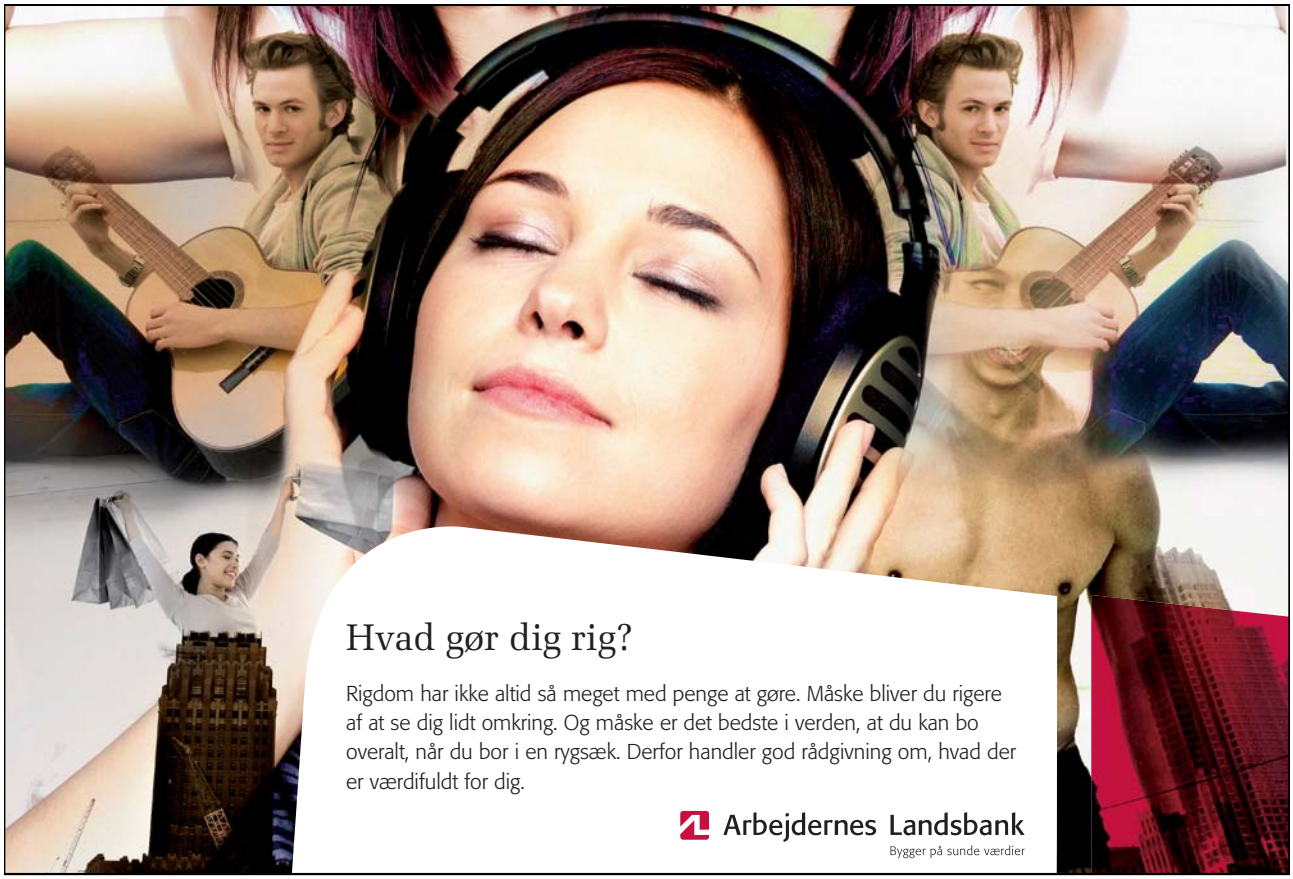

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If you carefully examine the above, you will see that the cost assigned to completed units totals $8,012,403. This amount is the per unit cost of $12.3268 multiplied times the 650,000 units that were completed and transferred on. The ending work in process is $1,457,097, determined as 125,000 equivalent units of material at $8.9768 each, plus 100,000 equivalent units of conversion at $3.35 each. A check mark is placed beside the total cost allocation ($9,469,500 = $8,012,403 + $1,457,097) as a reminder that this schedule must allocate the entire cost incurred within the Melting Department. If the total cost allocation does not equal the total cost incurred, an error has been made.

20.1 Cost of Production Report

The preceding schedules are combined into a single report called a cost of production report. The report summarizes the activity within Navarro's Melting Department for the month of June, as shown on the facing page.

A similar report would be prepared for each Department. These reports are used for many management purposes, such as inventory control, efficiency studies, incentive pay plans, and the like. They also provide the basis for the entries that are needed to update the ledger accounts for the inventory cost allocations.

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Navarro Steel

Cost of Production Report

JUNE 20X5

Department: Melting

Weighted-Average Method

UNIT RECONCILIATION:

	QUANTITY SCHEDULE
Beginning Work in Process	300,000
Started into Production	600,000
Total Units into Production	900,000
Transferred to Skim/Alloy	650,000
Ending Work in Process	250,000
Total Units Reconciled	900,000

EQUIVALENT UNITS CALCULATIONS:

		CONVERSION	
	DIRECT MATERIALS	DIRECT LABOR	FACTORY OVERHEAD
Transferred to Skim/Alloy	650,000	650,000	650,000
Ending Work in Process	125,000	100,000	100,000
Total Units Reconciled	775,000	750,000	750,000

Ending WIP Completion Status:
Materials = 50%
Conversion = 40%

COST PER EQUIVALENT UNIT:

	TOTAL COST	DIRECT MATERIALS	CONVERSION: DIRECT LABOR	CONVERSION: FACTORY OVERHEAD
Beginning Work in Process	$ 2,104,500	$ 1,602,000	$ 337,500	$ 165,000
Started into Production	7,365,000	5,355,000	1,350,000	660,000
Total Cost	$ 9,469,500	$ 6,957,000	$ 1,687,500	$ 825,000
Equivalent Units (from above)		÷ 775,000	÷ 750,000	÷ 750,000
Cost per Equivalent Unit (June)		$ 8.9768	$ 2.25	$ 1.10
			$ 3.35	
			$ 12.3268	

COST ALLOCATION:

	TOTAL COST	EQUIVALENT UNITS (from above): DIRECT MATERIALS	CONVERSION: DIRECT LABOR	CONVERSION: FACTORY OVERHEAD
Transferred to Skim/Alloy Dept. (650,000 units @ $12.3268 each)	$ 8,012,403	650,000	650,000	650,000
Ending Work in Process				
Incurred (Material @ $8.9768)	$ 1,122,097	125,000		
Incurred (Conversion @ $3.35)	335,000		100,000	100,000
Total Ending Work in Process	$ 1,457,097			
Total Cost Allocation	$ 9,469,500			

20.2 Journal Entries

These journal entries are needed to record the June activity within the Melting Department:

6-30-X5	Work in Process Inventory - Melting		7,365,000	
	Raw Materials Inventory			5,355,000
	Salaries Payable			1,350,000
	Factory Overhead			660,000
	To record material, labor, and overhead for the month of June for the Melting Department (see cost of production report)			
6-30-X5	Work in Process Inventory - Skim/Alloy		8,012,403	
	Work in Process Inv. - Melting			8,012,403
	To transfer completed units from Melting Department to Skim/Alloy Department			

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The journal entries, along with the beginning work in process of $2,104,500, result in an ending work in process of $1,457,097. The following T-account portrays the cost flow through the Work in Process account of the Melting Department:

WORK IN PROCESS
MELTING DEPARTMENT

Beginning Balance	2,104,500	8,012,403	Transfer to Skim/Alloy
June Costs	7,365,000		
Total Debits	9,469,500	8,012,403	Total Credits
Ending Balance	1,457,097		

20.3 Subsequent Departments

It is very important for you to notice that the journal entry to transfer $8,012,403 out of the Melting Department (credit) is offset with an increase in the Work in Process of the Skim/Alloy Department (debit). The Skim/Alloy Department's T-account for June might look something like this (amounts are assumed):

WORK IN PROCESS
SKIM/ALLOY DEPARTMENT

Beginning Balance	3,500,000	14,505,400	Transfer to Mold/Extrude
Transfer From Melting	8,012,403		
June Costs	5,000,000		
Total Debits	16,512,403	14,505,400	Total Credits
Ending Balance	2,007,003		

The corresponding journal entries for the Skim Alloy Department for June are as follows (don't forget, a debit to Work in Process of the Skim/Alloy unit was also recorded in the earlier entry):

6-30-X5	Work in Process Inventory - Skim/Alloy	5,000,000	
	Raw Materials Inventory		2,000,000
	Salaries Payable		1,500,000
	Factory Overhead		1,500,000
	To record material, labor, and overhead for the month of June for the Skim/Alloy Department (amounts are assumed/note that overhead can be applied on a different basis in each department!)		
6-30-X5	Work in Process Inv. - Mold/Extrude	14,505,400	
	Work in Process Inventory - Skim/Alloy		14,505,400
	To transfer completed units from Skim/Alloy Department to Mold/Extrude Department		

And, the Mold/Extrude Department has this T-account and related entries:

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WORK IN PROCESS
MOLD/EXTRUDE DEPARTMENT

Beginning Balance	2,000,000	20,000,000	Transfer to Finished Goods
Transfer From Skim/Alloy	14,505,400		
June Costs	7,000,000		
Total Debits	23,505,400	20,000,000	Total Credits
Ending Balance	3,505,400		

6-30-X5	Work in Process Inv. - Mold/Extrude		7,000,000	
	Raw Materials Inventory			3,000,000
	Salaries Payable			3,000,000
	Factory Overhead			1,000,000
	To record material, labor, and overhead for the month of June for the Mold/Extrude Department (amounts are assumed/note that overhead can be applied on a different basis in each department!)			
6-30-X5	Finished Goods Inventory		20,000,000	
	Work in Process Inv. - Mold/Extrude			20,000,000
	To transfer completed units from Mold/Extrude Department to finished goods inventory			

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Notice that the costs transferred from the Mold/Extrude unit go to the finished goods inventory, since this is the final process.

20.4 The Big Picture

You have probably heard it said "not to lose site of the forest for the trees." This means that the details sometimes obscure the big picture. Here, the "big picture" is to remember that we are trying to assign money spent to items produced (and still in production). By examining the schedule below of work in process, you will see that Navarro assigned $19,365,000 to work in process and transferred $20,000,000 to finished goods during June. As a result, total work in process inventory should have declined by $635,000 ($19,365,000 minus $20,000,000); a fact that can be verified by comparing the beginning and ending work in process balances ($7,604,500 - $6,969,500 = $635,000). Navarro's balance sheet at June 30, 20X5, would include $6,969,500 as the work in process inventory category.

	Beginning Balance	June Costs	Cost Transfers	Ending Balance
Melting	$ 2,104,500	$ 7,365,000	$ (8,012,403)	$ 1,457,097
Skim/Alloy	3,500,000	5,000,000	8,012,403. (14,505,400)	2,007,003
Mold/Extrude	2,000,000	7,000,000	14,505,400. (20,000,000)	3,505,400
	$ 7,604,500	$19,365,000	$(20,000,000)	$ 6,969,500

20.5 FIFO Process Costing

Thus far, the discussion and illustration of process costing has been based upon the weighted-average method. When you consider that the objective is to allocate cost to inventory, it should come as no surprise that other "inventory methods" can be used. One such alternative is the first-in, first-out (FIFO) method.

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21. Activity-Based Costing

In the previous chapter you learned about job costing, and this chapter presented process costing. You may be wondering why there could possibly be a need for yet another approach to determining how much a product costs to produce. Nevertheless, in recent times a number of companies have expressed frustration with the traditional methods. This has led to an increased utilization of a uniquely different approach called activity-based costing (ABC). A simplified explanation of ABC is that it attempts to divide production into its core activities, define the costs for those activities, and then allocate those costs to products based on how much of a particular activity is needed to produce a product. Before digging into the details, it is best to first consider the pros and cons of ABC.

21.1 Pros of ABC

Traditional costing methods divide costs into product costs and period costs. The period costs include selling, general, and administrative items and are charged against income in the period incurred. Product costs are the familiar direct materials, direct labor, and factory overhead. You know how these costs are traced/allocated to production under both job and process costing techniques. However, some managers reject this methodology as conceptually flawed. For example, it can be argued that the cost of a finished product should include not only the cost of direct materials, but also a portion of the administrative cost necessary to buy the raw materials (e.g., many companies have a separate administrative unit in charge of all purchasing activity, like writing specifications, obtaining bids, issuing purchase orders, and so forth). Conversely, the cost of a plant security guard is part of factory overhead, but some managers fail to see a correlation between that activity and a finished product; after all, the guard will be needed no matter how many units are produced.

Activity-based costing attempts to overcome the perceived deficiencies in traditional costing methods by more closely aligning activities with products. This requires abandoning the traditional division between product and period costs, instead seeking to find a more direct linkage between activities, costs, and products. This means that products will be charged with the costs of manufacturing and nonmanufacturing activities. It also means that some manufacturing costs will not be attached to products. This is quite a departure from traditional thought.

Another benefit of ABC is that a product is only charged with the cost of capacity utilized. Idle capacity is isolated and not charged to a product or service. Under traditional approaches, some idle capacity may be incorporated into the overhead allocation rates, thereby potentially distorting the cost of specific output. This may limit the ability of managers to truly understand and identify the best business decisions about product pricing and targeted production levels. This problem was touched on in the previous chapter’s discussion of capacity utilization.

21.2 Cons of ABC

One limitation of ABC is that external reporting must be based on traditional absorption costing methods. Absorption costing requires the traditional division between product costs and period costs, with inventory absorbing all of the manufacturing costs and none of the period costs. As a

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result, ABC may produce results that differ from those required under generally accepted accounting principles (GAAP). Therefore, ABC is usually viewed as supplemental in nature. It is used for internal management decision making, but it may not be suitable for public reporting (note: when the aggregate financial statement results do not differ materially between ABC and other methods, ABC can be used for both internal and external purposes).

The fact that ABC is not GAAP usually means that a company that wishes to benefit from ABC must develop two costing systems -- one for external reporting and one for internal management. Some companies feel they have enough to do without working through two costing methods! Another disadvantage of ABC is that it is usually more involved than other approaches. Rather than applying all factories overhead on some simple basis such as labor hours, it requires the development of numerous cost pools that must be individually allocated. In other words, ABC is a more intensive technique, and the costs to implement it may not be worth the trouble.

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21.3 The Reality of ABC

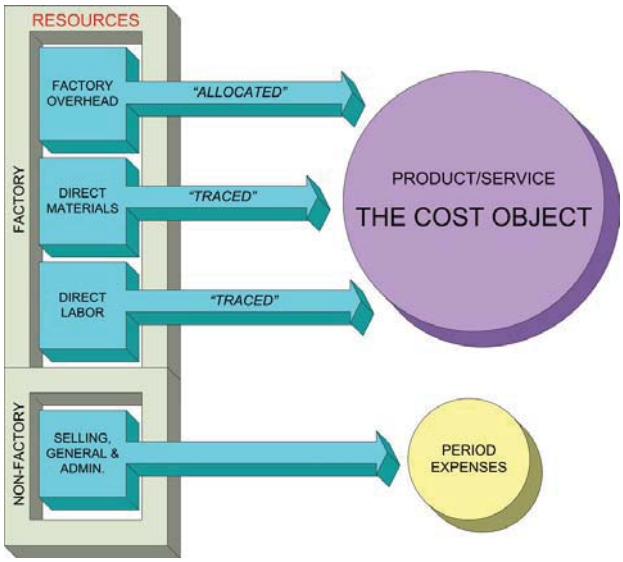
Despite the limitations of ABC, many companies utilize the method. A quick internet search will reveal millions of references to the approach, including various management consultant groups praising its merits. As you might suspect, many important business decisions about the fate of a product are based on assessment of profitability, and profitability boils down to comparing sales price to cost. Because the sales price is pretty well set, the “decision” about how to determine a product’s cost is obviously quite significant in assessing the bottom-line profitability for an individual product or service.

Now, for a single-product company with fairly stable inventory levels, this is much to do about nothing. Traditional and ABC methods will get to about the same end point. But, for multi-product/service firms, the arbitrary allocation of costs can pretty much “make or break” the perceived profitability of each product or service. As companies have grown larger and more diverse in output, there has been an accompanying concern about how costing occurs. Arguably, product diversification has been a major contributing factor into the management accountant’s pursuit of alternative costing devices like ABC.

Another driver of ABC-type approaches has been the advent of computer technology. Before modern information systems, it was very expensive to manipulate data. Most firms were perfectly content to live with simple approaches that allocated factory overhead on a single basis. The ease with which data can be managed under a sophisticated information system greatly reduces the cost and error rate associated with ABC. It is not surprising that the method’s popularity is inversely related to data processing costs.

21.4 A Closer Look at ABC Concepts

If you think about traditional costing methods, the “cost object” is usually an end product or service. Very simply, prime costs are traced to output while factory overhead is allocated to output. Nonfactory costs do not get assigned to a product:



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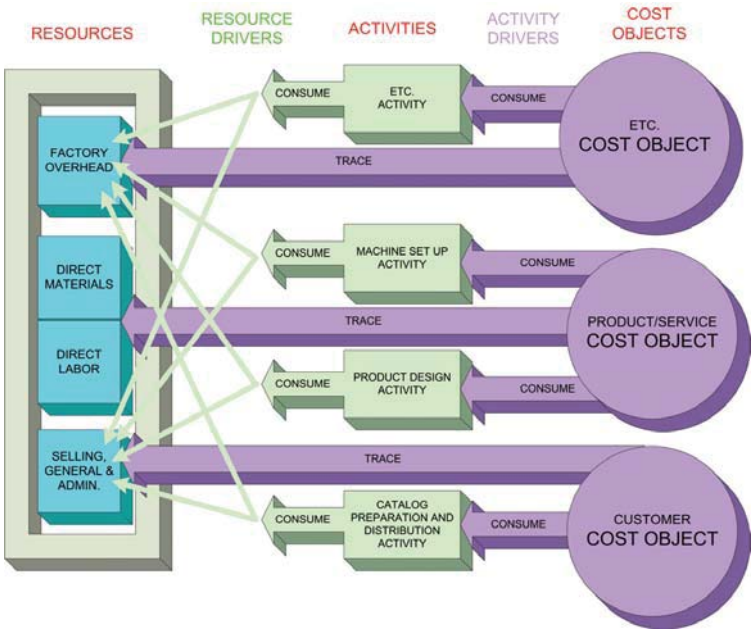
Compare this traditional logic to ABC, and you will see a reversal of the thought process. With ABC, the “cost objects” are broadened to include not only products/services, but other objects like customers, markets, and so on. These “cost objects” are seen as consuming “activities.” The “activity driver” is the event that causes consumption of an activity. For instance, each customer may receive a catalog, whether they order or not during a period. Preparation and distribution of the catalog is the “activity” that is being driven by the number of customers. Continuing, activities necessarily consume resources. Thus, preparation of a catalog will require labor, printing, office space, etc. Thus, activities drive the need for resources and are said to be “resource drivers.” The following graphic reveals the conceptual notion of ABC, which is quite different and much more involved than the traditional costing approaches. In reviewing the graphic, notice that costs that are directly traced to a cost object need not be “routed” through an activity:



One last item before moving on. The preceding graphic is simplistic. A business might have dozens of cost objects, hundreds of activities, and numerous resource pools to evaluate. A diagram of the interconnectivity can look like a printed circuit board design with multiple cost objects feeding off of many shared activities that in turn pull on various resources. At some point, the cost to implement and monitor ABC can exceed the benefit. Never forget the primary purpose is to allow management to get a better feel for product costs; some degree of arbitrariness will inevitability be accepted to avoid excessive complication.

21.5 The Steps to Implement ABC

Even a cursory review of the concepts of ABC will help you appreciate that several steps must be taken for a successful implementation:

1. STUDY PROCESSES AND COSTS -- It is said that ABC is process oriented. Therefore, the first step in implementing ABC is a detailed study of all business processes and costs. This extensive study will usually involve employees from throughout the organization.

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Employee involvement is crucial to get the system dialed in correctly, and so that there will be acceptance of the measures produced by the system. Employees at all levels need to believe the results of the accounting system before they will truly rely on the results.

2. IDENTIFY ACTIVITIES -- Once a business is understood, care should be used in selecting the business activities that will be central to the cost allocations. Too many activities and the system will become unmanageable; too few and the information will not be meaningful. It is helpful to think of activities at different levels:

   - Unit-level activities are those activities that have a one-to-one correspondence with a unit of output. For example, a telescope manufacturer may have to perform some final calibration activity to each finished product (whether it be an entry level scope or an advanced device). Thus, calibration may be seen as an activity.

   - Batch-level activities are those activities that must be performed, but can relate to one or more units of output. In some cases, shipping can be seen as an excellent example of a batch process. Assume that Nile is an online bookstore. Some customers order only one book while others may order a dozen books at a time. In each case the customer's books must be packaged and shipped. Roughly the same activity is required independent of how many books are put in a box.

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- Product-level activities are carried out at the product level, no matter the volume of production. Product design, product marketing, and so forth are typically cited as activities that have a one-to-one correspondence with the number of end products.

- Customer-level activities can take many forms. These include technical support help lines, catalogs, sales calls, and so on. You would generally expect this category to grow as the customer base expands.

  Other activity levels might be appropriate. Some businesses will identify market level activities. For example, most global companies' contract with an independent customs broker within each market served. Thus, the cost of customs brokerage services can be seen as a function of markets served. There is also entity sustaining activities. A public company in the USA must incur substantial costs to comply with the Sarbanes-Oxley legislation; this may cause the company to identify Sarbanes-Oxley compliance as a separate activity.

  The identification of activities is unique to each company. The above "levels" provide a frame of reference that is helpful in considering the important activities of an organization. Consultants who specialize in ABC can also be very helpful in coaching a company as it searches for its important activities that will become central to an ABC system. As a general rule, these consultants advise to (1) develop a list of every conceivable activity, (2) segregate the activities according to level, and (3) look for logical ways to combine similar activities within each level (but not across levels as this will undermine the basis on which activity cost will eventually be allocated to cost objects).

3. IDENTIFY TRACEABLE COSTS -- Whenever a cost is solely related to a specific cost object, that cost should be traced directly to the end object. The most obvious example of this is the direct material and direct labor that goes into an end product. But, there are other examples. The preparation of a product catalog can consume many hours of indirect labor and other internal resources that would be attributable to a related activity cost pool, but it may also involve an outside printer/ postage and that cost can be traced right to the "customer" cost object.

4. ASSIGN REMAINING COSTS TO ACTIVITIES -- After sorting out the costs that can be traced to cost objects, the remaining costs are assigned to activities. Sometimes this is easy and logical, and it is sometimes challenging. As examples, there may be a separate industrial engineering group that does nothing but machine set up prior to a production run. The cost of this group is easily assigned to the machine set-up activity, which in turn will be reallocated to a variety of end products. However, it may be that the industrial engineers are messy and the janitorial group must always do a major cleanup after each machine set up. Perhaps 10% of the janitorial staff's time should be assigned to machine set up and the other 90% to general maintenance. You can see how quickly ABC can get complex!

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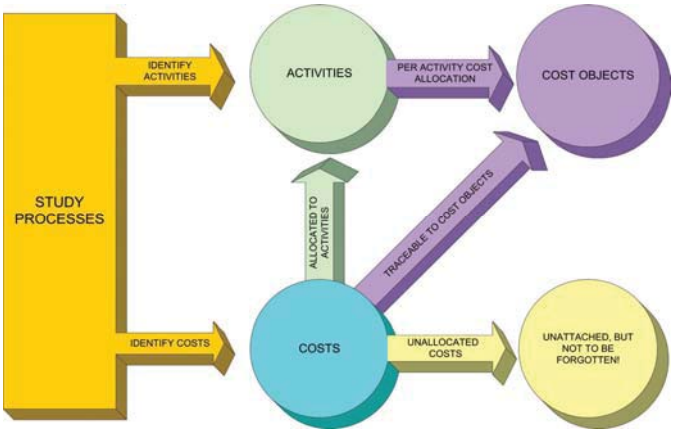
There is also the problem of trying to put a “square peg in a round hole.” Some resources are consumed and no one can agree as to the activity that consumed the resource. Someone perhaps decided that the entry gate to the factory should be nicely landscaped with seasonal flowers. What activity will absorb this cost, and more importantly, to what cost object shall this cost ultimately be attributed? If a product manager gets a bonus based on profitability for her unit, you can be sure she does not want her products to absorb any of the floral costs -- no matter how much she enjoys looking at the flowers! And, the marketing manager for a region half way around the globe surely does not want his market to bear the cost -- he and his customers have probably never seen the factory. Suffice it to say that the cost allocation decisions can be contentious, and some costs may never find a logical home. Therefore, ABC may leave some costs as unallocated.

Unallocated does not mean to “ignore”. While it may be perfectly logical to leave some costs as unallocated for purposes of identifying the cost of a specific product or other cost object, it would be foolhardy to forget about those costs in overall management of the organization. After all, they must be recovered. To survive, prices need to be high enough to recover the allocated and unallocated costs!

5. DETERMINE PER-ACTIVITY ALLOCATION RATES -- Once the costs for each activity have been determined in the aggregate, it is then necessary to unitize the cost pool. For example, if the catalog preparation activity cost pool contained $500,000 and 200,000 catalogs were produced, then the allocated catalog cost would be $2.50 each.

6. APPLY COSTS TO OBJECTS -- The final step is to utilize the activity-based rates in determining the amount of activity cost to allocate to each cost object. Continuing with the catalog illustration, we know that the allocated cost from the catalog preparation pool was $2.50 each. Of course, this is not the total cost, this is just the allocated amount. The total cost would also include the directly traceable amounts (printing, postage, etc.). This catalog cost, along with other customer-related costs would be compiled in some form of summary report. Managers would then have a measure of how much it costs to support one additional customer. Similarly, measures would be produced for each additional cost object.

The necessary steps to develop an ABC system are summarized as follows:



21.6 A Simple Analogy

The objective of ABC is to derive improved measures of cost. A simple analogy might be helpful in showing how ABC can achieve this outcome.

> Suppose you have two one-gallon pitchers filled with tea, one sweetened and one unsweetened. You desire to fill a pint glass with 75% sweetened and 25% unsweetened tea. You have an empty pint glass and it has no markings indicating fluid level. Is it possible for you to pour from the pitchers to the glass and achieve your special blend (no mixing within the pitchers is allowed)? About the best solution you can reach is based on guesswork.
>
> Now, assume you also have an empty cup (remember, two cups make a pint). You now have the added tool necessary to solve your problem and get the desired blend. For instance, you could (a) pour a cup of sweetened tea and transfer it to the glass, then (b) pour a cup of unsweetened and transfer it to the glass, then (c) shake the glass to achieve a 50/50 mix, then (d) pour a cup of the 50/50 mix from the glass back into the cup, then (e) top off the half-full glass of 50/50 mix with sweetened tea, and (f) shake the glass to achieve the 75/25 mix.

With the tea example, we see that the introduction of an intermediate container (cup) enables the correct allocation of the resource (tea) to the end object (glass). The analogy to ABC is that by introducing activity cost pools (the intermediate cup) we are better able to allocate the costs (resources) to end objects (products, customers, etc.). Without the activity cost pool, it becomes difficult/impossible to make a connection between each resource consumed and each end object.

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21.7 A Case Study in ABC

Enough general discussion on ABC, it is now time to consider a comprehensive illustration.

David Eng enjoys portable digital music players and golf. However, he was frustrated because the cord for his digital music player interfered with his golf swing. This modern problem prompted him to form the Golf and Music Enthusiast Company (GAME).

GAME developed two specialized products. The first product is GLASSESong, a pair of sunglasses with a built in music player and very short cord to the earbud speakers. The other is CAPlayer, a golf cap with a built in music player having a very short unobtrusive cord from the cap to the speakers.

GAME has been employing traditional costing methods, and applies factory overhead on the basis of labor costs. The products sell as fast as they can be produced so there is virtually no inventory. CAPlayer has sold 900,000 units and GLASSESong has sold 1,100,000 units. Each unit sells for $60. David Eng's new frustration is with the CAPlayer. It is reportedly much more expensive to produce than GLASSESong. Following is an analysis of GAME's cost of production by product:

	CAPlayer	GLASSESong
Direct material	$ 30,000,000	$ 44,000,000
Direct labor	7,000,000	2,000,000
Applied factory overhead (300% of direct labor)	21,000,000	6,000,000
Product cost	$ 58,000,000	$ 52,000,000
CAPlayer cost per unit ($58,000,000/900,000)	$64.44	
GLASSESong cost per unit ($52,000,000/1,100,000)		$47.27

Sales totaled $120,000,000 ((900,000 + 1,100,000) X $60), and selling, general and administrative costs totaled $6,000,000. The result is that GAME generated a $4,000,000 profit, computed as follows:

Revenues		$120,000,000
CAPlayer Cost	$ 58,000,000	
GLASSESong Cost	52,000,000	
SG&A	6,000,000	116,000,000
Profit		$ 4,000,000

Despite the overall profit, the per unit cost data suggests that the CAPlayer is losing money because the $60 per unit sales price is below the $64.44 per unit cost. David Eng has employed a cost consultant to review GAME's costing techniques and identify why the CAPlayer is so expensive. The consultant has returned a management report suggesting that the CAPlayer is actually much more profitable than GLASSESong. The consultant employed ABC in reaching this conclusion. Below is a review of the methods employed by the consultant:

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21.8 Study Process and Costs

The consultant's study of the business revealed the following additional information:

- The accompanying cost analysis details the $116,000,000 in total costs.
- The technology and core components are basically the same for each device.
- The extra material cost in a GLASSESong relates mostly to the polarized lenses.
- The extra labor in a CAPlayer is directly related to the manual labor for sewing.
- Both devices are generally produced in batches on the same automated assembly line, at the same pace, and through the same steps.
- The automated machinery is leased from Rebel Robotics which bases its rental charges on a "units processed" basis.
- There is one production line, and it must be "set up" for each production batch.
- CAPlayers are produced in batches of 9,000 and GLASSESongs are produced in batches of 1,000 units (therefore, CAPlayer required 100 set ups (900,000 units/9,000 units per set up) and GLASSESong required 1,100 set ups (1,100,000 units/1,000 units per set up)).
- Both products were designed by an internal development team.
- CAPlayers are sold in two markets -- the Americas and Europe (market research indicated the product would not be popular in Asia).
- GLASSESongs are sold in three markets -- Asia, Europe, and the Americas.
- Blast Advertising was hired to provide a comprehensive marketing campaign called "Get Your GAME On." This campaign was conducted in each of the three major markets, at a cost of $1,000,000 per campaign. The campaign in Asia promoted only GLASSESong; both products were promoted in Europe and the Americas.
- A tech support department has been established to help customers download music to their devices. The CAPlayers are sold only through the world's 1,000 most exclusive golf courses. The golf pros at these courses usually call once to learn the product and require no further assistance. The GLASSESong units are sold over the internet, and individual purchasers average one call per unit sold.

Cost Analysis

Direct materials	$ 74,000,000
Direct labor	9,000,000
Indirect labor	2,000,000
Indirect material	1,000,000
Factory maintenance	1,500,000
Robotics lease	20,000,000
Insurance	700,000
Other	1,800,000
Total Product Cost	$110,000,000
SG&A	
Management salaries	800,000
Selling expenses	500,000
Design and engineering	900,000
GAME on campaign	3,000,000
Business office rent	200,000
Accounting	600,000
Total Period Cost	6,000,000
TOTAL COSTS	$116,000,000

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21.9 Identify Activities

After carefully studying GAME Company, the consultant identified five unique activities. Costs for each of these activities was a significant consumer of resources. The robotics function related to the operation of the highly automated assembly line. A large part of the cost of robotics was tied directly to the number of units produced. Production set up was a batch level activity. The company was required to set up the assembly process for each batch of caps and glasses. Tech support was driven by the number of customers. Each purchaser of the glasses was identified as a "customer" and each golf course was identified as a "customer." The activity driver for product design is the number of products. The advertising activity is driven by the number of markets served.

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ACTIVITY	LEVEL	METRIC
Robotics	Unit Level	Number of units produced (900,000 + 1,100,000 = 2,000,000)
Production Set Up	Batch Level	Number of set ups (100 + 1,100 = 1,200)
Tech Support	Customer Level	Number of tech support calls (1,000 + 1,100,000 = 1,101,000)
Product Design	Product Level	Number of products designed (1 + 1 = 2)
Advertising Campaign	Market Level	Number of markets (1 + 1 + 1 = 3)

21.10 Determine Traceable Costs and Allocation Rates

Of the total costs, direct material and direct labor were traceable directly to the product cost object. The other costs were either deemed attributable to one of the five activities, or otherwise not allocated. The following spreadsheet was prepared based on careful analysis, interviews, and meetings. It shows what percentage of each cost category was attributable to each of the five activities – the percentages in each row must equal 100%.

Notice that none of the direct material and direct labor is attributable to an activity cost pool because it is traced to the end product. Other costs may be wholly attributable to one activity (e.g., the robotics lease cost is all attributable to the robotics activity). Finally, large portions of some costs could not be attributed to any of the identified activities and are simply placed in the Unallocated category.

Each percentage should have a logical basis (e.g., earbud speakers are very inexpensive and carried as indirect material; some of these earpieces were made into key chains to be given out free as part of the advertising campaign, thereby consuming 5% of the indirect materials pool).

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	B	D	F	H	J	L	N
1							
2		ACTIVITY COST POOLS					
3	COST ANALYSIS	Robotics	Production Set Up	Tech Support	Product Design	Advertising Campaign	Unallocated
4							
5	Direct materials	0%	0%	0%	0%	0%	0%
6	Direct labor	0%	0%	0%	0%	0%	0%
7	Indirect labor	40%	20%	10%	15%	0%	15%
8	Indirect material	20%	35%	5%	20%	5%	15%
9	Factory maintenance	25%	30%	0%	5%	0%	40%
10	Robotics lease	100%	0%	0%	0%	0%	0%
11	Insurance	25%	20%	10%	0%	0%	45%
12	Other	50%	30%	10%	5%	5%	0%
13	Total Product Cost						
14							
15	SG&A						
16	Management salaries	10%	10%	20%	20%	25%	15%
17	Selling expenses	0%	0%	15%	15%	60%	10%
18	Design and engineering	5%	5%	15%	75%	0%	0%
19	GAME on campaign	0%	0%	0%	0%	100%	0%
20	Business office rent	0%	0%	35%	25%	5%	35%
21	Accounting	5%	5%	10%	5%	10%	65%

21.11 Assign to Activities

Next, the costs are multiplied by the percentages to make allocations to each cost pool. For example, 20% of indirect material is allocated to robotics ($1,000,000 total indirect material X 20% = $200,000), etc. This process is revealed in the spreadsheet on the next page.

21.12 Determine Per-Activity Allocation Rates

Once the total cost for each activity pool is determined, it is divided by the activity quantity metric. For example, robotics cost $22,605,000 and 2,000,000 units were produced. Thus, this activity cost $11.3025 per unit. This calculation is repeated for each activity cost pool, and is summarized in the lower portion of the schedule on the next page.

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	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1														
2								ACTIVITY COST POOLS						
3	COST ANALYSIS			Robotics		Production Set Up		Tech Support		Product Design		Advertising Campaign		Unallocated
4														
5	Direct materials	$ 74,000,000	0%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -	0%	$ -
6	Direct labor	9,000,000	0%	-	0%	-	0%	-	0%	-	0%	-	0%	-
7	Indirect labor	2,000,000	40%	800,000	20%	400,000	10%	200,000	15%	300,000	0%	-	15%	300,000
8	Indirect material	1,000,000	20%	200,000	35%	350,000	5%	50,000	20%	200,000	5%	50,000	15%	150,000
9	Factory maintenance	1,500,000	25%	375,000	30%	450,000	0%	-	5%	75,000	0%	-	40%	600,000
10	Robotics lease	20,000,000	100%	$20,000,000	0%	-	0%	-	0%	-	0%	-	0%	-
11	Insurance	700,000	25%	175,000	20%	140,000	10%	70,000	0%	-	0%	-	45%	315,000
12	Other	1,800,000	50%	900,000	30%	540,000	10%	180,000	5%	90,000	5%	90,000	0%	-
13	Total Product Cost	$110,000,000												
14														
15	SG&A													
16	Management salaries	$ 800,000	10%	80,000	10%	80,000	20%	160,000	20%	160,000	25%	200,000	15%	120,000
17	Selling expenses	500,000	0%	-	0%	-	15%	75,000	15%	75,000	60%	300,000	10%	50,000
18	Design and engineering	900,000	5%	45,000	5%	45,000	15%	135,000	75%	675,000	0%	-	0%	-
19	GAME on campaign	3,000,000	0%	-	0%	-	0%	-	0%	-	100%	3,000,000	0%	-
20	Business office rent	200,000	0%	-	0%	-	35%	70,000	25%	50,000	5%	10,000	35%	70,000
21	Accounting	600,000	5%	30,000	5%	30,000	10%	60,000	5%	30,000	10%	60,000	65%	390,000
22	TOTAL COSTS	$116,000,000		$22,605,000		$ 2,035,000		$ 1,000,000		$ 1,655,000		$ 3,710,000		$ 1,995,000
23						Units		Set Ups		Calls		Designs		Markets
24	CAPlayer					900,000		100		1,000		1		3
25	GLASSESong					1,100,000		1,100				1		
26	Customers (courses)									1,000				
27	Customers (individuals)									1,100,000				
	Markets													
28	TOTAL ACTIVITY QUANTITY			2,000,000				1,200		1,101,000		2		3
29	ACTIVITY COST PER MEASURE (Total Cost/Total Quantity)			$11.3025		$1,695.83		$0.9083				$827,500		$1,236,667

21.13 Apply Costs to Cost Objects

Based upon this new information, the final step is to analyze the results. The consultant developed the following information. The top portion of this profitability analysis applies the per-activity cost information to show how the total cost of CAPlayer is actually much less than the total cost of GLASSESong. The lower portion compares costs and revenues to determine product profitability. Finally, note that the unallocated cost is included in the total column only; it is important, but not tied to either product.

PRODUCT PROFITABILITY ANALYSIS

		CAPlayer	GLASSESong	TOTAL
Direct Material	Traceable	$30,000,000.00	$44,000,000.00	$74,000,000.00
Direct Labor	Traceable	7,000,000.00	2,000,000.00	9,000,000.00
Robotics	$11.3025 per unit	10,172,250.00	12,432,750.00	22,605,000.00
Production Set Up	$1,695.83 per set up	169,583.33	1,865,416.67	2,035,000.00
Tech Support	$0.9083 per customer call	908.27	999,091.73	1,000,000.00
Product Design	$827,500 per design	827,500.00	827,500.00	1,655,000.00
		$48,170,241.60	$62,124,758.40	$110,295,000.00
Advertising Campaign	Asia		1,236,666.67	1,236,666.67
	Europe (shared)	618,333.33	618,333.33	1,236,666.66
	Americas (shared)	618,333.34	618,333.33	1,236,666.67
Total Traceable and Allocated Costs		$49,406,908.27	$64,598,091.73	$114,005,000.00
Unallocated Costs				1,995,000.00
Total Costs				$116,000,000.00
Product Revenues		$54,000,000.00	$66,000,000.00	$120,000,000.00
Total Traceable and Allocated Costs		49,406,908.27	64,598,091.73	114,005,000.00
Product Margin		$ 4,593,091.73	$ 1,401,908.27	$ 5,995,000.00
Unallocated Costs				1,995,000.00
Entity Profit				$ 4,000,000.00

21.14 What Just Happened?

By now your head is probably spinning with all the numbers. How is it possible that ABC's results were so different than the traditional costing method? In this case, traditional costing applied overhead based on direct labor costs. But, direct labor was just a small piece of the whole puzzle, and it did not fall evenly on both products. Further, the glasses required a lot more production set ups and tech support. In addition, glasses were very expensive to market in Asia because the advertising cost only benefited the one product in that market. These facts were not taken into account with the traditional costing method.

21.15 A Great Tool, But not a Panacea

The lesson for you as a manager or future manager is to move carefully in using cost information. It is important to fully consider many variables, some of which are not always apparent. Managerial accounting provides many tools to support your decision making task. ABC is one tool which has gained many fans, for the reasons illustrated in this chapter. It is about applying logic and reason. It provides a basis for costing and more. It enables systematic review of activities that will help you pinpoint opportunities for cost control and reallocation of capacity to higher yielding products. But,

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ABC is not perfect. In fact, ABC is no better than the process used to identify activities and allocation percentages. These elements are ultimately based on human judgment. Office politics can play a heavy hand in setting the components of any allocation model -- after all it is human nature for employees to want their products to appear to be performing well! Therefore, a good manager must provide strong leadership to be sure that the ABC model is constructed with financial integrity.

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