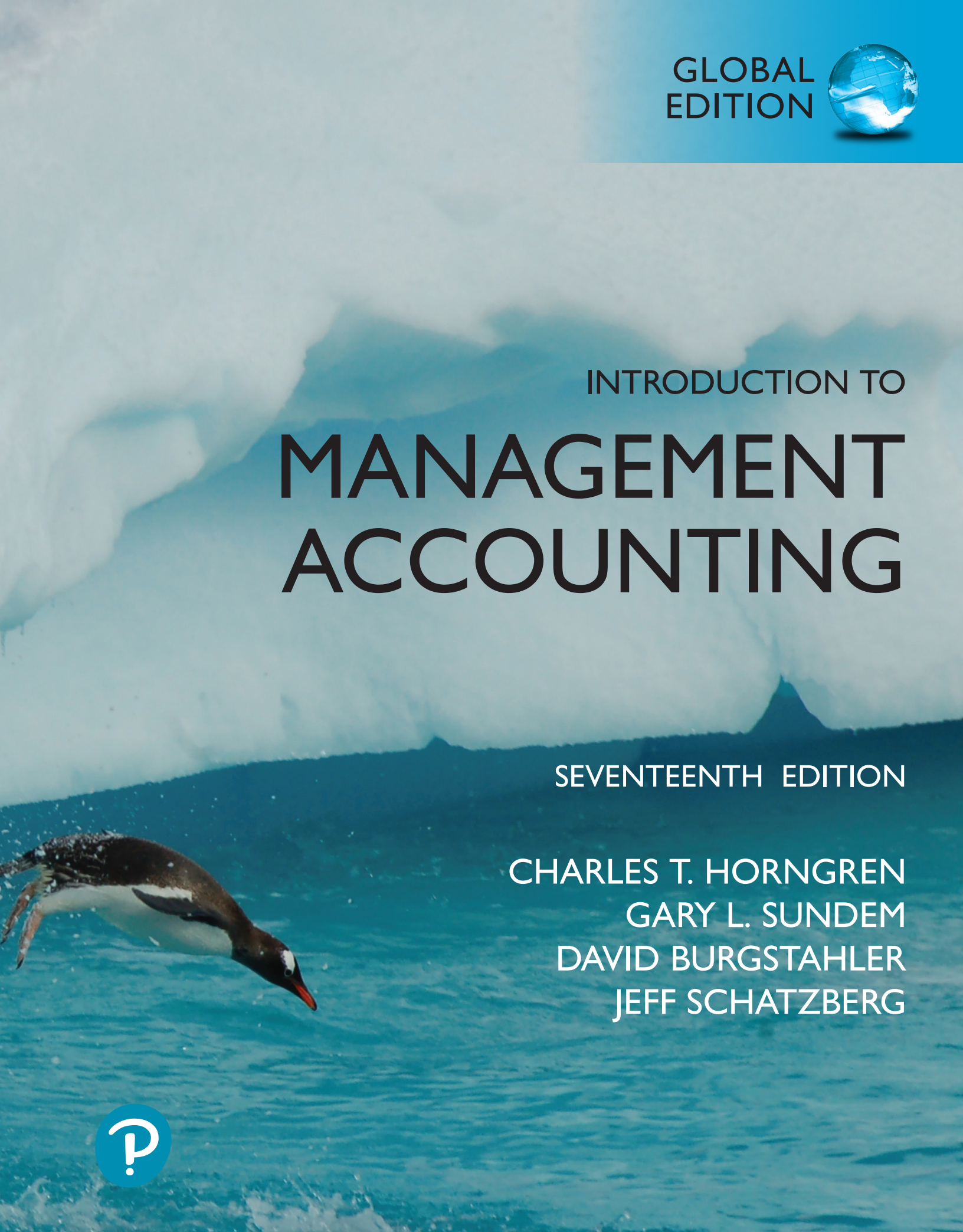
GLOBAL EDITION

INTRODUCTION TO

MANAGEMENT ACCOUNTING

SEVENTEENTH EDITION

CHARLES T. HORNGREN
GARY L. SUNDEM
DAVID BURGSTAHLER
JEFF SCHATZBERG



SEVENTEENTH EDITION
GLOBAL EDITION

Introduction to

MANAGEMENT ACCOUNTING

Charles T. Horngren
Stanford University

Gary L. Sundem
University of Washington – Seattle

David Burgstahler
University of Washington – Seattle

Jeff Schatzberg
University of Arizona

Pearson

Harlow, England • London • New York • Boston • San Francisco • Toronto • Sydney • Dubai • Singapore • Hong Kong
Tokyo • Seoul • Taipei • New Delhi • Cape Town • Sao Paulo • Mexico City • Madrid • Amsterdam • Munich • Paris • Milan

Keeping or Replacing Equipment

Objective 6

Decide whether to keep or replace equipment.

depreciation
The periodic cost of equipment that a company spreads over the future periods in which the company will use the equipment.

book value (net book value)
The original cost of equipment less accumulated depreciation.

accumulated depreciation
The sum of all depreciation charged to past periods.

We next examine another common decision in business, the replacement of old equipment. One important aspect of such a situation is that the book value of the old equipment is not a relevant consideration in deciding whether to purchase a replacement. Why? Because it is a past cost, not a future cost. When a company purchases equipment, it spreads the cost via **depreciation** expense over the future periods in which it will use the equipment. The equipment's **book value**, or **net book value**, is the original cost less accumulated depreciation. **Accumulated depreciation** is the sum of all depreciation charged to past periods. For example, suppose a $10,000 machine with a 10-year life span has depreciation of $1,000 per year. At the end of 6 years, accumulated depreciation is $6 \times \$1,000 = \$6,000$, and the book value is $\$10,000 - \$6,000 = \$4,000$.

Consider the following data for a decision about whether to replace an old machine:

	Old Machine	Replacement Machine
Original cost	$10,000	$8,000
Useful life in years	10	4
Current age in years	6	0
Useful life remaining in years	4	4
Accumulated depreciation	$ 6,000	0
Book value	$ 4,000	Not acquired yet
Disposal value (in cash) now	$ 2,500	Not acquired yet
Disposal value in 4 years	0	0
Annual cash operating costs (maintenance, power, repairs, coolants, and so on)	$ 5,000	$3,000

Let's prepare a comparative analysis of the two alternatives. Before proceeding, consider some important concepts. The most widely misunderstood facet of replacing equipment is the role of the book value of the old equipment in the decision. We often call the book value a **sunk cost**, which is really just another term for historical or past cost, a cost that the company has already incurred and, therefore, is irrelevant to the decision-making process. Nothing can change what has already happened. The Business First box on p. 259 illustrates this concept.

sunk cost
A historical or past cost, that is, a cost that the company has already incurred and, therefore, is irrelevant to the decision-making process.

The irrelevance of past costs for decisions does not mean that knowledge of past costs is useless. Often managers use past costs to help predict future costs. In addition, past costs affect future payments for income taxes (as explained in Chapter 11). However, the past cost itself is not relevant. The only relevant cost is the predicted future cost.

In deciding whether to replace or keep existing equipment, we must consider the relevance of four commonly encountered items:

1. Book value of old equipment: irrelevant because it is a past (historical) cost. Therefore, depreciation on old equipment is also irrelevant.
2. Disposal value of old equipment: relevant because it is an expected future inflow that usually differs across alternatives.
3. Gain or loss on disposal: This is the difference between book value and disposal value. It is therefore a meaningless combination of irrelevant and relevant items. The combination form, loss (or gain) on disposal, blurs the distinction between the irrelevant book value and the relevant disposal value. Consequently, it is best to think of each separately.
4. Cost of new equipment: relevant because it is an expected future outflow that will differ across alternatives. Therefore, the initial cost of new equipment (or its allocation in subsequent depreciation charges) is relevant.

Business First

Sunk Costs and Government Contracts

It is easy to agree that—in theory—managers should ignore sunk costs when making decisions. But in practice, sunk costs often influence important decisions, especially when a decision maker doesn't want to admit that a previous decision to invest funds was a bad decision.

Consider the governmental claims made during the famous Congressional debates regarding the termination of funding for the military's B-2 aircraft. As documented in the *St. Louis Post Dispatch*, Larry O. Welch, the air force chief of staff, claimed "the B-2 already is into production; cancel it and the $17 billion front end investment is lost." And Les Aspin, chairman of the House Armed Services Committee, stated "with $17 billion already invested in it, the B-2 is too costly to cancel."

The $17 billion already invested in the B-2 is a sunk cost. What matters are the future incremental costs and benefits—the costs necessary to complete production compared to the value of the completed B-2s. We want to avoid throwing good money after bad—that is, if the value of the B-2 is not at least equal to the future investment in it, Congress should cancel funding regardless of the amount previously spent.

Failure to ignore sunk costs is not unique to the U.S. government. In 1994, **Motorola** made critical decisions to ignore digital technology, and insisted that analog communications, in which it was heavily invested, was the wave of the future. Despite intense demands from wireless providers for digital cell phones, Motorola refused to even consider switching from analog to digital technology. It refused to acknowledge that its analog investments were a sunk cost. Motorola completely lost its dominance in the cell phone market, with its U.S. market share falling from 60% to 13% within 3 years.

Sources: Adapted from J. Berg, J. Dickhaut, and C. Kanodia, "The Role of Private Information in the Sunk Cost Phenomenon," unpublished paper, November 12, 1991; and W. Y. Davis, "Return the 'Sunk Costs are Sunk' Concept to Principles of Economics Textbooks," *Journal of Business and Economic Research*, Volume 3, Number 6, 2005.

Exhibit 6-5 shows the relevance of these items in our example. Book value of old equipment is irrelevant regardless of the decision-making technique we use. The "difference" column in Exhibit 6-5 shows that the $4,000 book value of the old equipment does not differ between alternatives. We should completely ignore it for decision-making purposes. The difference is merely one of timing. The amount written off is still $4,000, regardless of any available alternative. The $4,000 appears on the income statement either as a $4,000 deduction from the $2,500 cash proceeds received to obtain a $1,500 loss on disposal in the first year or as $1,000 of depreciation in each of 4 years. But how it appears is irrelevant to the replacement decision. In contrast, the $2,000 annual depreciation on the new equipment is relevant because the total $8,000 depreciation is a future cost that we can avoid by not replacing the equipment. The three relevant items—operating costs, disposal value, and acquisition cost—give replacement a net advantage of $2,500.

	Four Years Together		
	Keep	Replace	Difference
Cash operating costs	$20,000	$12,000	$8,000
Old equipment (book value)			
Periodic write-off as depreciation	4,000	—	
or			—
Lump-sum write-off		4,000*	
Disposal value	—	−2,500*	2,500
New machine			
Acquisition cost	—	8,000†	−8,000
Total costs	$24,000	$21,500	$2,500

The advantage of replacement is $2,500 for the 4 years together.

*In a formal income statement, these two items would be combined as "loss on disposal" of $4,000 − $2,500 = $1,500.

† In a formal income statement, written off as straight-line depreciation of $8,000 ÷ 4 = $2,000 for each of 4 years.

Exhibit 6-5

Cost Comparison—Replacement of Equipment Including Relevant and Irrelevant Items

Making Managerial Decisions

It is sometimes difficult to accept the proposition that past or sunk costs are irrelevant to decisions. Consider the ticket you have to a major football game in December. After getting the ticket, you learn that the game will be on TV, and you really prefer to watch the game in the comfort of your warm home. Does your decision about attending the game or watching it on TV depend on whether you were given the ticket for free or you paid $80 for it? What does this tell you about a manager's decision to replace a piece of equipment?

Answer

The amount paid, whether it be $0, $80, or $1,000, should make no difference to the decision. You have the ticket, and you have paid for it. That cannot be changed. If you really prefer to watch the game on TV, it may have been a bad decision to pay $80 for a ticket. But you cannot erase that bad decision. All you can do is choose the future action that has the most value to you. You should not suffer through a less pleasant experience just because you paid $80 for the ticket. Although the price you paid for the ticket is irrelevant, the price you could sell the ticket for now is relevant—this price is the opportunity cost of using the ticket yourself.

A manager must make the same analysis regarding the replacement of equipment. What the company spent for the old equipment is irrelevant. Keeping equipment that is no longer economical is just like using a ticket for an event that you would rather not attend. Additionally, the disposal value of the old equipment is relevant—this is the opportunity cost of keeping the equipment, corresponding to the opportunity cost of using the ticket rather than selling it to another fan.

Summary Problem for Your Review

PROBLEM

Exhibit 6-5 looks beyond 1 year. Examining the alternatives over the equipment's entire life ensures that peculiar nonrecurring items, such as loss on disposal, will not obstruct the long-run view vital to many managerial decisions. However, Exhibit 6-5 presents both relevant and irrelevant items. Prepare an analysis that concentrates on relevant items only.

SOLUTION

Exhibit 6-6 presents the analysis with relevant items only—the cash operating costs, the disposal value of the old equipment, and the acquisition cost of the new equipment. To demonstrate that the amount of the old equipment's book value will not affect the answer, suppose the book value of the old equipment is $500,000 rather than $4,000. Your final answer will not change. The cumulative advantage of replacement is still $2,500. (If you are in doubt, rework this example, using $500,000 as the book value.)

	Four Years Together		
	Keep	Replace	Difference
Cash operating costs	$20,000	$12,000	$8,000
Disposal value of old machine	—	−2,500	2,500
New machine, acquisition cost	—	8,000	−8,000
Total relevant costs	$20,000	$17,500	$2,500

Exhibit 6-6
Cost Comparison—Replacement of Equipment, Relevant Items Only

Identify Irrelevant or Misspecified Costs

Objective 7

Identify irrelevant and misspecified costs.

The ability to recognize irrelevant or misspecified costs is sometimes just as important to decision makers as identifying relevant costs. How do we know that past costs, although sometimes good predictors of future costs, are irrelevant in decision making? Let's consider such past costs as obsolete inventory and see why they are irrelevant to decisions.

Suppose **General Dynamics** has 100 obsolete aircraft parts in its inventory. The original manufacturing cost of these parts was $100,000. General Dynamics can (1) re-machine the parts for $30,000 and then sell them for $50,000 or (2) sell them as scrap for $5,000. Which should it do? This is an unfortunate situation, yet the $100,000 past cost is irrelevant to the decision to re-machine or scrap. The only relevant factors are the expected future revenues and costs:

	Re-machine	Scrap	Difference
Expected future revenue	$ 50,000	$ 5,000	$45,000
Expected future costs	30,000	—	30,000
Relevant excess of revenue over costs	$ 20,000	$ 5,000	$15,000
Accumulated historical inventory cost*	100,000	100,000	—
Net overall loss on project	$(80,000)	$(95,000)	$15,000

*Irrelevant because it is unaffected by the decision.

As you can see from the fourth line of the preceding table, we can completely ignore the $100,000 historical cost and still arrive at the $15,000 difference, the key figure in the analysis that yields re-machining as the optimal decision.

In addition to past costs, some future costs may be irrelevant because they will be the same under all feasible alternatives. These, too, we may safely ignore for a particular decision. Top management salaries are examples of expected future costs that may be unaffected by the decision at hand.

Other irrelevant future costs include fixed costs that will be the same whether a company selects machine X or machine Y. However, it is incorrect to conclude that fixed costs are always irrelevant and variable costs are always relevant. Variable costs can be irrelevant, and fixed costs can be relevant. For instance, sales commissions are variable costs that are irrelevant to a decision on whether to produce a product in plant G or plant H. The rental cost of a warehouse is a fixed cost that is relevant if one alternative requires the warehouse while the other does not. In sum, future costs (both variable and fixed) are irrelevant whenever they do not differ among the alternatives at hand and are relevant whenever they do differ between the alternatives.

Finally, it is also critical in decision making to identify misspecified costs. The pricing illustration in Chapter 5 showed that managers should analyze unit costs with care in decision making. There are two major ways to go wrong: (1) including irrelevant costs, such as the $0.03 allocation of unavoidable fixed costs in the **Nantucket Nectars**' make-or-buy example (pp. 244–245) that would result in a unit cost of $0.20 instead of the relevant unit cost of $0.17 and (2) comparing unit costs not computed on the same volume basis, as illustrated by the following example. Assume that a new $100,000 machine with a five-year life span can produce 100,000 units a year at a variable cost of $1 per unit, as opposed to a variable cost per unit of $1.50 with an old machine. A sales representative claims that the new machine will reduce total cost by $0.30 per unit after allowing $0.20 per unit for depreciation on the new machine. Is the new machine a worthwhile acquisition?

If the customer's expected volume is 100,000 units, unit-cost comparisons are valid, provided that new depreciation is also considered. Assume that the disposal value of the old equipment is zero, so annual depreciation is $100,000 ÷ 5 years, which equals $20,000. Because depreciation is an allocation of historical cost, the depreciation on the old machine is irrelevant. In contrast, the depreciation on the new machine is relevant because the new machine entails a future cost that the customer can avoid by not acquiring it.

	Old Machine	New Machine
Units	100,000	100,000
Variable costs	$150,000	$100,000
Straight-line depreciation	—	20,000
Total relevant costs	$150,000	$120,000
Unit relevant costs	$ 1.50	$ 1.20

The preceding calculation shows that the sales representative is correct if the customer's expected volume is 100,000 units. However, sales personnel often boast about the low unit costs of using their new machines but may neglect to point out that the unit costs are based on outputs far in excess of the activity volume of their prospective customer. In this case, if the customer's expected volume is only 30,000 units per year, the unit costs change in favor of the old machine.

	Old Machine	New Machine
Units	30,000	30,000
Variable costs	$45,000	$30,000
Straight-line depreciation	—	20,000
Total relevant costs	$45,000	$50,000
Unit relevant costs	$ 1.50	$1.6667

Generally, be wary of unit fixed costs. When feasible, use total fixed cost in your analysis, not fixed cost per unit. Why? Because you need to calculate a new fixed cost per unit for every different volume of production—often a cumbersome task—and if you don't recalculate it, your costs will be misspecified.

Conflicts Between Decision Making and Performance Evaluation

Objective 8

Discuss how performance measures can affect decision making.

You should now know how to make good decisions based on relevant data. However, knowing how to make these decisions and actually making them are two different things. Managers might be tempted to make decisions they know are sub-optimal—not in the best interests of the company—if the performance measures in place will reward them for those decisions. To motivate managers to make firm-wide optimal decisions, methods of evaluating managers' performance should be consistent with the appropriate decision model for the company.

Let's look at an example of a conflict between the analysis for decision making and the method used to evaluate performance. Consider the replacement decision shown in Exhibit 6-6 on p. 260, where there was a $2,500 advantage to replacing the machine rather than keeping it. To motivate managers to make the right choice, the method used to evaluate performance should be consistent with the decision model—that is, it should show better manager performance when a manager replaces rather than keeps the machine. Assume the firm uses accounting income to measure a manager's performance. The effect on accounting income in the first year after replacement compared with that in years 2, 3, and 4 follows:

	Year 1		Years 2, 3, and 4	
	Keep	Replace	Keep	Replace
Cash operating costs	$5,000	$3,000	$5,000	$3,000
Depreciation	1,000	2,000	1,000	2,000
Loss on disposal ($4,000 − $2,500)	—	1,500	—	—
Total cost	$6,000	$6,500	$6,000	$5,000

First-year costs will be $6,500 − $6,000 = $500 lower, making first-year income $500 higher, if the manager keeps the machine rather than replacing it. Because managers naturally want to make decisions that maximize the measure of their current performance, the manager may be inclined to keep the machine.

The conflict is especially severe if a company often transfers managers from one position to another. Why? Even though replacing the machine creates the $500 first-year decrease in income, over the long run this will be offset by a $1,000 annual increase in income in years 2 to 4. (Note that the net difference of $2,500 in favor of replacement over the 4 years together is the same as in Exhibit 6-6.) However, a manager who moves to a new position after the first year, bears the entire loss on disposal without reaping the benefits of lower operating costs in years 2 to 4, which creates a personal incentive for him to keep the machine.

The decision to replace a machine earlier than planned also reveals a possible error in the original decision to purchase the machine. The company bought the old machine 6 years ago for $10,000. Its expected life span was 10 years. However, if a better machine is now available, then the useful life of the old machine was really 6 years, not 10. This feedback on the actual life of the old machine has two possible effects, the first good and the second bad. First, managers might benefit by learning from the earlier mistake. If the manager overestimated the useful life of the old machine, the reliability of the predicted life for the new machine may be scrutinized. Feedback can help avoid repeating past mistakes. Second, the feedback on machine life creates incentives for a manager to make another mistake to cover up the earlier one. A "loss on disposal" could alert superiors to the incorrect economic-life prediction used in the earlier decision. By avoiding replacement, the manager avoids recognizing the loss on disposal and can spread the $4,000 remaining book value over the future as "depreciation," a more appealing term than "loss on disposal." The superiors may never find out about the incorrect prediction of economic life. Using accounting income for performance evaluation mixes the financial effects of various decisions, hiding both the earlier misestimation of useful life and the current failure to replace.

Conflicts between decision making and performance evaluation goals are widespread in practice. Unfortunately, there are no easy solutions. It is difficult to match performance evaluation and decision horizons, leading to conflicts like those in our equipment example. As a result, managers sometimes have incentives to focus on the short-term effects of decisions on their performance measures, rather than the long-term effects on the company.

Here and in Chapter 5 we introduced the important topics of relevant information and decision making. Our major focus was on how to determine and use relevant information when faced with various managerial decisions such as pricing, special orders, make or buy, adding or deleting a product line, and equipment replacement. We have emphasized the importance of understanding cost behavior in each of these decision situations. Now, we shift our emphasis from decision-making techniques to planning and control techniques. One of the most important planning techniques you will use as a manager is budgeting—the major topic in Chapters 7 and 8.

Highlights to Remember

1. **Use a differential analysis to examine income effects across alternatives and show that an opportunity-cost analysis yields identical results.** A differential analysis is a valuable tool for analyzing decisions; it focuses on the relevant items in the situation—differential revenues and differential costs. One should always consider opportunity costs when deciding on the use of limited resources. The opportunity cost of a course of action is the maximum profit forgone from other alternative actions. Decision makers may fail to consider opportunity costs because accountants do not report them in the financial accounting system.

2. **Decide whether to make or buy certain parts or products.** One of the most important production decisions is the make-or-buy decision. Should a company make its own parts or products or should it buy them from outside sources? Both qualitative and quantitative factors affect this decision. In applying relevant cost analysis to a make-or-buy situation, a key factor to consider is often the opportunity cost of facilities.

3. **Choose whether to add or delete a product line using relevant information.** Relevant information also plays an important role in decisions about adding or deleting products, services, or departments. Decisions on whether to delete a department or product line require analysis of the revenues forgone and the costs saved from the deletion.

4. **Compute the optimal product mix when production is constrained by a scarce resource.** When production is constrained by a limiting resource, the key to obtaining the maximum profit from a given capacity is to obtain the greatest possible contribution to profit per unit of the limiting or scarce resource.